Ann Ist Super Sanità 2024 | Vol. 60, No. 3: 179-183
DOI: 10.4415/ANN_24_03_02

Children's diet assessed with the Mediterranean Diet Index: the finding of new eating habits and their impact on a cohort of Italian children

Irene Rutigliano[1], Morena Luce Mansueto[2], Rossella Canestrale[1], Rossella Giorgio[1], Michele Sacco[1] and Maria Rosa Pastore[1]

[1]*Unità Operativa Complessa di Pediatria, Fondazione IRCCS "Casa Sollievo della Sofferenza", San Giovanni Rotondo, Foggia, Italy*
[2]*Scuola di Specializzazione in Pediatria, Università di Modena e Reggio Emilia, Modena, Italy*

Abstract

Objectives. Mediterranean Diet (MD) has been inversely associated with many diseases: it reduces total mortality and lowers cardiovascular risk. Despite the known benefits of MD, variations of dietary habits have occurred in recent years especially in young people. The aim of our study is to evaluate MD adherence in a cohort of Italian children and adolescents living in Southern Italy.

Methods and results. Adherence to MD was evaluated with the Mediterranean Diet Index (KIDMED). Sex, age, and anthropometric measures were recorded on a population of 132 children; of those 71.2% showed poor adherence to MD, 26.5% average adherence and only 2.3% good adherence. Higher prevalence of poor adherence was recorded in obese children and there was statistically significant inverse correlation between age and adherence score.

Conclusions. Our results highlight low adherence to MD in a cohort of Italian children. These findings support the importance of monitoring dietary habits, especially in adolescents.

Key words

- mediterranean diet
- dietary modifications
- child nutrition
- adolescent nutrition

INTRODUCTION

The term "Mediterranean Diet" (MD) is inspired to all the traditional eating habits of people living around the Mediterranean Basin. It is characterized by high consumption of fresh fruit, vegetables, cereals, legumes, moderate quantity of fish, eggs, cheese, dried fruit, nuts and low amounts of red meat and processed food. The main source of fat is supplied by the extra virgin olive oil. This dietary pattern contains a low dose of saturated fatty acids and high dose of monounsaturated fatty acids, a balanced ratio of polyunsaturated fatty acids, omega-6 and omega-3, high content of complex carbohydrates, fibres and antioxidants [1]. Previous studies have demonstrated an inverse correlation between MD and many diseases, including type 2 diabetes, obesity and metabolic syndrome, cardiovascular and cerebrovascular diseases, neurodegenerative diseases, and certain cancers [2, 3]. For its beneficial effects, in November 2010 MD has been recognized by United Nations Educational, Scientific and Cultural Organization (UNESCO) as "Intangible Cultural Heritage of Humanity". In the last years, with the urbanization phenomenon, dietary patterns different from the MD have increased, especially in adolescents. The "Western diet", a dietary pattern rich in saturated fat, refined grains, simple carbohydrates, and processed foods has replaced healthy food choices in the last years. This phenomenon is closely connected with the high prevalence of pediatric overweight and obesity worldwide [4]. In 2004, Serra-Majem *et al.* developed the KIDMED score (Mediterranean Diet Quality Index for children and adolescents), a nutritional index validated in several languages that evaluates the adherence to MD and the quality of diet in children and adolescents [1]. Several studies have explored adherence to MD in pediatric populations living in Mediterranean countries, but few papers concern Italian children [5, 6].

Address for correspondence: Morena Luce Mansueto, Scuola di Specializzazione in Pediatria, Università di Modena e Reggio Emilia, Via del Pozzo 71, 41124 Modena, Italy. E-mail: morena.mans@gmail.com.

The aim of this study is to assess the correlations existing between adherence to MD and anthropometric measures on a cohort of children living in Southern Italy.

MATERIALS AND METHODS

Recruitment

This study was conducted between April and September 2023 in the Pediatric Department of "Casa Sollievo della Sofferenza", in San Giovanni Rotondo (FG), Southern Italy. The analysed population included 132 children and young people (52.3% females and 47.7% males). The population age ranged from 2 to 17.9 years, mean age 11±3.4 years. The total cohort included healthy children, without important comorbidity. Informed consent was obtained from a parent or caregiver before participating to the study.

Anthropometric examinations

We collected anthropometric measures of all children in the same condition, as they were wearing underwear and T-shirt. Body weight was measured to the nearest 0.1 kilogram (kg) using an electronic scale. Height was measured with a standard stadiometer to the nearest 0.5 centimetre (cm) during maximal expiration. Body Mass Index (BMI) was used to evaluate nutritional status. Children were stratified according to sex and age-specific BMI using the World Health Organization (WHO) growth charts in: underweight (less than the 5th percentile), normal weight (5th percentile-85th percentile), overweight (85th percentile-97th percentile) and obese (97th percentile or greater) [7].

