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Original article

Relation between out-of-home eating and weight status in adolescents living in Sicily, southern Italy

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Summary. Overweight and obesity have increased dramatically over the last decades becoming the leading public health issue of the modern era. The transition from a traditional dietary patterns to a "Westernized" pattern, including consumption of fast-processed foods, "junk" foods and sweet beverages contribute to the development of overweigh and obesity. The aim of this study was to evaluate the relation between out of home eating and metabolic parameters in adolescents living in a Mediterranean area. The study had a cross-sectional design. Data were collected during two scholastic years (2012-13 and 2013-14) on 1643 adolescents of 13–16 years attending 15 secondary schools randomly selected in the urban area of the municipality of Catania. Demographic characteristics, physical activity status and eating habits were collected though a validated questionnaire and then the KIDMED score was calculated. Weight status was assessed by medical visit. Out-of-home eating was associated with being obese (OR 1.15, 95% CI: 1.01-1.15), especially when occurring for a main meal rather than for snack (OR 1.07, 95% CI: 1.02-1.22). These results were no longer significant after the adjustment for KIDMED score. Moreover, having a good adherence to Mediterranean diet was associated with 6% decreased odds of being obese (OR 0.94, 95% CI: 0.89-0.99). Adolescent eating out more than once per week were eating significantly less fruit and vegetables and more fast-foods and sweetened beverages. In conclusion, out-of-home eating is associated with unhealthy dietary choices among adolescents living in a Mediterranean country. The promotion of alternative nutritious snacks (such as nuts, fresh fruit and vegetables) in school setting should be considered.

Key words. Adolescent; BMI; out-of-home eating; overweight; obesity.

Introduction

Overweight and obesity have increased dramatically over the last decades becoming the leading public health issue of the modern era(1). Among the most studied factors, lifestyle modifications including rise in sedentary behaviors and unhealthy dietary choices seem to be the main factor responsible for such increasing rates in obesity(2). Current trends are even more alarming when considering the prevalence rates of overweight and obesity especially among the younger generations(3).Dietary habits and nutrition behaviors during this period of life may influence lifelong eating habits and contribute to the development of risk factors for disease in adulthood (4). Thus, a characterization of adolescents' dietary habits and identification of their food choices could help to reduce the impact of obesity in the present and the burden of obesity-related diseases in the future (5).

The increase of the socioeconomic status in developed countries contributed to the phenomenon of the "nutrition transition", defined as the modification of the food preferences from traditional dietary patterns to more "Westernized" habits, including consumption of fast-processed foods, "junk" foods, sweet beverages, and a higher consumption of meats and derivate (6, 7). This

process has been well documented in the Mediterranean region, where a progressive but consistent abandonment of the Mediterranean dietary pattern has been reported and associated with a deterioration of health. According cultural and scientific conventions, the Mediterranean diet is characterized by a number of key features: high consumption of fruit, vegetable, and legume as main source of fiber and plant antioxidant, such as vitamins and polyphenols (8-10); frequent consumption of fish as main sources of proteins and poly-unsaturated fatty acids (PUFA), which demonstrated beneficial effects on cardiovascular and mental health (11); daily consumption of olive oil, as main source of mono-unsaturated fatty acids (MUFA) (12); moderate consumption of alcohol, which has been reported to be related with decreased risk of cardiovascular diseases (13, 14); low consumption of meat and sweets, considered source of unhealthy fats, such as cholesterol and trans-fatty acids (15). The synergic action of all such features has been demonstrated to exert a number of beneficial effects toward human health and prolong lifespan (16-18). Despite the high content in foods rich in fats, the peculiar profile of MUFA and PUFA characterizing the Mediterranean diet are associated with lower risk of obesity and an overall better metabolic status (19).

This dietary pattern is associated with traditional habits of individual living in the Southern Mediterranean countries, which include consumption of meals at home in company of family members (20). The nutritional quality of foods consumed away from home may be poorer than those at home. Type and occasion of out of home eating (for instance, snaking versus main meal) may affect with different extent dietary habits of adolescents and, in turn, their health status. The aim of this study was to evaluate the relation between out of home eating and metabolic parameters in adolescents living in a Mediterranean area and to identify their food choices.

