

Eating and lifestyle habits in relation with weight status and place of living of adolescents in Sicily, Southern Italy

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Abstract.

BACKGROUND: Obesity among adolescents has increased worldwide becoming a major public health issue.

OBJECTIVE: The aim of this study was to investigate the relationship between eating and lifestyle habits, place of living, and weight status among adolescents living in Sicily, southern Italy.

METHODS: Between March and June 2010 and 2011, a sample of 1135 rural and urban adolescents was selected to join the study. Validated questionnaire were used to assess eating and lifestyle habits.

RESULTS: Rural students consumed during breakfast significantly higher amount of cereals, fruit juice, fruits, and home-made cakes over packaged snacks and reported to prefer home-made cakes and fruit as a snack whereas packaged snacks, baked goods and biscuits were preferred in the urban area. Lower BMI values observed among rural compared with urban students. Urban adolescents were found to be almost 2 times more likely to eat between meals ≥ 4 times per day and out of home ≥ 3 times per week. Unhealthy behaviours regarded also physical activity habits, being urban students less likely to practice physical activity and more likely to spend time on TV/computer. Comparisons of meals and physical activity habits by body composition revealed that obese adolescents were significantly associated with more frequent weekly out of home eating and breakfast, less sport practicing and more daily hours use of TV/computer.

CONCLUSIONS: Our findings showed that specific intervention programs regarding education on eating and lifestyle habits should be altered for use in urban and rural settings.

Keywords: Lifestyle, adolescents, eating, breakfast, snacking, habits

1. Introduction

Nowadays, it has been estimated that obesity among adolescents has increased worldwide, making this problem a major public health issue [1]. The importance of disease starts in early adolescence [2]. Furthermore, evidence suggests that childhood obesity may lead to long-term metabolic complications [3]. The ongoing increasing trends on childhood and adolescence obesity are supposed to be related with behavioural and environmental factors. Adolescents dietary

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habits are characterized by irregular eating pattern, frequent snacking, and skipping meals, especially breakfast [4]. Moreover, sedentary life, lack of physical activity, increased television watching and computer use have been found to be common behaviours adopted by adolescents that may be related with metabolic impairment [5]. Moreover, current evidence demonstrated a progressive non-conformity with traditional dietary patterns historically characterizing young generations living in certain areas, such as the Mediterranean region [6–10]. Mediterranean diet has been reported to confer a number of health benefits and lack of adherence to this dietary pattern has been hypothesized to be a plausible explanation for changes in metabolic status, especially among young generations [11, 12].

Eating and lifestyle habits are influenced by place of living, despite the intercorrelation with weight status is still controversial. No univocal results have been found on prevalence of overweight and obesity between urban and rural adolescents [13]. Moreover, reasons for such potential differences are not entirely understood. Only few studies have investigated whether eating and lifestyle habits influence adolescents weight status [14]. However, studies assessing whether place of living may influence both weight status and eating and lifestyle habits are scarce.

The aim of this study was to investigate the relationship between eating (including snacking and breakfast behaviour) and lifestyle (sedentary and physical activity) habits with place of living and weight status in two samples of urban and rural Italian young adolescents.

2. Methods

2.1. Study population

Between March and June 2010 and 2011, two cross-sectional surveys were conducted on students aged 13–16 years living in Sicily, southern Italy. Full details of methodology used have been published elsewhere [15]. Briefly, the city of Catania was arbitrarily chosen as the urban setting for the survey. The selection of adolescents in the urban setting provided a stratified random sampling technique, firstly by the selection of at least one public secondary school from each of the nine quarters of the city (according to the number of inhabitants of the area) and secondly by the selection of at least one class from the pool of eligible schools for the study. The enrolment of subjects residing in different areas of the city displayed the highest level of representation of children of different socioeconomic status. The enrolment of adolescents in the rural environment was based on a random selection of a single school from a pool of several public institutions sited in rural areas, as defined by the Organisation for Economic Co-operation and Development (OECD) criteria [16]. In most of rural settings in Sicily there is only one school serving many students resident in large areas. We considered only one school to represent the distribution of public teaching institutions sited in rural areas according to size, location, and student population. In order to ensure an adequate number of adolescents from the rural area, we invited all classes of students attending secondary school to participate.