Waist circumference was measured on the horizontal plane midway between the lowest border of rib cage and the upper border of iliac crest, at the end of normal expiration, with the adolescents standing erect and relaxed with arms at the sides and feet close together [8]. Waist to height ratio (WHtR) was obtained by dividing waist size by height in centimetres and deemed as an indicator of the distribution of body fat. Values of WHtR higher than 0.5 is considered as abdominal obesity [9].

Adherence to MD

We evaluated children's adherence to MD with the KIDMED score proposed by Serra-Majem *et al*. This questionnaire is composed of 16 dichotomous items related to different aspects of MD, each item can be assigned a value of +1 or -1, obtaining a maximum final score of +12. The items considered are: 1. takes a fruit or fruit juice every day (+1); 2. has a second fruit every day (+1); 3. has fresh or cooked vegetables regularly once a day (+1); 4. has fresh or cooked vegetables more than once a day (+1); 5. consumes fish regularly, at least 2-3/week (+1); 6. goes >1/week to a fast-food restaurant (-1); 7. likes pulses and eats them >1/week (+1); 8. consumes pasta or rice 5 times or more per week (+1); 9. has cereals or grains (bread, etc.) for breakfast (+1); 10. consumes nuts at least 2-3 times/week (+1); 11. uses olive oil at home (+1), 12. skips breakfast (-1); 13. has a dairy product for breakfast (+1); 14. has commercially baked goods or pastries for breakfast (-1); 15. takes two yoghurts and/or some cheese (40 g) daily (+1); 16. takes sweets and candy several times every day (-1) [10].

These items concern the daily consumption of fruits, vegetables, virgin olive oil, pasta/rice, milk and its derivatives; the weekly consumption of fish, legumes, nuts, cereals, and whole food; low consumption of red meat, commercial and processed foods, eggs, butter, sausages, fried and sweet food; the tendency to skip breakfast or eat fast food. Scores ≤3 reflect poor adherence to MD, indicating very low diet quality; scores 4-7 demonstrate an average adherence, suggesting that diet quality could be improved to meet the recommended MD intakes. Scores ≥8 indicate good adherence, reflecting optimal diet quality. We translated all the 16 items in Italian and provided clear explanations of the content to the child's parent or caregiver. The questionnaire was administered by a paediatrician.

Statistical analysis

Results are expressed as mean ± Standard Deviation (SD) with 95% confidence interval for continuous variables, as percentages for categorical and discrete variables. The Kolmogorov-Smirnov goodness of fit test was used for assessing the hypothesis of normality of the data, all data were normally distributed. Data were analyzed by t-Student test and χ^2 test. Bonferroni test and pairwise comparison according to Dunn-Bonferroni *post hoc* method were applied for multiple simultaneous comparisons. The calculation of Spearman's rho and Pearson's coefficients, as appropriated, were used to evaluate the degree of association between variables. Values of $p<0.05$ were considered statistically significant. Statistical analysis was performed with Statistical Package for Social Science (SPSS), Version 22 statistic software package.

RESULTS

Our cohort was composed by 132 children (63 males and 69 females), mean age 11±3.4 years (range 2-17.9 years). According to nutritional status 5.5% of the children were considered underweight, 53.9% normal weight, 18.8% overweight and 21.9% obese. Median BMI z-score was 0.7 (z-score interval: -0.23-1.5). In our analysis, 71.2% of the global population showed poor adherence to MD, 26.5% average adherence and only 2.3% good adherence.

There was no statistically significant association between BMI and adherence scores (rho=-0.074, p=0.407), but the prevalence of poor adherence was slightly higher (75%) in obese children compared to underweight (57.1%), normal weight (72.5%) and overweight (66.7%). The nutritional status of the study population and the degree of adherence to MD are described in *Figure 1*.

No difference was recorded in adherence to MD between males and females (score 2.33±2.5 for males, 1.94±2.8 for females, p=0.406). In particular, no adherence was found in 66.7% of males *vs* 75.4% of females, intermediate adherence wad found in 33.3% of males *vs* 20.3% of females, good adherence was found in 0% of males and 2.3% of females.

No association was detected between WHtR and adherence scores (rho=0.003, p=0.975), even after adjustment for age and sex (r=-0.008, p=0.948).

In our cohort, only 3.8% consumed more than one portion of vegetables per day, 87.9% consumed commercial food daily and 76.5% consumed cured meat more than twice a week. Regarding fast-food consumption, our data showed that 73.5% of our sample routinely consumed fast food or had hamburger at least once a week, the prevalence was higher in males (79.4%) compared to females (68.1%).

