Original Research

Eating Habits and Behaviors, Physical Activity, Nutritional and Food Safety Knowledge and Beliefs in an Adolescent Italian Population

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Key words: eating habits and behaviors, dietary questionnaire, educational programs, adolescents

Objective: The present study evaluates eating habits and behaviors, and nutritional and food safety knowledge of a group of Italian adolescents.

Design: A dietary questionnaire previously constructed and tested was self-administered during school time. Each section was evaluated using a separate score.

Setting: The study was carried out as a part of a nutritional surveillance project in the Aosta Valley Region, Northern Italy.

Subjects: Five hundred and thirty-two adolescent subjects, aged 15.4 ± 0.7 years, attending the second year of secondary schools participated in the study.

Measures: We evaluated eating habits, physical activity, meaning of healthy and unhealthy dietary habits and food, self-efficacy, barriers affecting healthy food choices, nutritional and food safety, weight, height, Body Mass Index (BMI).

Results: Only 37.0% of the sample have satisfactory eating habits; 18.5% have a very active lifestyle; only 8.6% have quite good nutritional knowledge, 2.4% have satisfactory food safety knowledge, although 43.7% have good hygiene practices.

Conclusions: The results point out unhealthy behaviors influencing adolescents' eating habits and suggest which of these must be considered in order to develop tailored nutrition interventions, improving adolescents' consciousness aimed at adopting a healthy lifestyle.

INTRODUCTION

It is well known and documented that diet and nutrition play important roles in maintaining health and preventing diseases [1,2]. Decrease in morbidity and mortality associated with lifestyle diseases may be achievable if satisfactory nutritional habits are adopted in early life and maintained in the long term [3,4]. During adolescence, young people are assuming responsibility for their own eating habits, health attitudes and behaviors [5]. In fact, attitudes play an important role in the adoption and maintenance of a variety of health and nutritional habits.

Although adolescents' growing independence is often associated with unconventional eating patterns [6,7] and dietary behavior during adolescence might be transitory in some individuals, health-related behaviors show tracking through adolescence [8] and there is clear evidence of their early consolidation. In a random sample of 1682 teenagers in Scotland, Sweeting et al. [9] found that overall changes in eating habits between 15 and 18 years were very slight, though females were more likely to have increased consumption of foods consistent with current recommendations. The authors concluded that dietary habits appear to be established in the mid-teens, by the age of 15 years, and are closely associated with lifestyle. We

can say that if habits acquired in adolescence persist into adult life, behaviors established in young people may have important long-term consequences for health.

Knowledge about healthy food choices and food safety can be predisposing factors for improving eating habits and adopting a healthy diet [10], although it is insufficient to motivate healthy eating [11]. Factors influencing eating behaviors need to be better understood to develop effective nutrition interventions tailored to individuals to improve their healthy eating [12]. Therefore, determinants such as habits, attitudes, self-efficacy, barriers to change and the meaning of "healthy" and "unhealthy" diet and food must be considered.

An important determinant of the practice of healthy behaviors is a sense of self-efficacy, which is the belief that an individual can control his own practice of a particular behavior [13,14]. In fact, motivation to adopt healthy eating patterns and self-efficacy are important determinants of behavioral change [15–17]. Strecher et al. [18] found strong a relationship between self-efficacy and both change and maintenance of behavior, as well as Rimal [19] having pointed out that knowledge-behavior correlations were greater among those with high self-efficacy, when compared with those with low self-efficacy. Recognition of barriers to change is among the enabling factors affecting food choices. Croll et al. [20] found that barriers to healthy eating in adolescents include a lack of time, limited availability of healthy foods in schools and a general lack of concern about following healthy eating recommendations. The authors suggest that interventions are needed which assist adolescents in translating good nutritional knowledge into healthy behaviors. According to Zhao et al. [21], nutritional knowledge, as well as some dietary behaviors and lifestyle of adolescents, improved greatly after a nutrition education program, changing students' unhealthy living attitudes and dietary habits. In the present study we evaluated eating habits, physical activity, meaning of healthy and unhealthy dietary habits and food, self-efficacy, possible barriers affecting healthy food choices, nutritional and food safety knowledge in a selected group of adolescents in the Aosta Valley Region, Northern Italy. In addition, adolescents' weight and height were measured to compute BMI to investigate the possible relationship between BMI and the above mentioned variables.