A total of 1174 children were invited to participate to the survey (excluding absent students from their class during the study) and 1135 provided informed consent from parents prior to filling out the questionnaire. Participation was not compulsory and participants were assured of complete anonymity.

2.2. Questionnaire

The questionnaires were administered to the participants by a trained medical doctor, following specific protocol to ensure the same procedure among all classes. Participants were invited to fill all items and encouraged to report any questions concerning parameters that they did not know or understand. It took approximately 20 minutes to complete the questionnaire.

The first part of the questionnaire included demographic information such as student's age, gender, nationality, weight, height, parents' education and occupation category. This part was then followed by evaluation of several aspects of nutritional and lifestyle behaviour of students concerning snacking, breakfast, and physical activity habits. We previously tested the reliability of the instrument. The α -coefficient for internal consistency was found to be 0.774 for items regarding breakfast and snack habits and 0.676 for those regarding lifestyle and physical activity habits. The test-retest reliability showed a good temporal stability over time of both the sections (0.769 and

0.699, respectively, with all correlation coefficients statistically significant with $P < 0.001$). Items included in the questionnaire were the following.

Snaking 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 outside of the 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.

Breakfast habits: in this part, children were asked (i) how many times per week they eat breakfast (response options were categorized in three categories ranging from “never” to “more than 4”) and, if not, the reason why (with response options categorized in having not enough time, not liking it, not being hungry, and not having anyone that provide it to the children, other); (ii) where do they usually eat breakfast (with response options categorized in at home, at school, during the trip to the school); (iii) with whom do they eat breakfast (with response options categorized in alone or with brother or sister, at least one parent, friends); (iv) how long time do they spend for breakfast (with response options categorized in less than 5 minutes, less than 15 minutes, more than 15 minutes); and finally what do they usually eat at breakfast.

Physical activity habits: this part aimed at assess (i) how many times a week children participate in physical activity (response options were categorized in four categories ranging from “never” to “more than 4”); (ii) how many hours they spend watching the TV or using a computer per day (response options were categorized in four categories ranging from “less than 1” to “more than 4”); (iii) what do they prefer to do during free time (with response options categorized in practicing a sport, watching TV or listening to music or reading a book or using computer or playing videogames, spend time with friends out of home).

2.3. Statistical analysis

Continuous variables are presented as means \pm 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 Kruskal-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.

Food items consumed for breakfast were plotted with multidimensional graphical format by place of living and BMI categories. The analysis regarded only subject that declared having breakfast, and was separately conducted for boys and girls because we supposed that food consumption may be different between genders. In the figures, the consumption of food items was indicated by a reference circle of radius ranging from 0 to 100%. Differences among categories were tested by Chi-square test.

Associations among eating and lifestyle habits with place of residence (urban/rural) and 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. All reported *p* values were based on two-sided tests and compared to a significance level of 5%. SPSS 20.0 software (Statistical Package for Social Sciences, Chicago, IL, USA) was used for all statistical analyses.

3. Results

The demographic characteristics of the sample enrolled in the study are presented in Table 1. The mean age was not significantly different between urban and rural adolescents whereas BMI was lower among the latter. Moreover, educational and occupational level of adolescents' parents living in the urban area was higher among participants living in the urban compared with the rural areas (Table 1).