We documented a statistically significant inverse correlation between age and adherence scores (rho=-0.226, p=0.009). We divided our sample into quartiles of age: I quartile: <8.3 years, II quartile; 8.3-11.3 years; III quartile: 11.3-13.8 years; IV quartile: 13.8-17.94 years; mean adherence score was 3.15±2.8 in first quartile of age, 2.12±2.4 in second quartile, 2.41±2.7 in third and 0.85±2.3 in fourth (p=0.005). These results were also confirmed by the trend test (p=0.006). In linear regression analysis MD adherence score was significantly predicted by age (adjusted R2 6.4%, beta =-0.255, p=0.03).

DISCUSSION

Mediterranean Diet has traditionally been given a great value in both children and adults for its beneficial effects. In our study, we investigated the diet quality of a cohort of Italian children and adolescents living in Southern Italy by using the KIDMED Index and we found an overall low adherence to MD, more evident in adolescents. This is in agreement with recent literature which suggests that adherence to traditional MD is decreasing in children and adolescents living in the Mediterranean countries [11, 5]. Data from a recent systematic review showed how different adherence scores can be among different Mediterranean countries, i.e., poor adherence varied from 1.6% in Spanish children to 62.8% in Greek adolescents while good adherence varied from 4.3% in Greek adolescents to 53.9% in Spanish children [12]. In Italy Roccaldo *et al*. studied for the first time, in the ZOOM8 study, adherence to MD in a representative sample of 1,740 Italian children, aged 8-9 years, from Northern, Central and Southern Italy. They reported an optimal KIDMED score in only 5% of the sample, while 62% and 32% of the sample had intermediate and low score, respectively [5]. In this study, low adherence to MD was explained in most cases by low consumption of fruits and vegetables and higher consumption of commercial food. This is in line with our study as we found that the consumption of more than one portion per day of vegetables is rare (only 3.8% of our cohort) in contrast with the large daily consumption of commercial food (recorded in 87.9% of children). This could be explained with the increasing use of commercial products and the growing spread of fast-food restaurants. This "Westernization" of the diet is the result of the globalization phenomenon. The Western diet phenomenon is particularly common among adolescents: as adolescents grow older, they tend to eat outside, abandoning the familial model of MD. This is confirmed in our study, in fact we revealed an inverse correlation between age and MD adherence. This is also consistent with other studies conducted on Greek adolescents. One of those verified the correlation between adolescent increasing buyer power and MD adherence, reporting an increased fast-food consumption and breakfast skipping in adolescents who received larger sums of money [12].

Moreover, it was observed in several Mediterranean countries that inhabitants of urban areas are less likely to be adherent to traditional dietary patterns than those living in rural areas [13].

High intakes of fast-food and processed products along with low consumption of vegetables are related to the increasing prevalence of overweight and obesity in infancy, childhood, and adolescence in all countries. In 2013 WHO estimated that about 42 million children were overweight or obese and over 70 million will be overweight or obese by 2025 [14]. Overweight and obesity are strongly associated with the develop-