METHODS

Sampling

All the students of both sexes attending the second year of all the high schools (n = 17) in the Aosta Valley Region (a mostly mountainous area), Northern Italy, were informed about the study [no. of subjects = 889 individuals, equal to 0.74% of the entire population (120.342 individuals) living in the Aosta Valley Region on December 31st, 2001]. The Aosta Valley Region population is equal to 0.20% of the Italian population;

of the total subjects, 52.2% live in Aosta town, while the others live in the rural area.

The overall students attending high schools were equal to 4.460 subjects (46.6% males and 53.4% females). We decided to select only the second year high school students (889 subjects) as we intend to follow-up the adolescents in the last school year after a nutrition education intervention. Out of the seventeen high schools, nine were located in Aosta town and eight in the whole region.

The study was carried out as part of a wider nutritional surveillance project that also included several nutritional assessment measurements, such as anthropometric (body weight, body height, skin folds and body circumferences) and functional parameters (blood pressure).

All students were surveyed over the course of four months, from March to the end of June 2002. Five hundred and thirty-two subjects, 254 males (47.7%) and 278 females (52.3%), participated in the study. This was a cross-sectional study, aware of the limitations included in such kind of study, in that it may not always be possible to distinguish whether the exposure preceded or followed the diseases. Informed written consent was obtained from each student and their parents.

The response rate of about 60% can be explained on the basis that 40% of the students refused to undergo nutritional assessment measurements and were therefore excluded from the sample. The mean age of the sample was 15.4 ± 0.7 years, with a prevalent distribution between 15 (64.8% of subjects) and 16 years (26.2% of subjects).

Data Collection

1. Questionnaire

A dietary questionnaire previously constructed and tested with regard to its reliability [22] was self-administered during school time. It is divided into nine main sections. Except for section 1 that contained information on personal data collected by means of seven questions, the other sections contained 71 items overall. Appendix 1 shows the questionnaire, which contains various topics as described below.

Section 2 - Eating habits: consisting of 14 questions. This section was designed to investigate the food habits of the adolescents, especially regarding breakfast contents, number of meals a day, daily consumption of fruit and vegetables as well as of both soft and alcoholic beverages.

Eight of the questions had the following response categories: always, often, sometimes, never; the other 6 have instead 4 response categories structured in different ways.

The score assigned to each response ranged from 0 to 3, with the maximum score assigned to the healthiest one and the minimum score to the least healthy one. The total score of this section was 42.

Section 3 - Physical activity: it contained 6 questions aimed at investigating physical activity levels. All responses were

structured in different ways according to each question, each score ranging from 0 to 3, with the maximum score assigned to the healthiest habit. The total score of this section was 18.

Section 4 - Healthy and unhealthy dietary habits and food: consisting of 5 questions aimed at investigating the students' beliefs about healthy and unhealthy diet and food. Each question had 4 different responses, with the score ranging from 0 to 3. The total score of this section was 15.

Section 5 - Self-efficacy: it contained 8 questions with 3 response categories and the following scores: no = 0, I don't know = 1, yes = 2. This section was aimed at estimating how much each student is able to assume attitudes and behaviors that could improve his or her health status related to nutrition. The total score was 16.

Section 6 - Barriers to change: consisting of 9 questions with 2 response categories and the following scores: yes = 0, no = 1; the questions aimed at investigating what difficulties, if any, the students had in modifying their eating habits in order to improve them. A score of 1 was assigned to the major barrier towards change; in this way greater barriers to change were related to higher scores. The total score of this section was 9.