Methods

Design, setting, participants

The study had a cross-sectional design. The sample size was estimated in a minimum of 964 subjects considering a school population of 10,000, a confidence level of 95% and a margin of error of 3%. Data were collected during two scholastic years (period October-May of 2012-13 and 2013-14) on 1643 adolescents of 13–16 years attending 15 secondary schools in the urban area of the municipality of Catania (Sicily, southern Italy). Classroom were randomly selected through random number generator and all pupils attending that classroom were invited to participate. The schools were selected based on the socioeconomic level of the ten districts of the city to obtain a various range of socioeconomic status (SES) among the participants according the district's socioeconomic level in which schools were located. Data on socioeconomic level of the ten districts was provided from the Department of School Policies of Catania. Out of the 1766 adolescents attending the last year of school invited to participate, 1643 (93%) provided informed consent from parents and oral consent to participate to the study. Participation was not mandatory and participants were assured of complete anonymity. Data collection was performed by three trained medical doctors. The study was approved by the ethic committee of the Department of School Policies of Catania.

Demographic characteristics

Participants completed a questionnaire during school hours in the classroom in presence of a teacher and researchers, and attended a short clinical visit to perform anthropometric measurements in a separate room. Data collection was performed by three medical doctors and a member of the Department of the School Policies following a specific protocol to ensure that the same conditions were met for all participants.

The questionnaire consisted in a first part including demographic information, such as the adolescents' age, their parent's education level and job. Socio-cultural categories were given by other surveys taking into account education (primary, secondary/high school, and university) and occupation [unemployed and unskilled professions (i.e., manual workers); partially skilled professions (i.e., professors, nurses, etc.); skilled professions and white collars (i.e., medical doctors, lawyers, managers, etc.)] of participants' parents and was categorized in high, medium, and low according to the highest category achieved (21, 22). Physical activity status was evaluated by Physical Activity Questionnaire for Adolescents

(PAQ-A) (23). Body weight (BW, Kg), body height (HT, cm) and waist circumference (WC, cm) were measured to the nearest 100 g and 0.5 cm respectively. BMI was computed as weight in kilograms divided by the square of height in meters, and international age- and gender-specific cut-off points for children according to the International Obesity Task Force were used to define their weight status in terms of underweight, overweight and obesity(24).

Eating habits

A specific part of the questionnaire explored adolescents' eating habits. In this section, adolescents were asked (i) how many times per day do they eat between meals (response options were categorized in three categories ranging from "never" to "more than 4"); (ii) how many times do they eat out-of-home (namely pub, fast-food, restaurant) during one week (response options were categorized in four categories ranging from "never" to "more than 4"); (iii) which fast-food and snacks do they usually consume. The eating habits instrument was previously validated (25) and showed an alpha-coefficient for internal consistency 0.774 for items regarding snacking habits and temporal stability over time temporal stability over time of both the sections (correlation coefficient 0.769, statistically significant with $P < 0.001$).

Structure of Mediterranean adherence score

The KIDMED index (Mediterranean Diet Quality Index for children and adolescent) developed by Serra-Majem et al. (26) was used to evaluate the different adherence to the Mediterranean diet. Increased consumption of foods characterizing the Mediterranean diet, such as fruit and vegetables, dairy products, grains and cereals, nuts, fish, and olive oil provided one point, while foods supposed to be away from this dietary patterns, such as sweets, meat and fast foods as well as lack of breakfast provided inverse points. For a maximum score of 12, a total score of 0-3 reflected poor adherence, a score of 4-7 described average adherence, and a score of 8-12 a good adherence to the Mediterranean diet.