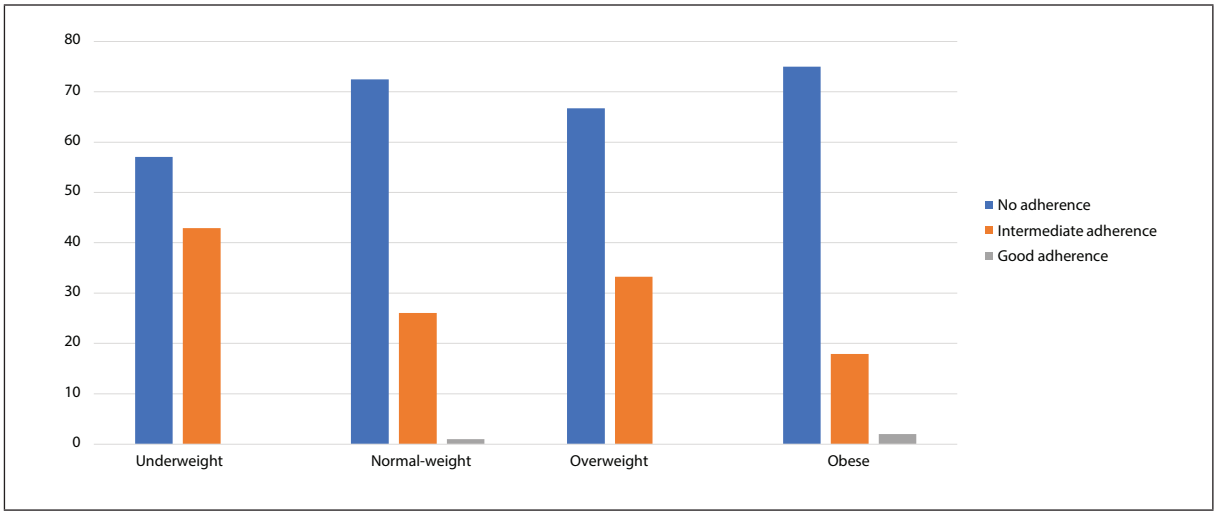

Figure 1
Adherence to Mediterranean Diet in underweight, normal-weight, overweight and obese subset.

ment of multiple cardiovascular risk factors [15]. In our study we didn't find any association between KIDMED scores and BMI, but a slightly higher prevalence of poor adherence was recorded in the obese subset. Nevertheless, the positive correlation between low adherence to MD and overweight/obesity in children has been widely proved in previous studies [16-19]. Ojeda-Rodriguez *et al*. studied the effect of a lifestyle intervention on a population of children and adolescents with abdominal obesity by using the KIDMED score. Participants were able to reduce their BMI and improve their MD adherence, reaching an average final KIDMED score corresponding to optimal diet quality [20].

Waist-to-height ratio is a strong anthropometric predictor of obesity and indicator of cardiometabolic risk in children and it has been previously proved that adherence to MD decreases waist circumference [8]. In the IDEFICS study by Tognon *et al*., high adherence to MD was inversely associated with overweight and obesity in the cross-sectional analysis and with waist circumference or WHtR in the prospective analysis [21]. In our analysis, we didn't observe any correlation between MD adherence and WtHR, since all of the patients' subsets showed a high frequency of poor MD adherence.

According to previous evidence [18, 6, 19], in our study sex was not associated with MD adherence, although other studies suggested that in western societies women tend to have better dietary habits than men [22]. A cohort study by Field *et al*. also reported that parents' concerns about body weight has a strong influence on adolescents' diets [23].

Our study presents both strengths and limitations. We described two important trends, in accordance with recent literature. The first consideration is the overall low adherence to MD in our cohort of children living in Southern Italy, regardless of sex or current nutritional status. This underlines an important variation from the traditional healthy dietary habits of this Mediterranean area. The second finding is the strong inverse correlation between age and MD adherence.

A limitation of our study was the sample size, as it was a pilot study, and the fact that children were enrolled in a single Hospital.

CONCLUSIONS

Our Center experience shows an overall low adherence to MD in underweight, normal-weight, overweight and obese children living in Southern Italy, regardless of nutritional status; this could easily lead to the spread of obesity as predicted by the WHO. With the "Western Diet" phenomenon, children are slowly abandoning the MD. It is thus important to monitor eating habits, especially in adolescents, and provide lifestyle interventions and dietary education in Southern Italy, disregarding the fact that MD is a cultural inheritance of this area. Those strategies should lead to the prevention of childhood obesity and overweight to avoid the future development of metabolic syndrome, atherosclerosis, and cardiovascular diseases. In order to gain an understanding of the dietary habits of the Italian pediatric population, future research should be conducted on a larger population and children living in different areas should be enrolled.

Authors' contributions

IR developed the idea of the study and collected data from the study population, participated in analysis and interpretation of the results and gave final approval to the draft. RC participated in data collection and drafting of the Manuscript. RG participated in data collection and drafting of the Manuscript. MLM participated in interpreting data and in review and revision of the draft. MS participated in critical review and revision of the article and MRP conducted the final draft revision and gave approval to the article submitted.

Conflict of interest statement

The Authors report no funding and conflicts of interest.

Received on 10 October 2023.
Accepted on 27 May 2024.

