

## Are 6-8 year old Italian children moving away from the Mediterranean diet?

C. Zani<sup>1</sup>, E. Ceretti<sup>1</sup>, S. Grioni<sup>2</sup>, G.C.V. Viola<sup>1</sup>, F. Donato<sup>1</sup>, D. Feretti<sup>1</sup>, A. Festa<sup>1</sup>, S. Bonizzoni<sup>3</sup>, A. Bonetti<sup>4</sup>, S. Monarca<sup>5</sup>, M. Villarini<sup>5</sup>, S. Levorato<sup>5</sup>, A. Carducci<sup>6</sup>, M. Verani<sup>6</sup>, B. Casini<sup>6</sup>, A. De Donno<sup>7</sup>, T. Grassi<sup>7</sup>, F. Bagordo<sup>7</sup>, E. Carraro<sup>8</sup>, Si. Bonetta<sup>8</sup>, Sa. Bonetta<sup>8</sup>, U. Gelatti<sup>1</sup> and MAPEC-LIFE Study Group\*

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*Parole chiave: Questionario sui consumi alimentari, dieta mediterranea, indice mediterraneo italiano*

### Abstract

**Background.** The Mediterranean diet (MD) is considered one of the healthiest dietary models, as it decreases the risk of chronic diseases and may modulate the organism's early response to environmental pollution. In recent decades, Mediterranean countries have been replacing their traditional diet with other less healthy eating habits, especially among children and teenagers.

**Objective.** The aim of this study was to evaluate the MD and the level of adherence to it in 6-8 year old Italian children, in relation to residence, lifestyle, and social and family contexts.

**Methods.** A questionnaire was administered to the children's parents in two seasons in 5 Italian towns. The diet section contained 116 questions investigating the frequency of consumption of different types of food. The Italian Mediterranean Index (IMI) was calculated according to the intake of 6 typical Mediterranean and 4 non-Mediterranean foods. On the basis of IMI score, MD adherence was classified as low ( $\leq 3$  IMI score), medium (4-5) and high ( $\geq 6$ ). Total energy load and diet composition in micro- and macronutrients were calculated from consumption frequency.

**Results.** Diet analysis was computed on 1164 subjects with two complete questionnaires. Body mass index, calculated for each subject, showed that 28.9% of the children were overweight, the figure varying slightly with area of residence. Our findings showed that 59.0% of the children had a low score for MD adherence.

**Conclusions.** The results of this study showed that most Italian children did not follow the MD and socio-economic characteristics appeared not to be associated with type of diet.

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<sup>1</sup> Department of Medical and Surgical Specialities, Radiological Science and Public Health, University of Brescia, Brescia, Italy

<sup>2</sup> Epidemiology and Prevention Unit, IRCCS Foundation, Istituto Nazionale dei Tumori, Milan, Italy

<sup>3</sup> Comune di Brescia, Brescia, Italy

<sup>4</sup> Centro Servizi Multisetoriale e Tecnologico – CSMT Gestione S.c.a.r.l., Brescia, Italy.

<sup>5</sup> Department of Pharmaceutical Sciences, University of Perugia, Perugia, Italy.

<sup>6</sup> Department of Biology, University of Pisa, Pisa, Italy.

<sup>7</sup> Department of Biological and Environmental Science and Technology, University of Salento, Lecce, Italy.

<sup>8</sup> Department of Public Health and Paediatrics, University of Turin, Turin, Italy.

\* MAPEC-LIFE Study Group: University of Brescia: L Covolo, R Levaggi, RM Limina, G Mazzoleni, I Zerbini; Comune di Brescia: C Furia; CSMT Gestione S.c.a.r.l.: P Colombi, F Braga; University of Perugia: C Fatigoni, M Moretti, S Vannini; University of Pisa: B Bruni, E Caponi, G Donzelli; University of Salento: A Idolo, M Guido, G Devoti, MR Tumolo, F Serio; University of Turin: V Romanazzi, C Pignata, T Schilirò, G Gilli

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## Introduction

The Mediterranean diet (MD) is considered one of the healthiest dietary models and numerous epidemiological and nutritional studies have shown that Mediterranean countries have benefited from lower rates of chronic disease morbidity and higher life expectancy in the last few decades (1). The traditional Mediterranean diet protects against cardiovascular diseases, certain tumours, such as colo-rectal, prostate and breast tumours, and many other pathologies associated with oxidative stress (1). Moreover, the MD is known to be rich in vitamins and antioxidants, and this might modulate the organism's early response to environmental pollution according to some studies (2-4).