Section 7 - Nutritional knowledge: it contains 11 questions, each with 4 response categories structured in different ways. This section focused on various nutritional aspects, aimed at investigating the level of knowledge that the students had in this area. The response categories were 4, scoring 1 for each correct answer and 0 otherwise. The total score of this section was 11.

Section 8 - Food safety knowledge: it contained 10 questions, each with 4 response categories structured in different ways: this section focused on students' knowledge level regarding food safety. The score was 1 for the correct answer to each question and 0 otherwise. The total score of this section was 10.

Section 9 - Food safety and behavior in hygiene practices: it contained 8 questions, 7 of which present the following response categories: always, often, sometimes, never; the last one (section 9, question 6) had 4 different responses structured in different ways. This section aimed at investigating each student's behavior in hygiene practices related to food safety and its impact on health. The score ranged from 0 to 3, with the maximum score assigned to the healthiest behavior in hygiene practices. The total score of this section was 24.

As a measure of internal consistency of each questionnaire section, in a previous study [22] we computed Cronbach's alphas, while Pearson's correlation was used as a measure of temporal stability. Cronbach's alphas ranged from a minimum of 0.55 (section 6) to a maximum of 0.75 (Section 2), the sections with a poor internal consistency being sections 6, 7 and 8. Pearson's correlation, used to assess test-retest reliability for each of the sections, was very high: Pearson's correlation coefficients ranged from a minimum of 0.78 to a maximum of 0.88, indicating a very good temporal stability of the questionnaire. All Pearson's correlation coefficients were statistically significant with $p < 0.01$.

The total score of each section was divided into tertiles, with the lowest tertile assigned to the worst evaluation and the highest to the best evaluation, except for section 6 (barriers to change) for which the greater barriers to change were related to the highest tertile.

The study was carried out as a part of a wider nutritional surveillance project with the cooperation of both the school teachers and the medical staff of the Regional Public Health Department of the Aosta Valley Region. Before starting the study, many meetings were organised with teachers and students to explain the aim of the research and to request their participation.

The questionnaire was self-administered during school time under the supervision of the teacher and of a dietitian. In order to minimize the possibility of bias, all supervisors had received 8 hours of instruction about the questionnaire and were standardized in answering any of the students' questions if explanations were needed.

We chose to self-administer the questionnaire as this makes it possible to collect simultaneously a large quantity of information from many subjects in a short period of time, costs less to administer than personal interview and requires fewer trained personnel. On the other hand, a self-administered questionnaire makes it more difficult to verify response truthfulness [23]. Since the questionnaire was completed under the teacher's and dietitian's supervision, checking that the students completed all the answers, non-response rate was equal to zero. Completing the questionnaire took about 50 minutes.

Data Collection

2. Weight and Height Measurements for BMI Calculation

Students' weight and height were measured by health personnel (physicians and dietitians) according to standard conditions after setting up a classroom as a medical surgery in each school. Body weight was measured on subjects wearing only underwear and without shoes by means of a steelyard scale (precision ± 100 g); body height was measured on subjects without shoes by means of a stadiometer (precision ± 1 mm). BMI was calculated as a ratio between weight and height squared with weight in kilograms and height in meters.

Data Analyses

The scores obtained in each section are expressed as mean ± standard deviation. The percentage distribution of students in each tertile score was calculated by using the statistical Package for the Social Sciences [24]. T-Student test was calculated to investigate differences in scores obtained by males and females, normal and over weight plus obese subjects; Pearson's correlation coefficients were computed to analyse the relationship between BMI and the investigated variables.

Reference Standards

Eating habits, physical activity, meaning of healthy and unhealthy dietary habits and food, food safety and behavior in hygiene practices were evaluated by comparing them with the Dietary Guidelines for Italians' Healthy Diet [25].