Food consumption during breakfast stratified by place of living and BMI status is plotted graphically in Figs. 1 and 2, respectively. As shown in Fig. 1, despite food consumption differed between boys and girls, we observed a significantly higher consumption of cereals, fruit juice, fruits, and home-made cakes over packaged snacks in rural compared with urban adolescents. Similar pattern of food items distribution was found when compar-

Table 1
Demographic characteristics of the study population

	Total N= 1135	Rural N= 204	Urban N= 931	P
Gender, <i>n</i> (%)				0.720
Male	627 (55.2)	115 (56.4)	512 (55)	
Female	508 (44.8)	89 (43.6)	419 (45)	
Age, years (mean ± SD)	13.2 (0.5)	13.2 (0.5)	13.2 (0.5)	0.996
BMI classes, <i>n</i> (%)				<0.001
Under and normal weight	612 (53.9)	139 (68.1)	473 (50.8)	
Overweight	411 (36.2)	54 (26.5)	357 (38.3)	
Obese	112 (9.9)	11 (5.4)	101 (10.8)	
Mother education, <i>n</i> (%)				0.012
None or primary	95 (8.4)	20 (9.8)	75 (8.1)	
Secondary	511 (45)	108 (52.9)	403 (43.3)	
High school	392 (34.5)	62 (30.4)	330 (35.4)	
University	137 (12.1)	14 (6.9)	123 (13.2)	
Father education, <i>n</i> (%)				0.011
None or primary	94 (8.3)	22 (10.8)	72 (7.7)	
Secondary	408 (35.9)	89 (43.6)	319 (34.3)	
High school	499 (44.0)	76 (37.3)	423 (45.4)	
University	134 (11.8)	17 (8.3)	117 (12.6)	
Mother occupation, <i>n</i> (%)				<0.001
Housewife	542 (47.8)	99 (48.5)	443 (47.6)	
Unskilled professions	257 (22.6)	67 (32.8)	190 (20.4)	
Partially skilled professions	219 (19.3)	24 (11.8)	195 (20.9)	
Skilled professions	91 (8.0)	14 (6.9)	77 (8.3)	
Specialized/managerial	26 (2.3)	0 (0)	26 (2.8)	
Father occupation, <i>n</i> (%)				<0.001
No occupation	64 (5.6)	22 (10.8)	42 (4.5)	
Unskilled professions	553 (48.7)	109 (53.4)	444 (47.7)	
Partially skilled professions	377 (33.2)	58 (28.4)	319 (34.3)	
Skilled professions	100 (8.8)	12 (5.9)	88 (9.5)	
Specialized/managerial	41 (3.6)	3 (1.5)	38 (4.1)	
Nationality, <i>n</i> (%)				0.148
Italian	1108 (97.6)	202 (99)	906 (97.3)	
Other	27 (2.4)	2 (1)	25 (2.7)	

ing adolescents by BMI status (Fig. 2), with higher consumption of fat foods (such as chocolate/sugary cereals, packaged snacks, croissants, and spread creams) among overweight and obese adolescents compared with normal weighted.

Comparison of food preferences for snacking and fast-food are plotted in Figs. 3 and 4, respectively. The most preferred snacks were sandwiches and potato chips or popcorn, with no significant difference between rural and urban adolescents. In contrast, a significantly higher proportion of rural adolescents reported to prefer home-made cakes and fruit as snack ($P < 0.05$), whereas packaged snacks, baked goods, and biscuits were preferred in the urban areas (Fig. 3). Regarding fast-food preferences, sandwiches were the most consumed food, but hamburgers and kebab were significantly more consumed among adolescents living in the urban rather than rural areas (Fig. 4).

The pattern of snacking, breakfast, and physical activity habits of students by place of living and BMI status are presented in Tables 2 and 3. For two of the items related to snaking habits ((i) “how many times per day do you eat between meals” and (ii) “how many times per day do you eat outside of the home”) a significant difference between