This dietary pattern is characterized by a high consumption of vegetables, grains, nuts, olive oil and pulses, a moderate consumption of poultry, fish, eggs and dairy products, and a low consumption of red meat (5).

In recent decades, however, the Mediterranean countries appear to be replacing their traditional diet with other less healthy eating habits, especially among children and teenagers (6-7). The progressive globalisation of food products has contributed to a decrease in the consumption of healthy foods (8) and an increase a high-energy diet pattern rich in saturated fats and low in micronutrients, such as vitamins. This is also related to an increase in obesity, especially in children, in both Mediterranean and some industrialized countries (9-10). Food choices are also related to socio-economic factors and individual's level of nutritional expertise; family, school environment, peers and the media also influence lifestyle (9).

The aim of this study was to evaluate the level of MD adherence in a sample of 6-8-year-old Italian children, according to residence, lifestyle, and social and family contexts.

This study was included in the MAPEC-Life project (Monitoring Air Pollution Effects on Children for Supporting Public Health Policy), which was funded by the European Commission as part of the LIFE+ Program, the European environment fund, and it is a multicentre cohort study. The study protocol is reported in Feretti et al. (11) and is outlined below. The purpose of the MAPEC-Life project is to analyse the association between environmental exposures (both outdoor and indoor), diet and other variables of children's lifestyle and early biological effects on buccal cells, and to examine the role of these confounding factors on biological effects in children induced by air pollutants.

In order to evaluate the association between the levels of air pollution and early biological effects in buccal cells of children aged 6-8 years, we recruited about 1000 children in 5 Italian towns (Brescia, Lecce, Perugia, Pisa and Turin) with different air pollution levels. The environmental and biological samples were collected in two different seasons (winter and late spring) to take into account seasonal differences in air pollution.

Children's diet was evaluated because it might modulate the body's response to an environmental insult, as regards food groups with potentially genotoxic action, such as grilled food, due to the possible presence of polycyclic aromatic hydrocarbons produced by cooking, or food groups with high levels of antioxidants.

This paper presents the data collected on children's diet.

## Materials and methods

### *Food frequency questionnaire*

We developed and validated a questionnaire for collecting data on different air pollution exposures and diet in primary school children enrolled in the MAPEC-

Life study. The questionnaire, which is described in detail in Zani et al. (12), was self-administered and filled in by the parents of the children enrolled in the MAPEC study.

The questionnaire was divided into the following sections according to the MAPEC-Life protocol: personal details; home characteristics (traffic level, heating systems, presence of a fireplace); traffic near the school, child's general health status, physical activity and other aspects of her/his lifestyle; second-hand smoke exposure at home; parents' characteristics (education, work, smoking habits) and diet.

The diet section contained 116 questions about different food items, divided into the following groups: bread; pasta and cereals; pulses; vegetables; fruit; meat; fish; milk and dairy products; desserts and cakes; non-alcoholic beverages and sugar. There was also a short section on the type of fat (butter, olive oil, seed oil, margarine) used for preparing, cooking and dressing the food.

For each item the respondents could choose between 7 different categories of consumption frequency, ranging from "1 or 2 times a day" to "less than once a week"; a "never" option was also included. Nine categories for frequency of drinking sugar-sweetened beverages were included, since it was assumed that several doses would be consumed a day.

The questions on food consumption frequencies considered all the children's meals throughout the day, both at home and in the school dining-room. Each subject had to answer the same questionnaire twice, in two different seasons, winter and late spring.

The data on consumption frequency enabled us to calculate total energy load and diet composition in terms of micro- and macronutrients using NAF software developed by the Milan Cancer Institute's Unit of Nutritional Epidemiology (13). This

programme allows consumption frequency to be converted into amounts of nutrients in the diet, given a standard amount of food consumed per serving.