According to the International Obesity Task Force (IOTF) [26,27], Cole's age-specific cut-off points reference standard for BMI [28] was used to identify overweight and obesity in young age. Cole's centile curves were drawn so that at age 18 years they passed through the widely used cut off points of 25 and 30 kg/m^2 for overweight and obese adult. The resulting curves were averaged to provide age and sex specific cut off points from 2–18 years [28]. The IOTF suggests [26,27] that Cole's cut off points are less arbitrary and more internationally based than current alternatives (they were developed by measuring 97.876 males and 94.851 females, respectively, from birth to 18 years of age living in Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the United States) and will help to provide internationally comparable prevalence rates of overweight and obesity in children and adolescents.

Research Protocol Approval by Ethics Committee

The research protocol was approved both by the Ethics Committee of the Faculty of Medicine of the University of Pavia and by the Ethics Committee of the Regional Public Health Department of the Aosta Valley Region.

RESULTS

Sample

Characteristics of the sample are shown in Table 1. Group mean age is 15.4 ± 0.7 years and BMI mean value is 21.9 ± 3.4 kg/m^2 for males and 21.0 ± 2.9 kg/m^2 for females. According to Cole's cut-off points reference standard for BMI [28], 20.8% of males and 14.7% of females are overweight, and 4.7% of males and 1.1% of females are obese. As far as underweight is concerned, Cole does not give any suggestion, and we decided to judge underweight subjects as those under

the 3rd centile, therefore 0.4% of males and 2.5 of females are underweight.

Eighty-four point four percent of the students live in a traditional family, while the others (15.6%) live either with the mother or with the father or with grandparents. Most of the students' parents have a junior high school licence or a high school licence, while only about 10% have graduated. Regarding parents' occupations, office-worker is the most represented (24.5% of the fathers and 33.5% of the mothers).

Dietary Questionnaire

Table 2 shows the percentage distribution of subjects according to tertile scores.

Eating Habits. The total score (42) was divided into tertiles, where the lowest one referred to "inadequate eating habits", the medium one referred to "partially satisfactory eating habits" and the highest one referred to "satisfactory eating habits". The mean score obtained is 29 ± 5, without any statistically significant differences between males and females. Seven point five percent of the students show "inadequate eating habits", 55.5% have "partially satisfactory eating habits", while only slightly more than one third of the sample (37.0%) show "satisfactory eating habits". The worst eating habits are skipping breakfast (about 20% of the sample); 33.1% of males and 44.6% of females do not drink milk or yogurt at breakfast; 92.1% of the subjects do not eat at least two portions of fruit and vegetables every day. With about 25% of the sample, consumption of cakes and sweets is too high, in that a dessert or cake is always consumed at each meal.

Physical Activity and Lifestyle. The total score (18) was divided into tertiles, where the lowest one referred to "sedentary physical level", the medium one referred to "partially moderate physical level" and the highest one referred to "active physical level". The mean score obtained is 11 ± 3, without any statistically significant differences between males and females. A statistically significant difference was found between normal and overweight plus obese boys, with the highest score obtained by normal weight boys (12 ± 3 vs. 11 ± 3) (p = 0.03). Only 18.5% of the students have a very active lifestyle, while about one third (29.7%) show a sedentary physical level,

Table 1. Sample Characteristics

Variables	Males (n = 254) mean ± SD	Females (n = 278) mean ± SD
Age (years)	15.5 ± 0.7	15.4 ± 0.7
Weight (kg)	65.4 ± 11.5	55.7 ± 9.2
Height (m)	1.73 ± 0.07	1.63 ± 0.07
BMI (kg/m^2)	21.9 ± 3.4	21.0 ± 2.9
Overweight subjects' BMI (kg/m^2)	25.4 ± 1.4 (20.9%)[a]	25.6 ± 1.8 (14.7%)[a]
Obese subjects' BMI (kg/m^2)	31.2 ± 1.4 (4.7%)[a]	30.7 ± 2.5 (1.1%)[a]
Underweight subjects' BMI (kg/m^2)	15.9 (0.4%)[a]	15.7 ± 0.3 (2.5%)[a]

[a] Between parentheses, percentage of subjects.