Statistical analysis

Continuous variables are presented as means ± standard deviations and differences between groups were tested by Student's independent *t*-test or Mann-Whitney U-test according to their normal or not-normal distribution, respectively (normality of variables' distribution was tested by Kolmogorov-Smirnov test). Accordingly, one-way ANOVA using Bonferroni correction and Kruskall-Wallis test was used for multiple comparisons. Categorical variables are presented as absolute and relative frequencies and differences between groups were tested by contingency tables and Chi-square test. Associations among eating and lifestyle habits with BMI status (normal weight/overweight and obese) were evaluated by logistic regression analyses and odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were calculated. A P-value <0.05 was used to denote significant differences in all analyses. Tests were performed using SPSS 21.0 (SPSS Inc, Chicago, IL).

Results

The general characteristics of the study population are shown in Table 1. The mean age of the participants was 12 years old, 45.8 % were boys. About one third of the girls and 2 thirds of the boys were obese. Obese children were more likely to have parents with lower cultural and socio-economic background. No particular differences across weight status categories were found in relation to lifestyle habits such as physical activity level and snacking behaviors. However, a higher percentage of obese children were eating out of home more frequently than normal weigh ones (P = 0.001). Conversely, a lower percentage of obese children had good adherence to the Mediterranean diet compared to normal weighted (0.005).

Several models of multivariate analysis were performed to better identify independent predictors of obesity (Table 2). Out-of-home eating was associated with being obese (OR 1.15, 95% CI: 1.01-1.15), especially when occurring for a main meal rather than for snack (OR 1.07, 95% CI: 1.02-1.22). However, when also the level of adherence to the Mediterranean diet was

Table 1. Demographic characteristics and eating habits according to weight status in 1586 adolescents living in Sicily, southern Italy.

	Normal weight N = 1198	Overweight N = 243	Obese N = 145	P-value
Age (years), mean (SD)	12.1 (0.7)	12.0 (0.7)	12.1 (0.6)	0.775
Gender, n (%)				<0.001
Male	478 (37.9)	151 (62.0)	97 (67.2)	
Female	744 (62.1)	92 (38.0)	48 (32.8)	
BMI, mean (SD)	18.5 (1.9)	23.2 (1.4)	28.1 (2.8)	<0.001
Parents' education, n (%)				0.044
Secondary or lower	612 (51.1)	155 (63.7)	92 (63.5)	
High school	380 (31.7)	66 (27.3)	41 (28.6)	
University	206 (17.2)	22 (9.1)	11 (7.9)	
Parents' occupation, n (%)				0.026
Unskilled professions	701 (58.5)	191 (78.5)	101 (69.8)	
Partially skilled professions	386 (32.2)	49 (20.0)	41 (28.6)	
Skilled professions	110 (9.2)	3 (1.4)	2 (1.6)	
Physical activity, n (%)				0.638
Low	423 (35.3)	89 (36.6)	62 (42.6)	
Medium	540 (45.1)	116(47.9)	67 (45.9)	
High	235 (19.6)	38 (15.5)	17 (11.5)	
Daily snack between meals, n (%)				0.233
0-1 times	567 (47.3)	243 (48.1)	69 (47.6)	
2-3 times	450 (37.6)	90 (37.0)	55 (37.9)	
>3 times	181 (15.1)	36 (14.8)	21 (14.5)	
Out-of-home eating (frequency), n (%)				0.001
0-3 times/mo	645 (53.8)	118 (48.6)	66 (45.5)	
1 time/w	356 (29.7)	80 (32.9)	45 (31.0)	
>1 time/w	197 (16.4)	45 (18.5)	34 (23.4)	
Out-of-home eating (occasion), n (%)				0.124
Snack	862 (72.0)	173 (71.2)	104 (71.7)	
Main meal	180 (15.0)	38 (15.6)	22 (15.2)	
KIDMED score, n (%)				0.005
Low	435 (36.3)	111 (45.7)	72 (49.5)	
Medium	677 (56.5)	125 (51.4)	70 (48.2)	
Good	86 (7.2)	7 (2.9)	3 (2.3)	

included into the model, none of the previous variables remained significant while having a good adherence was associated with 6% decreased odds of being obese (OR 0.94, 95% CI: 0.89-0.99). When examining the relation between the components of the KIDMED score and the frequency of out-of-home eating, children eating out more than once per week were eating significantly less fruit and vegetables. Conversely the consumption of fast-foods and sweetened beverages increased with the frequency of out-of-home eating (Table 3).