Furthermore, we calculated the Italian Mediterranean Index (IMI) based on the paper by Agnoli et al. (14), but excluding alcohol consumption. IMI score is based on 10 items: high intakes of 6 typical Mediterranean foods (pasta; vegetables, such as raw tomatoes, leafy vegetables, onion, garlic, lettuce and fruiting vegetables; fruit; pulses; olive oil; fish); low intakes of 4 non-Mediterranean foods (sugar-sweetened beverages, butter, red meat and potatoes). If consumption of typical Mediterranean foods was in the third tertile of the distribution, the child received 1 point; all other intakes received 0 points. If consumption of non-Mediterranean foods was in the first tertile of the distribution, the subject received 1 point.

#### *Statistical analysis*

All the demographic and socio-economic data were processed to investigate the associations with the Italian Mediterranean Index (IMI), and two-sided statistical tests were performed with a p-value of 0.05 as the threshold for rejecting the null hypothesis.

Data analysis was performed for all the children, and stratified by town of residence and the principal socioeconomic characteristics of the children's parents.

Based on IMI score, ranging from 0 to 10, adherence to Mediterranean diet (MD) was classified as low ( $\leq 3$ ), medium (4-5) or high ( $\geq 6$ ) (7).

Agreement between the MD adherence categories assessed with the winter and late spring questionnaires was computed using Cohen's Kappa statistic (K) for dichotomous variables and Spearman's rho coefficient (r) for ordinal or continuous variables, including total energy intake and amounts of different nutrients.

## Results

A letter of invitation was sent to 3144 children attending 26 primary schools in Italy. The parents of 1769 children (56.3%) agreed to participate in our study and provided their informed consent. The first step was to enrol 1354 children in 5 Italian towns, whose parents completed the winter questionnaire (84.7% of those who agreed to participate). The parents of

1164 of these children completed the same questionnaire again in late spring, whereas 190 (14.0%) refused to complete it or were excluded according to the MAPEC-Life study protocol (11).

Data analysis was only performed for subjects whose parents completed both questionnaires. As reported in Table 1, 50.8% of them were males and the number of children enrolled in each of the 5 Italian towns was similar. The mean age  $\pm$  standard

Table 1 - Demographic and socio-economic characteristics of the 1164 children and their parents in 5 Italian towns.

Characteristics	Brescia N=250	Turin N=227	Pisa N=210	Perugia N=235	Lecce N=242	Total N=1164
Children: males N (%)	119 (47.6)	120 (52.8)	97 (46.2)	136 (57.9)	119 (49.2)	591 (50.8)
Children's age, years mean $\pm$ SD	7.2 $\pm$ 1.0	7.1 $\pm$ 0.9	7.0 $\pm$ 0.9	7.1 $\pm$ 1.0	7.0 $\pm$ 0.9	7.0 $\pm$ 0.9
Overweight children (%) (BMI>17.4 kg/m <sup>2</sup> )	55 (22.0)	68 (29.9)	65 (31.0)	70 (29.8)	78 (32.2)	336 (28.9)
Mother of Italian nationality* N (%)	207 (82.8)	181 (79.7)	163 (77.6)	203 (86.4)	221 (91.3)	975 (83.7)
Mother's education $\geq$ 13 years*	194 (77.9)	181 (79.7)	176 (83.8)	215 (91.5)	208 (85.9)	973 (83.7)
Mother's occupational status*						
employed	188 (75.1)	178 (78.4)	152 (72.4)	180 (76.6)	148 (61.2)	846 (72.7)
unemployed	21 (8.4)	26 (11.5)	21 (10.0)	29 (12.3)	34 (14.0)	131 (11.2)
housewife	41 (16.5)	23 (10.1)	37 (17.6)	26 (11.1)	60 (24.8)	187 (16.1)
Mother current smoker*	39 (15.7)	60 (26.4)	41 (19.6)	33 (14.0)	47 (19.4)	220 (18.9)
Father of Italian nationality*	211 (84.4)	184 (81.1)	174 (82.8)	210 (89.4)	228 (94.2)	1007 (86.5)
Father's education $\geq$ 13 years *	169 (67.9)	176 (77.5)	152 (72.7)	202 (86.0)	188 (77.7)	874 (76.0)
Father's occupational status*						
employed	232 (92.8)	202 (89.0)		212 (90.2)	207 (85.5)	1035 (88.4)
unemployed	11 (4.4)	18 (7.9)	20 (9.6)	15 (6.4)	12 (5.0)	63 (6.5)
retired	7 (2.8)	7 (3.1)	6 (2.9)	8 (3.4)	23 (9.5)	51 (5.1)
Fathers current smoker*	54 (21.7)	79 (35.6)	62 (29.5)	45 (19.6)	68 (28.2)	307 (26.7)