Table 2. Percentage Distribution of Subjects according to Tertile Scores

Questionnaire sections	1st tertile	2nd tertile	3rd tertile
2. Eating habits	7.5 (40)[a]	55.5 (295)[a]	37.0 (197)[a]
3. Physical activity and lifestyle	29.7 (158)	51.7 (275)	18.6 (99)
4. Healthy and unhealthy dietary habits and food	12.0 (64)	54.9 (292)	33.1 (176)
5. Self-efficacy	7.1 (38)	27.5 (146)	65.4 (348)
6. Barriers to change	85.6 (455)	13.3 (71)	1.1 (6)
7. Nutritional knowledge	42.1 (224)	49.3 (262)	8.6 (46)
8. Food safety knowledge	70.1 (373)	27.5 (146)	2.4 (13)
9. Food safety and behavior in hygiene practices	10.9 (58)	45.5 (242)	43.6 (232)

[a] Between parentheses, number of subjects.

not consistent with a healthy lifestyle. In response to the question "what do you prefer to do during free time?" 47.7% of the sample answered watching television, using the computer, listening to music, reading a book, while only 21.7% reported practicing a sport and 17.6% going for a walk. In general, males are more active than females: 22.3% versus 15.1%; in response to the question "Do you usually practice a physical activity?", 40.9% and 27.3% respectively of males and females answered "always".

Healthy and Unhealthy Dietary Habits and Food. The total score (15) was divided into tertiles, where the lowest one referred to "little comprehension of the meaning of healthy and unhealthy dietary habits and food", the medium one referred to "sufficient comprehension of the meaning of healthy and unhealthy dietary habits and food" and the highest one referred to "good comprehension of the meaning of healthy and unhealthy dietary habits and food". The mean score obtained is 11 ± 2, without any statistically significant differences between males and females. Slightly more than half of the sample (54.8%) have sufficient comprehension of the meaning of healthy and unhealthy diet and food, while only one third (33.1%) have a good comprehension, with a higher proportion among females (39.4% v. 26.2%). In response to the question:" According to you, which is a healthy diet?", 70.7% of the sample answered correctly (a healthy diet is a diet rich in different foods), nevertheless only 47.3% of the subjects reported eating a varied diet every day, as section 2 (eating habits) indicates. Regarding the question "According to you, which is a healthy food?", 38.5% reported that "a food rich in protein" is the healthiest one, 4.2% chose "a food rich in calories", 27.1% "a microbiologically tested food" and 30.2% "a food without preservatives and additives".

Self-Efficacy. The total score (16) was divided into tertiles, where the lowest one referred to "incapacity for using advice aimed at improving one's well-being", the medium one referred to "sufficient capacity for using advice aimed at improving one's well-being" and the highest one referred to "good capacity for using advice aimed at improving one's well-being". The mean score obtained is 13 ± 3, without any statistically significant differences between males and females. A good percentage of the subjects (65.4%) reported being able to use advice aimed at improving their well-being, while 7.1% think

they are not able to do this. In response to the question:" Do you think you are able to modify your diet, if needed?", 13.6% answered "I'm not able" and 36.4% " I don't know".

Barriers to Change. The total score (9) was divided into tertiles, where the lowest one referred to "no barriers in modifying one's own eating habits with the aim of improving them", the medium one referred to "some barriers in modifying one's own eating habits with the aim of improving them" and the highest one referred to "a lot of barriers in modifying one's own eating habits with the aim of improving them". The mean score obtained is 3 ± 2, without any statistically significant differences between males and females. Eighty-five point six per cent of the students have no barriers to change, with a higher proportion among females (87.8 % vs. 83.2%); 13.3% have some barrier to change, with a higher proportion among males (16.0% vs. 10.8%).