REFERENCES

1. García Cabrera S, Herrera Fernández N, Rodríguez Hernández C, et al. Kidmed test; prevalence of low adherence to the mediterranean diet in children and young; a systematic review. Nutr Hosp. 2015;32(6):2390-9. doi: 10.3305/nh.2015.32.6.9828
2. Casas R, Sacanella E, Estruch R. The immune protective effect of the Mediterranean diet against chronic low-grade inflammatory diseases. Endocr Metab Immune Disord Drug Targets. 2014;14(4):245-54. doi: 10.2174/1871530314666140922153350
3. Widmer RJ, Flammer AJ, Lerman LO, et al. The Mediterranean diet, its components, and cardiovascular disease. Am J Med. 2015;128(3):229-38. doi: 10.1016/j.amjmed.2014.10.014
4. Han JC, Lawlor DA, Kimm SY. Childhood obesity. Lancet. 2010;375(9727):1737-48. doi: 10.1016/S0140-6736(10)60171-7
5. Roccaldo R, Censi L, D'Addezio L, et al; ZOOM8 Study group. Adherence to the Mediterranean diet in Italian school children (The ZOOM8 Study). Int J Food Sci Nutr. 2014;65(5):621-8. doi: 10.3109/09637486.2013.873887
6. Grosso G, Marventano S, Buscemi S, et al. Factors associated with adherence to the Mediterranean diet among adolescents living in Sicily, Southern Italy. Nutrients. 2013;5(12):4908-23. doi: 10.3390/nu5124908
7. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85(9):660-7. doi: 10.2471/blt.07.043497
8. Bacopoulou F, Landis G, Rentoumis A, et al. Mediterranean diet decreases adolescent waist circumference. Eur J Clin Invest. 2017;47(6):447-55. doi: 10.1111/eci.12760.
9. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review

and meta-analysis. Obes Rev. 2012;13(3):275-86. doi: 10.1111/j.1467-789X.2011.00952.x
10. Serra-Majem L, Ribas L, García A, Pérez-Rodrigo C, Aranceta J. Nutrient adequacy and Mediterranean Diet in Spanish school children and adolescents. Eur J Clin Nutr. 2003;57:35-9.
11. Iaccarino Idelson P, Scalfi L, Valerio G. Adherence to the Mediterranean Diet in children and adolescents: A systematic review. Nutr Metab Cardiovasc Dis. 2017;27(4):283-99. doi: 10.1016/j.numecd.2017.01.002
12. Grammatikopoulou MG, Gkiouras K, Daskalou E, et al. Growth, the Mediterranean diet and the buying power of adolescents in Greece. J Pediatr Endocrinol Metab. 2018;31(7):773-80. doi: 10.1515/jpem-2018-0039
13. Scali J, Richard A, Gerber M. Diet profiles in a population sample from Mediterranean southern France. Public Health Nutr. 2001;4:173-82. doi: 10.1079/PHN200065
14. De Onis M, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. Am J Clin Nutr. 2010;92:1257-64. doi:10.3945/ajcn.2010.2978
15. Çağiran Yilmaz F, Çağiran D, Özçelik AÖ. Adolescent obesity and its association with diet quality and cardiovascular risk factors. Ecol Food Nutr. 2019;58(3):207-18. doi: 10.1080/03670244.2019.1580581
16. Lazarou C, Panagiotakos DB, Matalas AL. Physical activity mediates the protective effect of the Mediterranean diet on children's obesity status: The CYKIDS study. Nutrition. 2010;26(1):61-7. doi: 10.1016/j.nut.2009.05.014
17. Cakir M, Akbulut UE, Okten A. Association between Adherence to the Mediterranean Diet and Presence of Nonalcoholic Fatty Liver Disease in Children. Child Obes. 2016;12(4):279-85. doi: 10.1089/chi.2015.0197
18. Tugba K.Cömert, Mehtap Çerkez, Aslı G. Tekin, et al. Compliance with Mediterranean Diet Quality Index (Kidmed) and eating patterns in school-age children with gaziantep, Turkey. American Journal of Food and Nutrition. 2015;3(1):28-33. doi: 10.12691
19. Lazarou C, Panagiotakos DB, Matalas AL. Level of adherence to the Mediterranean diet among children from Cyprus: the CYKIDS study. Public Health Nutr. 2009;12(7):991-1000. doi: 10.1017/S1368980008003431
20. Ojeda-Rodríguez A, Zazpe I, Morell-Azanza L, et al. Improved diet quality and nutrient adequacy in children and adolescents with abdominal obesity after a lifestyle intervention. Nutrients. 2018;10(10):1500. doi: 10.3390/nu10101500
21. Tognon G, Hebestreit A, Lanfer A, et al. Mediterranean diet, overweight and body composition in children from eight European countries: cross-sectional and prospective results from the IDEFICS study. Nutr Metab Cardiovasc Dis. 2014;24(2):205-13. doi: 10.1016/j.numecd.2013.04.013
22. Li KK, Concepcion RY, Lee H, et al. An examination of sex differences in relation to the eating habits and nutrient intakes of university students. J Nutr Educ Behav 2012;44(3):246-50. doi: 10.1016/j.jneb.2010.10.002
23. Field AE, Camargo CA Jr, Taylor CB, et al. Peer, parent, and media influences on the development of weight concerns and frequent dieting among preadolescent and adolescent girls and boys. Pediatrics. 2001;107(1):54-60. doi: 10.1542/peds.107.1.54