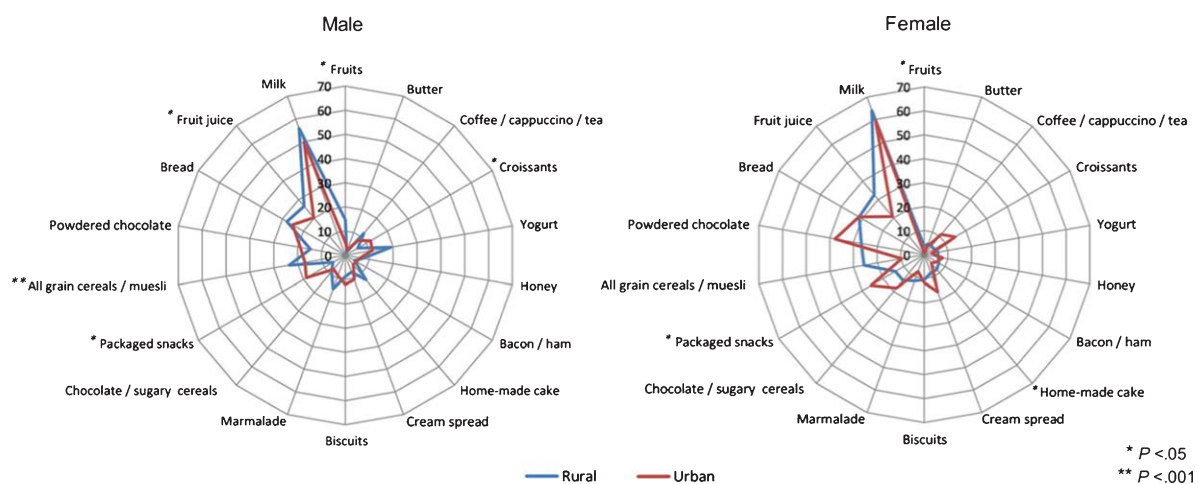


Fig. 1. Students food preferences for breakfast, by place of living.

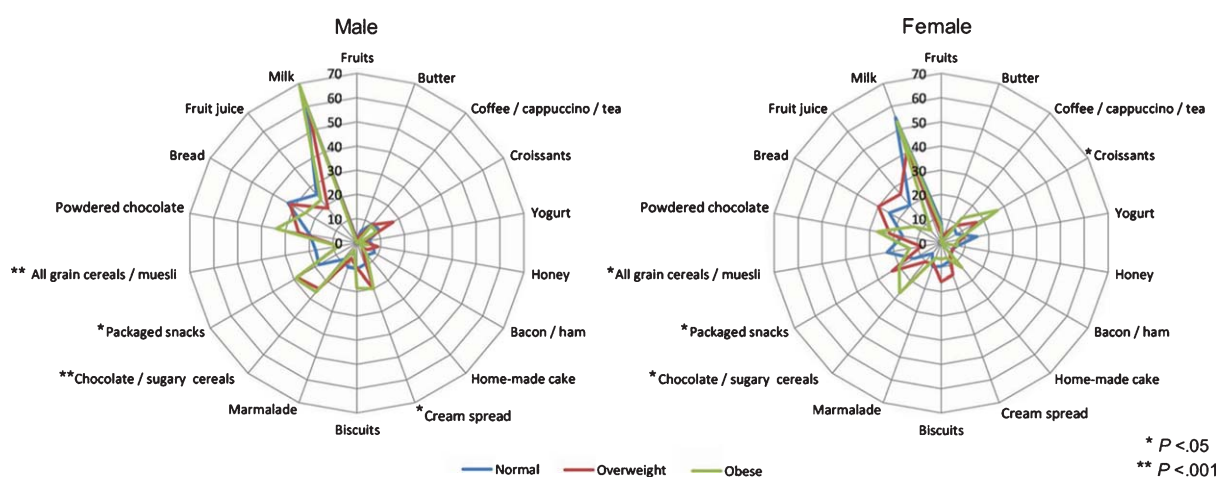


Fig. 2. Students food preferences for breakfast, by BMI.

urban and rural adolescents was found, resulting in the former being more likely to eat between meals and outside of the home compared with the latter (11.2% vs. 4.9% and 9.8% vs. 20.4%, $P < 0.001$ for both analysis). When comparing such variables according to BMI, similar trends have been observed for obese students (Table 3). There were no significant differences in daily consumption of breakfast by place of living, whereas obese students were more likely to have breakfast more than 4 times per week compared with normal and overweight. Some differences occurred regarding the reasons why students skipped breakfast: urban adolescents reported mostly not having enough time (56%) and not being hungry (32.4%) whereas rural adolescents' answers were more equally distributed among all options (Table 2). Several differences between urban and rural areas occurred also with regard on where students consume breakfast, with whom, and on how long time they spend on it (Table 2). In fact, rural adolescents were more likely to consume breakfast outside of the home ($P = 0.033$), mostly with brother/sister or alone ($P < 0.001$) and in less time ($P < 0.001$) compared with urban adolescents.