\* comparison among 5 towns: p<0.01

deviation (SD) was  $7.0 \pm 0.9$  years. According to body mass index, the percentage of overweight children was 28.9%, the highest percentage (32.2%) being in Lecce and the lowest (22.0%) in Brescia. The majority of the children's parents were Italian (83.7% of mothers and 86.5% of fathers), with some differences between the 5 towns: Lecce had the lowest percentage of foreign parents (8.7% of mothers and 5.8% of fathers), Pisa the highest percentage of foreign mothers (22.4%) and Turin the highest percentage of foreign fathers (18.9%). The majority of the mothers had at least a high school education: Brescia had the lowest percentage (77.9%) and Perugia the highest (91.5%). With regard to the children's mothers, 72.7% were employed and 16.1% were housewives; Lecce had the highest percentage of housewife mothers (24.8%,  $p < 0.01$ ). The percentage of current smokers among mothers was 18.9%, with the highest percentage (26.4%) in Turin and the lowest (14.0%) in Perugia. Similar differences were found for the children's fathers.

Table 2 shows adherence to the Mediterranean diet (MD), classified as low ( $\leq 3$ ), medium (4-5) or high ( $\geq 6$ ), based on IMI score. More than half of the children (59.1%) displayed low adherence to MD; Lecce had the highest percentage of low

adherence (66.1%), Turin and Perugia the lowest (56%).

MD adherence was not associated with the characteristics of the children or their parents (data not reported in table), except that girls were more adherent than boys (58.8% vs 41.2% respectively;  $p = 0.01$ ). Children's BMI, dichotomised as under/normal weight vs. overweight/obese, was not associated with parents' nationality, level of education or employment status (employed vs. unemployed and/or housewife) (data not reported in table).

The agreement between MD adherence categories in the winter and late spring questionnaires was assessed (Table 3): the percentage of agreement between the first and second IMI score was 59%, with a  $k$ -value of 0.27. Small significant differences were shown in IMI score in different seasons: mean IMI was  $3.5 \pm 1.7$  in winter vs  $3.3 \pm 1.7$  in late spring ( $p < 0.05$ ). The agreement of IMI score computed with two questionnaires was moderate, Spearman's  $r = 0.5$ .

The analysis of energy intake computed on the basis of food frequency showed a good agreement in the two seasons, with Spearman  $r = 0.6$  (mean:  $2,219 \pm 859$  Kcal/day in winter and  $2,091 \pm 826$  Kcal/day in late spring). No differences were found for any macronutrients or micronutrients consumed in the two seasons (data not reported).

Table 2 - Adherence to Mediterranean diet (MD) based on Italian Mediterranean Index (IMI) in 6-8-year-old children in 5 Italian towns.

IMI	Brescia n (%)	Turin n (%)	Pisa n (%)	Perugia n (%)	Lecce n (%)	Total n (%)
$\leq 3$ low adherence	147 (58.8)	128 (56.4)	119 (56.7)	133 (56.6)	160 (66.1)	687 (59.0)
4-5 medium adherence	75 (30.0)	73 (32.1)	72 (34.3)	67 (28.5)	63 (26.0)	350 (30.1)
$\geq 6$ high adherence	28 (11.2)	26 (11.5)	19 (9.0)	35 (14.9)	19 (7.9)	127 (10.9)

Table 3 - Score of adherence to Mediterranean diet (MD) computed by a questionnaire completed twice (winter and late spring) by the children's parents.