Discussion

In this study we found that a higher frequency of out-of-home eating was associated with being overweight and obese. However, such association with adverse health outcomes was mainly related with out-of-home main meals rather than snacking. Besides these eating habits, a higher adherence to the Mediterranean diet was associated with lower odds of being obese, suggesting that quality, rather than quantity of out-of-home eating may be responsible for the association with obesity.

Previous investigations showed that out-of-home eating was associated with unhealthy food choices and

Table 2. Association between eating habits and being overweight/obese in 1586 adolescents living in Sicily, southern Italy. Conditional regression analyses were conducted to calculate odds ratios (ORs) and 95% confidence intervals (CI).

	Model 1	Model 2	Model 3	Model 4
Daily snack between meals				
0-1 times	1	1	1	1
2-3 times	1.10 (0.95-1.28)	1.12 (0.84-1.50)	1.05 (0.78-1.41)	0.99 (0.78-1.26)
>3 times	1.14 (0.94-1.38)	1.16 (0.82-1.64)	1.08 (0.81-1.44)	1.01 (0.84-1.21)
Out-of-home eating (frequency):				
<1 per week	-	1	1	1
1 per week	-	1.09 (0.77-1.54)	1.11 (0.85-1.44)	0.99 (0.79-1.24)
>1 per week	-	1.17 (1.02-1.34)	1.15 (1.01-1.25)	0.95 (0.77-1.17)
Out-of-home eating (occasion):				
Snack	-	-	1	1
Main meal	-	-	1.07 (1.02-1.22)	1.03 (0.85-1.64)
KIDMED score				
Low	-	-	-	1
Medium	-	-	-	0.95 (0.80-1.13)
High	-	-	-	0.94 (0.89-0.99)

Model 1: adjusted for age, gender, BMI, parents' education, physical activity, parents' occupation; Model 2: model 1 plus out of home eating (frequency); Model 3: model 2 plus out of home eating (occasion) ; Model 4: model 3 plus KIDMED score.

Table 3. Distribution of characteristics of the Mediterranean dietary pattern (evaluated through the KIDMED score) by frequency of out-of-home eating.

	Not eating out (<1 per week) N=829	Regular eating out (1 per week) N=481	Frequent eating out (>1 per week) N=276	P-value
KIDMED (high)				
Fruit or fruit juice	458 (55.2)	248 (51.6)	135 (48.9)	<0.001
Second serving of fruit daily	121 (14.6)	66 (13.7)	37 (13.4)	0.002
Fresh or cooked vegetables daily	345 (41.6)	178 (37.0)	101 (36.6)	<0.001
Fresh or cooked vegetables >1/day	66 (8.0)	25 (5.2)	13 (4.7)	<0.001
Regular fish consumption (at least 2–3/week)	234 (28.2)	131 (27.2)	80 (29.0)	0.336
Pulses >1/week	135 (16.3)	79 (16.4)	43 (15.6)	0.545
Pasta or rice almost daily (≥5/week)	780 (94.1)	460 (95.6)	264 (95.7)	0.766
Cereal or cereal product for breakfast	539 (65.0)	315 (65.5)	177 (64.1)	0.841
Regular nut consumption (at least 2–3/week)	220 (26.5)	125 (26.0)	71 (25.7)	0.645
Use of olive oil at home	827 (99.8)	481 (99.6)	276 (99.6)	0.898
No breakfast	120 (14.5)	71 (14.8)	40 (14.5)	0.701
Dairy products for breakfast	550 (66.3)	320 (66.5)	181 (65.6)	0.223
Commercially baked goods or pastries for breakfast	350 (42.2)	205 (42.6)	116 (42.0)	0.676
Fast-foods consumption weekly	264 (31.8)	221 (45.9)	152 (55.1)	<0.001
Sweetened beverages weekly	541 (65.2)	346 (71.9)	203 (73.5)	<0.001
Two yogurts and/or 40 g cheese daily	400 (48.3)	230 (47.8)	135 (48.9)	0.545
Sweets and candy several times a day	79 (9.5)	48 (10.0)	27 (9.8)	0.645