Regarding physical activity habits, rural adolescents resulted practicing sport more often than urban ($P < 0.001$) as well as spending less time on TV/computer use ($P = 0.003$) and preferring out of home entertainment ($P < 0.001$) (Table 2). As expected, less active adolescents (never practicing sports, spending more than 4 hours using



Fig. 3. Students food preferences for snack, by place of living.

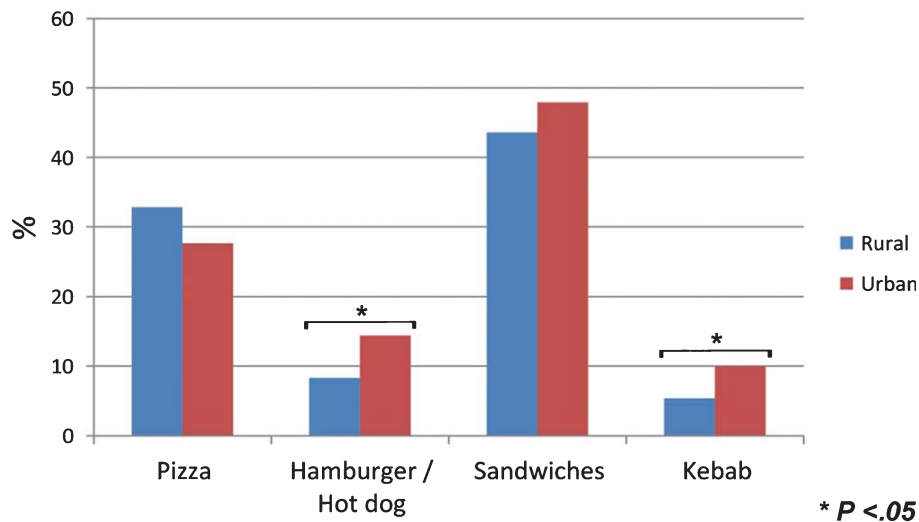


Fig. 4. Students food preferences for fast-food, by place of living.

TV/computer, and preferring home entertainment) were more likely to be obese ($P=0.006$, $P=0.003$, and $P<0.001$, respectively; Table 3).

The multivariate logistic regression analyses revealed that urban adolescents were more than twice more likely to often eat between meals (OR 2.24, 95% CI: 1.13–4.44) and out of the home (OR 2.03, 95% CI: 1.36–3.02). Urban adolescents were also less likely to practice physical activity (OR 0.66, 95% CI: 0.46–0.94) and more likely to spend time on TV/computer (OR 1.6, 95% CI: 1.15–2.23). Analysis of meals and physical activity habits by body composition revealed that obese adolescents were significantly associated with more frequent weekly out of the home eating, having breakfast, practicing less sport, and more daily hours of TV/computer (Table 4).

Table 2
Snacking, breakfast, and physical activity habits by environmental status