IMI	Brescia	Turin	Pisa	Perugia	Lecce	Total
Winter questionnaire (median $\pm$ SD)	3.5 $\pm$ 1.6	3.6 $\pm$ 1.7	3.3 $\pm$ 1.7	3.8 $\pm$ 1.8	3.0 $\pm$ 1.6	3.5 $\pm$ 1.7
Late spring questionnaire (median $\pm$ SD)	3.3 $\pm$ 1.7	3.4 $\pm$ 1.6	3.3 $\pm$ 1.7	3.5 $\pm$ 1.7	2.9 $\pm$ 1.6	3.3 $\pm$ 1.7
Mean difference (95% CI)	0.27 (0.06-0.5)	0.2 (0.03-0.4)	0 (-0.2-0.2)	0.34 (0.1-0.5)	0.1 (-0.1-0.3)	0.2 (0.1-0.3)
Spearman's rho	0.47	0.49	0.49	0.56	0.47	0.50

## Discussion

For our study we enrolled 1164 children living in 5 Italian towns (2 in the north, 2 in the centre and 1 in the south of Italy) with regional differences as regards both environmental air pollution levels and diet pattern. Adherence to the Mediterranean diet in 6-8-year-old Italian children was measured using a score (IMI) based on 10 traditional foods in this diet pattern (14).

The literature contains many different diet scores, and several epidemiological studies used the Mediterranean diet adherence index to make a global evaluation of diet quality according to traditional Mediterranean foods and nutrients (15) and to evaluate diet as a protective factor for many chronic diseases.

We computed IMI based on the results of a food frequency questionnaire administered twice, in winter and late spring. The results showed that most of the Italian children studied (60%) had a low adherence to the MD, in agreement with other recent studies on general population (10, 16-17). The percentage of high MD adherence is very low in our sample (13.1%) and there were no differences among the children living in the 5 towns; the lowest percentage of good adherence to MD was in Lecce (Southern Italy).

We did not find an association between MD adherence and socio-economic characteristics, contrary to the results of other studies reporting that the proportion

of well-educated and higher-income parents was greater among children with high MD adherence (9-10).

These apparent discrepancies may be due to various factors. In this study, the parents of about half (56.3%) of the children agreed to participate, and 90.3% of them were eligible for the research. We were unaware of the socio-economic characteristics of the subjects who refused to be enrolled in the study. The demographic characteristics of our sample, however, are similar to the national ones. For instance, the average percentage of children born in Italy with at least one foreign parent was similar to the nationwide figure of 19% (18).

In addition, the level of education of both mothers and fathers was above the national average (47.8% vs 27.2% for graduate mothers and 39.5% vs 17.7% for graduate fathers, in our sample and Italy, respectively). Accordingly, a much higher percentage of mothers (72.7%) in our sample were in employment compared to the whole country (51%). Lastly, the sample showed a lower proportion of smokers (19.8% of mothers, 26.7% of fathers) compared to Italian percentages in the 35-45-year age bracket (24.5% of women, 35.4% of men) (18), although few data are available on the smoking habits of parents in Italy.

The children enrolled in our study were therefore a selected sample of the general population, with a higher level of education

and occupation level and a lower percentage of smokers among their parents, which makes the results even more worrying. If these children of a relatively high socio-economic level were mostly non-adherent to the MD, we wonder to what extent the Italian general population, especially the lower classes, is following the guidelines for a healthy diet provided by nutritional councils promoting the benefits of the MD (19).

These results are in agreement with those of recent studies showing that the new generations are moving away from a healthy nutritional model, such as the MD, and adopting poor eating habits, including a high calorie intake, which, combined with low levels of physical activity, is leading to an increase in childhood overweight and obesity (6-7, 20).