Nutritional Knowledge. The total score (11) was divided into tertiles, where the lowest one referred to "insufficient nutritional knowledge", the medium one referred to "good nutritional knowledge" and the highest one referred to "quite good nutritional knowledge". The mean score obtained is 7 ± 2 with a statistically significant difference (p < 0.05) between males and females (6 ± 2 for males v. 7 ± 2 for females). About half of the subjects (49.2%) have good nutritional knowledge (most females), but 42.2% of the students (most males) have insufficient nutritional knowledge. Only 8.6% of the sample have quite good nutritional knowledge (higher among females). The most frequent mistakes related to dietary fibre, food protein content and energetic values. In response to the question "Which is the nutrient that contains the most energy?", only 12.5% of the students answered fats, 37.2% said carbohydrates and 42.6% answered protein.

Food Safety Knowledge. The total score (10) was divided into tertiles where the lowest one referred to "insufficient food safety knowledge", the medium one referred to "good food safety knowledge" and the highest one referred to "quite good food safety knowledge". The mean score obtained is 3 ± 2 without any statistically significant differences between males and females. Seventy point one per cent of the adolescents have an insufficient food safety knowledge; 27.5% have a good food safety knowledge and only very few students (2.4%) have quite good safety knowledge.

Food Safety and Behavior in Hygiene Practices. The total score (24) was divided into tertiles, where the lowest one referred to "inadequate behavior in hygiene practices"; the medium one referred to "partially adequate behavior in hygiene practices" and the highest one referred to "quite good behavior in hygiene practices". The mean score obtained is 17 ± 4 with statistically significant differences ($p < 0.05$) between males and females (16 ± 4 for males v. 18 ± 4 for females).

A total of 43.7% of the students have quite good behavior in hygiene practices, mostly the girls (54.7%) when compared to the boys (31.5%), while the percentages between sexes are reversed in the two other tertiles (males 17.3% v. females 5.0% in the lowest tertile; males 51.2% vs. females 40.3% in the medium tertile). In response to the following questions " Do you read the instructions for use and for preservation written on packaged foods?", "After drinking a glass of milk, do you usually put the bottle of milk back in the fridge?", "Do you eat canapés that have been left lying out for a long time at the bar?", "If the butcher touches ham with his hands without gloves, do you eat it?", only less than half of the students chose the right answer.

Table 3 summarizes the various scores obtained in each section by males and females, respectively.

Table 3. Scores Obtained in the Various Questionnaire Sections by Males and Females

Questionnaire sections	Scores	Males n = 254	Females n = 278
2. Eating habits	Low[a]	9	10
	Mean[b]	29 ± 5	29 ± 6
	High[c]	40	40
3. Physical activity and lifestyle	Low	0	1
	Mean	12 ± 3	11 ± 3
	High	18	17
4. Healthy and unhealthy dietary habits and food	Low	1	0
	Mean	11 ± 2	11 ± 2
	High	15	15
5. Self-efficacy	Low	0	4
	Mean	13 ± 3	13 ± 2
	High	16	16
6. Barriers to change	Low	0	0
	Mean	3 ± 2	3 ± 2
	High	9	8
7. Nutritional knowledge	Low	0	3
	Mean	6 ± 2	7 ± 2
	High	11	10
8. Food safety knowledge	Low	0	0
	Mean	4 ± 2	4 ± 2
	High	9	10
9. Food safety and behavior in hygiene practices	Low	0	0
	Mean	16 ± 4	18 ± 4
	High	24	24

[a] Lowest score.

[b] Mean score ± Standard Deviation.

[c] Highest score.

Dietary Questionnaire and BMI

Dietary questionnaire scores were analysed in relation to students' BMI, considering two groups: normal weight subjects versus overweight plus obese subjects. No statistically significant differences emerged between the two groups for any sections of the dietary questionnaire except for section 3 relating to physical activity, for which normal weight boys obtained higher score (12 ± 3 score) than overweight plus obese ones (11 ± 3 score) ($p = 0.03$). In addition, no significant correlation ($p = $ N.S.) emerged between scores obtained in each section and BMI values, except for section 4 (healthy and unhealthy dietary habits and food) where a negative correlation was found for the total sample ($p < 0.001$; $R = -0.71$).