	Rural N=204	Urban N=931	P
<i>Snacking habits, n (%)</i>			
Daily eat between meals:			<0.001
0-1 times	152 (74.5)	477 (51.2)	
2-3 times	42 (20.6)	350 (37.6)	
≥4 times	10 (4.9)	104 (11.2)	
Weekly out of home eating:			<0.001
Never	117 (57.4)	509 (54.7)	
1-2 times	52 (25.5)	134 (14.4)	
3-4 times	15 (7.4)	98 (10.5)	
more than 4 times	20 (9.8)	190 (20.4)	
<i>Breakfast habits, n (%)</i>			
Weekly breakfast:			0.595
never	83 (40.7)	412 (44.3)	
1-3 times	71 (34.8)	315 (33.8)	
more than 4 times	50 (24.5)	204 (21.9)	
If never, because:			<0.001
having not enough time	17 (34)	126 (56)	
don't like or not being hungry	12 (24)	73 (32.4)	
anyone provide it to the children	9 (18)	1 (0.4)	
other reasons	12 (24)	25 (11.1)	
Where eat breakfast:			0.033
at home	146 (94.8)	638 (87.8)	
at school	6 (3.9)	53 (7.3)	
during the trip to the school	2 (1.3)	36 (5)	
With whom eat breakfast:			<0.001
alone or brother/sister	56 (36.4)	446 (61.3)	
At least one parent/grandparent	89 (57.8)	231 (31.8)	
friends	9 (5.8)	50 (6.9)	
Time to eat breakfast:			<0.001
less than 5 minutes	53 (34.4)	325 (44.7)	
less than 15 minutes	45 (29.2)	353 (48.6)	
more than 15 minutes	56 (36.4)	49 (6.7)	
<i>Physical activity habits, n (%)</i>			
Weekly practicing sports:			<0.001
never	16 (7.8)	111 (11.9)	
1-2 times	35 (17.2)	321 (34.5)	
3-4 times	92 (45.1)	306 (32.9)	
more than 4 times	61 (29.9)	193 (20.7)	
Daily TV/computer use:			0.003
less than 1 hour	59 (28.9)	200 (21.5)	
1-2 hours	79 (38.7)	299 (32.1)	
3-4 hours	40 (19.6)	254 (27.3)	
more than 4 hours	26 (12.7)	178 (19.1)	
Spare time preferences:			<0.001
practicing sport	67 (32.8)	348 (37.4)	
home entertainment	61 (29.9)	382 (41)	
out of home entertainment	76 (37.3)	201 (21.6)	

Table 3
Snacking, breakfast, and physical activity habits by BMI categories

	Normal weight <i>N</i> =612	Overweight <i>N</i> =411	Obese <i>N</i> =112	<i>P</i>
<i>Snacking habits, n (%)</i>				
Daily eat between meals:				<0.001
never	378 (61.8)	210 (51.1)	41 (36.6)	
1–3 times	184 (30.1)	158 (38.4)	50 (44.6)	
more than 4 times	50 (8.2)	43 (10.5)	21 (18.8)	
Weekly out of home eating:				0.001
never	357 (58.3)	225 (54.7)	44 (39.3)	
1–2 times	107 (17.5)	57 (13.9)	22 (19.6)	
3–4 times	47 (7.7)	47 (11.4)	19 (17)	
more than 4 times	101 (16.5)	82 (20)	27 (24.1)	
<i>Breakfast habits, n (%)</i>				
Weekly breakfast:				0.044
never	287 (46.9)	171 (41.6)	37 (33)	
1–3 times	203 (33.2)	140 (34.1)	43 (38.4)	
more than 4 times	122 (19.9)	100 (24.3)	32 (28.6)	
If never, because:				0.273
having not enough time	73 (56.2)	52 (46.4)	18 (54.5)	
don't like or not being hungry	34 (26.2)	38 (33.9)	13 (39.4)	
anyone provide it to the children	6 (4.6)	3 (2.7)	1 (3)	
other reasons	17 (13.1)	19 (17)	1 (3)	
Where eat breakfast:				0.055
at home	439 (89.6)	273 (87.8)	72 (90)	
at school	25 (5.1)	26 (8.4)	8 (10)	
during the trip to the school	26 (5.3)	12 (3.9)	0 (0)	
With whom eat breakfast:				0.153
alone or brother/sister	269 (54.9)	181 (58.2)	52 (65)	
at least one parent/grandparent	190 (38.8)	104 (33.4)	26 (32.5)	
friends	31 (6.3)	26 (8.4)	2 (2.5)	
Time to eat breakfast:				0.061
less than 5 minutes	214 (43.7)	131 (42.1)	33 (41.3)	
less than 15 minutes	206 (42)	155 (49.8)	37 (46.3)	
more than 15 minutes	70 (14.3)	25 (8)	10 (12.5)	
<i>Physical activity habits, n (%)</i>				
Weekly practicing sports:				0.006
Never	53 (8.7)	53 (12.9)	21 (18.8)	
1–2 times	181 (29.6)	140 (34.1)	35 (31.3)	
3–4 times	223 (36.4)	137 (33.3)	38 (33.9)	
more than 4 times	155 (25.3)	81 (19.7)	18 (16.1)	
Daily TV/computer use:				0.003
less than 1 hour	149 (24.3)	92 (22.4)	18 (16.1)	
1–2 hours	226 (36.9)	119 (29)	33 (29.5)	
3–4 hours	149 (24.3)	111 (27)	34 (30.4)	
more than 4 hours	88 (14.4)	89 (21.7)	27 (24.1)	
Spare time preferences:				<0.001
practicing sport	262 (42.8)	128 (31.1)	25 (22.3)	
home entertainment	199 (32.5)	177 (43.1)	67 (59.8)	
out of home entertainment	151 (24.7)	106 (25.8)	20 (17.9)	