Overweight children accounted for 28.9% of our sample, with slightly higher prevalence (30.8%) in males and in Southern Italy (32.2%), in line with other surveys on

the prevalence of overweight and obesity in this age group in the Italian population (35.9%) (21) and in the Italian “OKkio alla SALUTE” survey in 2014 (30.7%) (22-23). We did not find that the socio-economic level was associated with children being overweight, contrary to the results of the “OKkio alla SALUTE” survey and the European project COSI (24).

Our results showed that 49.7% (N = 577) of the children did not eat vegetables of any kind (except potatoes) regularly and 19% did not eat fruit (N = 221), including those children whose parents declared an occasional consumption of these nutrients, less than once a week. 23% of subjects also claimed to consume sugary beverages and/or fruit juice at least once a day. These findings are roughly in line with those of other recent surveys. The OKkio alla SALUTE study, for instance, found that 8% of Italian school children did not eat breakfast (17% in Sicily, 6% in the North-East), 31% did not have an

Table 4 - Comparison of the results of the present study with those of two nationwide Italian surveys (INN-CA study and INRAN-SCAI study) for mean daily intake (g/day) of principal nutrients.

	INN-CA 1994-1996 (Turrini et al., 2001)	INRAN-SCAI 2005-2006 (Leclercq et al., 2009)	MAPEC-Life study 2014-2016
Number of children (age range)	138 (1-9 years)	52 (3-9 years)	1164 (6-9 years)
Cereals *	139.7	185.5	219.8
Tubers #	30.2	47.2	38.7
Vegetables and fresh fruit	406.8	266.6	494.2
Nuts	1.5	1.2	1.5
Milk and dairy products	261.5	259.1	311.5
Processed meat	17.2	23.3	30.9
Eggs	10.1	20.0	8.0
Meat	81.6	76.2	54.7
Fish	24.1	40.2	51.6
Pulses	10.5	10.1	15.4
Condiment fats	16.5	33.2	22.7
Sweet and salad snack	105.1	88.2	123.2
Sugar-sweetened beverages	93.9	107.9	120.0

\* Cereals: including different type of pasta, pizza, rice, cereals for breakfast and wheatmeal.

# Tubers: potatoes and derived products

adequate breakfast (i.e. balanced in terms of carbohydrates and proteins), 52% consumed high-density foods such as snacks, 41% consumed sugar-sweetened beverages every day (17% of them more than once a day), 25% did not eat fruit and vegetables every day, and only 2% consumed at least 4 servings per day (19).

Two large multicentre studies have been conducted on school-age children in Italy: the INN-CA study (25), which reported food consumption data for children aged 1-9 years and assessed in 1994-1996, and the INRAN-SCAI study (26-27) on the food intake of children aged 3-9 years in 2005-2006. A comparison of these two studies and the present study is shown in Table 4. There was no significant difference between the studies with regard to the average consumption of the principal nutrients, namely cereals, tubers, nuts, milk and dairy products, seasoning, vegetables and fats. The consumption of meat decreased from 81.6 grams/day in the INN-CA study and 76.2 g/day in the INRAN-SCAI survey to 54.7 g/day in the present study, whereas the consumption of processed meat increased from 17.2 g/day and 23.3 g/day, respectively, to 30.9 g/day; fish consumption also underwent a significant increase. The consumption of sweets, snacks and sugar-sweetened drinks increased as well: for soft drinks the increase was +26 g/day compared to the INN-CA study and +13 g/day compared to the INRAN-SCAI study; for sweets and snacks the increase was +18 and +35 g/day, respectively, compared to the two studies. Taken together, these findings suggest that some changes are occurring in the dietary habits of Italian children, the overall trends being a decrease in the consumption of healthy food and an increase in high-energy diets.

In conclusion, 6-8-year-old Italian children seem to move away from the Mediterranean diet. It is therefore important to support the diffusion of self-defence tools, particularly healthy lifestyle choices, including the Mediterranean diet, for

promoting health and possibly contrasting the effects of harmful environmental agents, such as air pollution, especially with regard to children's health.

**Conflict of interest:** None

**Ethics standards disclosure:** The project has been approved by the local Ethics Committee (Comitato Etico Provinciale della Provincia di Brescia) on 15 January 2014 and the local Health Authorities of each town involved in the study. Written informed consent was obtained from all subjects' parents.