adverse health outcomes, with special regard to body weight and incidence of obesity(27). However, most of the studies reporting significant association between out-of-home eating and obesity were mainly conducted in relation to fast-food consumption(28).In our sample, consumption of fast-foods is high when considering street foods, which are more characterized by high carbohydrate rather than fat content. However,

type of oils used for some fried foods, large portion sizes usually served, and the high energy-density characterizing these foods are the main reasons for such adverse metabolic effects (29). Consumption of such foods is in line with the modern "Westernization" of the dietary habits, a process occurring also in the Mediterranean region since the last few decades. This phenomenon is particularly evident among younger generations, which are the part of population most likely to be affected by modern lifestyles. When comparing out-of-home eating with adherence to the Mediterranean diet and its components, adolescents eating frequently out of home were more likely to eat less fruit and vegetable and more sugar-sweetened soft drink. Such dietary choices represent plausible explanations of our findings, because they are typically associated with increased BMI and obesity. Overall, eating-out adolescents presented more unhealthy dietary choices with a more overall energy-dense dietary pattern contributing to a positive energy balance, one of the main determinant of weight gain.

In contrast with the aforementioned factors associated with out-of-home eating, occasion of out-of-home eating (snack *versus* main meal) was not related with obesity. As well, also frequent snacking was not associated with obesity. Previous studies reported contrasting results on this topic, some of which showing a significant association between frequent snacking and obesity (30-32) and weight gain (33, 34) while other reporting null results (35-37). In our study we did not found that snacking was associated with obesity, either it was at home or out. From an observational standpoint over the last decades, foods consumed during snacking are higher in energy content than in the past and humans do not compensate for the energy intake

from snacks, especially not for snacks that are consumed on an irregular basis(38). On the other hand, consuming more meals over the day, including snacks, may be associated with a readjustment of the amount of calories eaten at main meals(39). Thus, it is more likely that the quality of the snack, rather than the quality, to affect body weight. Overall, this was in line with the finding that snacking was not associated with adherence to the Mediterranean diet (in positive or negative), suggesting that either the adolescents were having snacks or not, weight status was rather related with other components of the diet. Considering that the participants of the study are living in a Mediterranean area, part of them may consume healthy snacks, such as nuts, which have been demonstrated to have benefits towards human health (40). Although unhealthy snack foods (such as chocolate bars, salty snacks, etc.) may be consumed in addition to, rather than instead of a regular meal, also main occasions of eating (such as lunch) may be characterized by unhealthy foods, which most likely happen to be out of home. One of the most influential factors for adolescents' food choices is food availability (41). The globalization of the food market and the high accessibility to corporate fast-food restaurants in large urban centres may negatively affect food choices of younger generations. The urban setting may provide more options to eat out of home, such as more fast-foods, pubs, and restaurants so to encourage people to eat out and have such food preferences. We previously showed that such difference in food preferences by place of living was not relevant among adults (42), whereas was significantly related to the urbanized environment when considering younger generations (21). However, lower consumption of foods characterizing a Mediterranean dietary pattern was associated with adverse metabolic outcomes (43-45).

Results of this study should be considered in light of some limitations. First, the cross-sectional study design does not allow to define causation, rather only associations. The possibility of residual confounding factors or co-linearity among variables should also be taken into account. Second, information retrieved in this study was self-reported, thus recall and misreporting bias may affect data quality.

In conclusion, out-of-home eating is associated with unhealthy dietary choices among adolescents living in a Mediterranean country. Modern trends leading to out-of-home consumption of foods of low nutritional value is a potential risk factor to be discouraged future intervention studies aimed to tackle the obesity epidemic. From a public health perspective, higher taxation for unhealthy junk and fast-foods (including sweetened beverages) and promotion of consumption of alternative nutritious snacks (such as nuts, fresh fruit and vegetables) in school setting should be considered.

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