Table 4
Multivariate logistic regression analyses of lifestyle habits by environment and body composition

	Rural vs. Urban ^a		Normal vs. Overweight/Obese ^b	
	OR (95% CI)	P	OR (95% CI)	P
Daily eat between meals:		0.021		0.205
≤3 times	1		1	
≥4 times	2.24 (1.13–4.44)		1.3 (0.86–1.97)	
Weekly out of home eating:		<0.001		0.02
≤2 times	1		1	
≥3 times	2.03 (1.36–3.02)		1.38 (1.05–1.8)	
Weekly breakfast:		0.063		0.011
≤3 times	1		1	
≥4 times	0.7 (0.48–1.01)		1.47 (1.09–1.98)	
Weekly practicing sports:		0.024		0.005
≤3 times	1		1	
≥4 times	0.66 (0.46–0.94)		0.65 (0.48–0.88)	
Daily TV/computer use:		0.005		0.002
≤2 times	1		1	
≥3 times	1.6 (1.15–2.23)		1.49 (1.16–1.91)	

4. Discussion

This study provided a general picture of the typical aspects related to nutrition and lifestyle behaviour, place of living, and body composition characterizing adolescents living in urban and rural areas of Sicily, southern Italy. A significant difference between urban and rural adolescents regarding eating and physical activity habits was found. Concerning the association between snacking habits and place of living, rural adolescents reported eating rarely between meals compared with urban. Moreover, food choice has been found to significantly differ between the two environments, as urban adolescents were more like to consume food richer in fat and calories during breakfast and snack compared with rural. Adolescents living in a rural setting had healthier lifestyle and such behaviour may have influence on their body weight, as assessed by our findings. Adolescents have typical meal habits, high in fat and low in healthy foods, often selecting sweet foods due to its palatability and availability. When analysing such preferences by place of living, rural adolescents were more likely to consume fresh fruit as a snack between meals whereas those living in an urbanized centres could have easier access to fatty foods. This may reflect the so-called phenomenon of “nutrition transition”, represented by the shifting away from traditional dietary patterns, such as the Mediterranean diet, in favour of Westernized food preferences, which has been associated with a potential negative impact on health of individuals living in the Mediterranean area [17–19]. According to literature, young populations reported that one of the most influential factors in their food choices is food availability [20–22]. The high variability of industrial products (especially packaged snacks) and, hence, availability in large urban centres may negatively affect food choice of younger adolescents. Moreover, food availability at home may play a fundamental role in food preference. In fact, it has been previously reported that parents’ responsibility for making foods available to their children has a profound impact on adolescents’ preferences and, consequently, consumption [23]. Another noteworthy finding was the higher consumption of home-made dessert among rural adolescents compared with urban. Despite we have no certainty that this type of dessert was, in fact, healthier than packaged snacks, it could be possible that a high rate of mothers in rural areas do not work (as shown by our results) and they are used to spend more time at home providing more home-made dishes rather than confectioneries or eat out of home compared with urban families. In contrast, the urban setting may provide more options to eat out of home, such as more pubs, restaurants, and ethnic cuisine, so to encourage people to eat out and have such food preferences. Despite we previously demonstrated that such difference of food preferences by place of living was not evident among adults [24], younger generations living in

the Mediterranean areas have been demonstrated to significantly abandon more traditional dietary pattern also due to the effects of urbanized environment [7].