## Riassunto

### *I bambini italiani di 6-8 anni stanno abbandonando la dieta mediterranea?*

**Introduzione.** La dieta mediterranea (DM) è considerata uno dei modelli alimentari più sani in quanto diminuisce il rischio di sviluppare malattie croniche e può modulare la risposta precoce dell'organismo agli insulti dell'inquinamento ambientale. Negli ultimi decenni, i paesi tipicamente Mediterranei stanno sostituendo la loro dieta tradizionale con altre abitudini alimentari meno salutari e questo sta avvenendo soprattutto tra i bambini e gli adolescenti.

**Obiettivo.** Lo scopo di questo studio era di valutare la dieta e il livello di aderenza alla DM nei bambini italiani di 6-8 anni, in relazione alla residenza, al loro stile di vita e ai contesti socio-familiari.

**Metodi.** È stato distribuito un questionario ai genitori dei bambini in 5 città italiane in due diverse stagioni. La sezione riguardante la dieta prevedeva 116 domande per indagare la frequenza di consumo dei diversi alimenti. È stato calcolato l'indice Mediterraneo italiano (IMI) in base al consumo di 6 alimenti tipicamente mediterranei e 4 alimenti non mediterranei. Sulla base del punteggio IMI, l'aderenza alla DM è stata classificata come bassa ( $IMI \leq 3$ ), media (4-5) e alta ( $\geq 6$ ). Inoltre è stato calcolato il carico di energia totale e la composizione della dieta in micro e macronutrienti.

**Risultati.** L'analisi è stata condotta su 1164 soggetti che avevano due questionari completi. L'indice di massa corporea, calcolato per ciascun bambino, ha mostrato che il 28,9% del nostro campione è in sovrappeso, percentuale che varia nelle diverse città.

I nostri risultati mostrano che il 59,0% dei bambini ha una bassa aderenza alla DM ( $IMI < 3$ ).

**Conclusioni.** Il risultato di questo studio mostrano che la maggior parte dei bambini italiani non segue una DM e i fattori socio-economici non sembrano essere associati al tipo di dieta.