DISCUSSION

The present study of more than 500 15-year-old students provided results with implications for designing programs for health promotion and improvement in nutritional habits for adolescents.

The sample contains a slightly higher percentage of females than males, which reflects gender distribution in the entire Aosta Valley Region population. Most of the students live in a traditional family. Parents' educational level is not high, as most of the fathers have a junior high school licence and most of the mothers have a high school licence.

As far as BMI is concerned, most of the adolescents are in the normal range of values according to Cole's reference standards [28], while prevalence of overweight subjects in both sexes is high, but higher in males. On the other hand, the prevalence rate of obese adolescents is low. Nevertheless, the high percentage of overweight subjects is worrying, and preventive and corrective strategies need to be undertaken in school programs aimed at weight control and therefore at reducing this risk condition. A few subjects are underweight under the 3rd centile, including just one male and seven females, highlighting that overweight is undoubtedly the most important problem in this Italian area. Our data are higher than those reported by Cacciari et al. [29] in a sample of subjects aged 6–20 years, which show a prevalence of overweight in Central-Northern Italy equal to 17% in boys and 10% in girls and a prevalence of obesity equal to 2% in boys and 1% in girls, respectively. Nevertheless, our data are lower than those found in Southern Italy [30–34], in agreement with a higher prevalence of overweight and obesity in this area. Our results can be explained by the fact that, even though our subjects live in a mountainous area, they mostly have a sedentary lifestyle as shown from the results of section 3 of the questionnaire. In addition, foods such as cheese rich in fats, sausages, butter and lard are traditional components of local meals in this Region.

Overweight and obesity were not related to scores obtained in the dietary questionnaire, except for physical activity level in

males as well as for beliefs about healthy and unhealthy diet and food in both sexes, which influence overweight and obese adolescents in making unhealthy food choices.

Data on eating habits show a low intake of milk and yogurt at breakfast as well as of fruit and vegetables and high consumption of cakes and sweets. In addition, about 20% of the adolescents do not have breakfast every day. These results are inconsistent with the Dietary Guidelines for Italians' healthy diet [25].

As far as physical activity and lifestyle are concerned, though most adolescents have moderate physical levels, about one third of the students show a sedentary lifestyle, with a higher proportion among females. This result represents a typical adolescent habit consisting in spending many hours in sedentary activities (watching television, using the computer, listening to music, reading a book) [35]. Watching television has been linked with an unhealthy diet, high cholesterol levels [36] and overweight and obesity [5,37]. This may be influenced by unhealthy nutrition messages in commercials [38], eating snack foods and decreased physical activity [35].

The meaning of healthy and unhealthy dietary habits is sufficiently known by the students, while the meaning of healthy food is less clear: in fact, 38.5% of the subjects report that a food rich in protein is the healthiest one. Our results are similar to those of Croll et al. [39] who found, in a sample of 203 American adolescents attending senior high schools, that adolescents have a significant amount of knowledge regarding healthy habits as they believe that healthy eating involves moderation, balance and variety. Despite this knowledge, they encounter barriers to healthy eating, above all a general lack of concern about following healthy eating recommendations. Our results suggest that lay understanding of healthy eating does generally conform to dietary guidelines, and therefore health promotion priorities should focus on physical and psychological constraints to healthy eating, rather than attempting to increase the adolescents' knowledge as a whole.

Perceived self-efficacy, i.e. the belief that an individual may carry out a specific behavior, was strongly related to healthy eating patterns [13,40]. This finding is consistent with the reports showing self-efficacy to be a key factor in the eating behavior of middle aged women [41]. We found no significant statistically difference associated with gender in line with the report of Kingery [40] in his study on college students, but in contrast with the results of Gracey et al. [42] who reported that boys had significant lower self-efficacy scores than girls. In our study, perceived self-efficacy in modifying one's own diet, if needed, has to be improved, in agreement with the results of Roach et al. [43] who found that using behavioral techniques to improve self-efficacy can be effective in weight loss promotion and can produce positive outcomes.