In the present survey, only a minority of our sample (slightly more than 20%) reported having breakfast more than 4 times per week, with no significant difference between urban and rural adolescents. This breakfast frequency is strongly lower than those reported by the majority of European (76%), French (84%), and British (62.2%) adolescents [25, 26]. We found some differences in food consumption by gender, with girls eating healthier foods compared with boys, although not consistently. One reason for this difference by gender could be that girls may pay more attention in food choices to control their weight [27]. Several studies reported that having breakfast is associated with decreased risk of being overweight or obese [28, 29]. In our survey, we did not observe the corroborated association between having breakfast and body weight, whereas we found an inverse association. We speculated that the weight gain in adolescents having more frequently breakfast depended on the quality of food intake. Indeed, we documented that the foods consumed by our sample was characterized in higher content of fats compared with northern European countries [30]. Differences in such food patterns for breakfast also reflected adolescents' place of living. Rural adolescents preferred healthier foods and reported to spend more time to consume breakfast than urban. Although breakfast-related habits have been associated with weight status in children and adolescents [29] we failed to find such association. Our results are thus consistent only in part with evidence in literature regarding breakfast habits and we hypothesize that univocal conclusion cannot be drafted without taking into account not only the frequency, but also the content of breakfast [31].

Physical activity analyses indicated that sport practices were less frequent among adolescents living in urban than those in rural areas. Moreover, those from urban areas engaged in higher rates of sedentary activities than rural children that were more likely to have a more active lifestyle. When considering the relation among these variables, BMI and place of living, urban children were more likely to be overweight or obese. When asked preferences on spare time activities, urban adolescents were more likely to prefer sports than rural. Although these findings may seem in conflict, it is possible that adolescents from urban areas would receive higher rates on the measures assessing physical activity because the measure did applied more to their activities, such as play sports. Contrarily, rural adolescents were engaged in activities not covered by our questionnaire or which are not perceived as physical activity, such as playing out with friends or using bicycle. Thus, associated with other covariates, such lifestyle behaviours, may result in a higher expenditure of energy for rural rather than for urban adolescents.

In the present study, the prevalence of overweight and obese adolescents compared with those with normal weight was significantly higher in terms of unhealthy snacking habits, food preferences, and low physical activity. A logical explanation is that energy imbalance due to high-fat diet and low-physical activity habits increase the likelihood of being overweight or obese [32]. Moreover, such aspects were significantly associated with place of living, resulting urban adolescents having less healthy habits than those living in the rural setting. Several studies have pointed out a variety of social factors influencing adolescents' eating habits that may be affected by cultural values and knowledge about food types and preparation [23, 33] as well as parents' beliefs and practices [34]. Thus, environmental factors should be taken into account when assessing nutritional behaviour among adolescents, as they may subsequently influence the onset of obesity.

Results of this study should be considered in light of some limitations. First, existing reference data for nutritional assessment of 13–16 years old adolescents in Sicily are not representative of all populations because data were collected in only two cities. Second, it was a cross-sectional study design, thus conclusions cannot be attributed to plausible causes, rather valuable assumptions that could be used for further investigations. Furthermore, data collected was self-reported, leading to possible misreporting bias.

In conclusion, results of this study raise several issues deserving further exploration. Our findings showed that specific intervention programs regarding education on eating and lifestyle habits should be altered for use in urban and rural settings. Regarding snacking habits, adolescents from urban areas may need more information on frequency of snacks between meals and improvement in their quality (i.e. eating health food instead of fatty foods), as our data indicated that they were more likely to engage in these unhealthy behaviours. Adolescents from the rural environment were more active than urban students, but their activities did not depend on specific wants and such healthy habits could disappear with adulthood. Thus, intervention in making rural adolescents more conscious of the benefits of physical activity may be important, as well as increasing the variety of activity and the promotion of enrolling them to sport activities.

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