## References

1. Sofi F, Macchi C, Abbate R, Gensini GF, Casini A. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. *Public Health Nutr* 2014; **17**: 2769-82.
2. Szeto YT, Benzie IF, Collins AR, et al. A buccal cell model comet assay: Development and evaluation for human biomonitoring and nutritional studies. *Mutat Res* 2005; **578**: 371-81.
3. Holland N, Bolognesi C, Kirsch-Volders M, et al. The micronucleus assay in human buccal cell as a tool for biomonitoring DNA damage: the HUMN project perspective on current status and knowledge gaps. *Mutat Res* 2008; **659**: 93-108.
4. Bonassi S, Znaor A, Ceppi M, et al. An increased micronucleus frequency in peripheral blood lymphocytes predicts the risk of cancer in humans. *Carcinogenesis* 2007; **28**: 625-31.
5. Davis C, Bryan J, Hodgson J, Murphy K. Definition of the Mediterranean Diet; A Literature Review. *Nutrients* 2015; **7**: 9139-53.
6. Hebestreit A, Ahrens W. Relationship between dietary behaviours and obesity in European children. *Int J Pediatr Obes* 2010; **5**: 45-47.
7. Bonaccio M, Di Castelnuovo A, Bonanni A, et al. Decline of the Mediterranean diet at a time of economic crisis. Results from the Moli-sani study. *Nutr Metab Cardiovasc Dis* 2014; **24**: 853-60.
8. 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**: 991-1000.
9. Bonaccio M, Bonanni AE, Di Castelnuovo A, et al. Low income is associated with poor adherence to a Mediterranean diet and a higher prevalence of obesity: cross-sectional results from the Moli-sani study. *BMJ-Open* 2012; **2**: e001685.
10. 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**: 205-13.
11. Feretti D, Ceretti E, De Donno A, et al. Monitoring air pollution effects on children for supporting public health policy: the protocol of the prospective cohort MAPEC study. *BMJ Open* 2014; **4**: e006096.
12. Zani C, Donato F, Grioni S, Viola GCV, et al. Feasibility and reliability of a questionnaire for evaluation of the exposure to indoor and outdoor air pollutants, diet and physical activity in 6-8-year-old children. *Ann Ig* 2015; **27**: 646-56.
13. Pala V, Sieri S, Palli D, et al. Diet in the Italian EPIC cohorts: presentation of data and methodological issues. *Tumori* 2003; **89**: 594-607.
14. Agnoli C, Krogh V, Grioni S, et al. A priori-defined dietary patterns are associated with reduced risk of stroke in a large Italian cohort. *J Nutr* 2011; **141**: 1552-8.
15. Bach-Faig A, Berry EM, Lairon D, et al. Mediterranean diet pyramid today. Science and cultural updates. *Public Health Nutr* 2011; **14**: 2274-84.
16. Pelucchi C, Galeone C, Negri E, La Vecchia C. Trends in adherence to the Mediterranean diet in an Italian population between 1991 and 2006. *Eur J Clin Nutr* 2010; **64**: 1052-6.
17. Bagordo F, Grassi T, Serio F, Idolo A, De Donno A. Dietary habits and health among university students living at or away from home in southern Italy. *J Food Nutr Res* 2013; **52**: 164-71.
18. Istituto Nazionale di Statistica (ISTAT). Available from: <http://www.istat.it> (Last accessed 2016 June 18).
19. Società Italiana di Nutrizione Umana (SINU). Tables of recommended dietary intakes of nutrients. Available from: [http://www.sinu.it/html/pag/tabelle\\_larn\\_2014\\_rev.asp](http://www.sinu.it/html/pag/tabelle_larn_2014_rev.asp) (Last accessed 2016 June 18).
20. Santomauro F, Lorini C, Tanini T, et al. Adherence to Mediterranean diet in a sample of Tuscan adolescents. *Nutrition* 2014; **30**: 1379-83.
21. Martone D, Roccaldo R, Censi L, Toti E, Catasta G, D'Addesa D, Carletti C; ZOOM8 Study Group. Food consumption and nutrient intake in Italian school children: results of the ZOOM8 study. *Int J Food Sci Nutr* 2013; **64**: 700-5.
22. "Okkio alla salute" survey. Available from: <http://www.epicentro.iss.it/okkioallasalute> (Last accessed 2016 June 18).
23. Nardone P, Lauria L, Buoncristiano M, Pizzi E, Galeone D, Spinelli A; Gruppo OKkio alla SALUTE 2008/9-2014. Dietary behaviour of children attending primary school in Italy found by the surveillance system "OKkio alla salute". *Epidemiol Prev* 2015; **39**: 380-5.
24. World Health Organization (WHO). European Childhood Obesity Surveillance Initiative (COSI), 2007. Available from: <http://www.euro>

- who.int/en/health-topics/disease-prevention/nutrition/activities/monitoring-and-surveillance/who-european-childhood-obesity-surveillance (Last accessed 2016 June 18).
25. Turrini A, Saba A, Perrone D, Cialfa E, D'Amicis A. Food consumption patterns in Italy: the INN-CA Study 1994-1996. *Eur J Clin Nutr* 2001; **55**: 571-88.
  26. Leclercq C, Arcella D, Piccinelli R, Sette S, Le Donne C, Turrini A; INRAN-SCAI 2005-06 Study Group. The Italian National Food Consumption Survey INRAN-SCAI 2005-06: main results in terms of food consumption. *Public Health Nutr* 2009; **12**: 2504-32.
  27. Sette S, Le Donne C, Piccinelli R, Arcella D, Turrini A, Leclercq C; INRAN-SCAI 2005-6 Study Group. The third Italian National Food Consumption Survey, INRAN-SCAI 2005-06-part 1: nutrient intakes in Italy. *Nutr Metab Cardiovasc Dis* 2011; **21**: 922-32.

Corresponding author: Claudia Zani, Department of Medical and Surgical Specialities, Radiological Sciences and Public Health, University of Brescia, 11 Viale Europa, 25123 Brescia, Italy  
e-mail: claudia.zani@unibs.it