Barriers to change must also be considered in planning nutrition education programs. The lack of students' knowledge about increasing dietary fibre ingestion is the greatest barrier to change, followed by ignorance on how to satisfy their own

energy expenditure and how to improve their own diet. Strategies for reducing dietary intake of sugar, fats and cholesterol are known by only one quarter of the students. Nevertheless, in general, 85.6% of the subjects report that they have no barriers to change, leading one to think that the questionnaire somehow underestimated barriers against change. In a cross-sectional study [44] carried out in the 15 member states of the European Union on approximately 1000 adults, including subjects aged 15 years, the most frequently mentioned perceived barriers to healthy eating concerned time and taste factors, while a lack of knowledge about healthy eating was not selected by many as an important barrier. Time-related factors were more important for younger respondents. Our results show no statistically significant differences between males and females, and thus are different from those of Gracey et al. [42] who showed that girls ranked barriers to change higher than boys and identified some different barriers they considered important.

Nutritional knowledge is a predisposing factor for eating behaviors [45], even though voluntary behavior improvement requires motivation, ability as well as the opportunity to improve one's own behavior [46]. Our girls have better knowledge than boys, perhaps because they are more involved in meal preparation and in general they look after their body image more than boys. Our results are in agreement with those of Wardle et al. [47] who showed that women attached greater importance to healthy eating than men and concluded that gender differences appear to be partly attributable to women's greater weight control involvement. Ignorance about some nutrient content of foods, particularly concerning dietary fibre and protein, as well as about food energy content, indicates adolescents' difficulties in translating nutritional advice into food choices in order to satisfy their own energy expenditure and to improve their own diet.

Knowledge about food safety is very poor and is lower than nutritional knowledge. The most important topics which students incorrectly answered are related to food toxinfection and to food preserving. This fact is in contrast with behavior in hygiene practices, as the score obtained is in general satisfactory, probably because behavior was acquired as a family habit, without a good related knowledge. Girls have better hygiene behavior than boys, perhaps because they are more involved in meal preparation and cooking foods.

Individual character and personality are decisively formed during adolescence. Young people begin to assume responsibility for their own food habits, health-related attitudes and behaviors. Planning an incisive nutritional intervention on a selected sample of the population requires identification of its nutritional problems and primary needs. Our study highlighted an extensive view on eating habits and behaviors of 15-year-old adolescents living in an Italian Northern Region in order to point out the most important unhealthy behaviors for planning nutrition education programs, aimed at the promotion of good health and well-being in adult life. The topics which could be targeted for intervention are related to body weight control,

including a body weight decrease in overweight and obese adolescents, by means of adopting healthy eating habits and behaviors and increasing physical activity. Also, current eating habits must be targeted for intervention, in particular by increasing intake of milk products, fruit and vegetables, decreasing sweet cake ingestion and promoting breakfast consumption. Students need education about food nutrient and energy contents in order to make appropriate food choices. The students' lack of knowledge about foods, rather than dietary habits, suggest that foods should be a focus for nutrition education programs.

In general, females value health more than males and more readily adopt preventive health strategies [48]. Females also acquire knowledge about healthy eating in response to a nutrition education program more satisfactorily than males [49].

CONCLUSION

In conclusion, different aspects of adolescents' eating behavior may be influenced by different factors, which need to be considered in designing nutrition promotion programs. Nutrition and health professionals should tailor educational and treatment strategies according to the specific desired dietary outcomes. Interventions should help to make healthy eating easy for adolescents to apply and explain the consequences of unhealthy eating in terms that they value, stressing meaningful short and long-term benefits for human health, providing knowledge, increasing consciousness of healthy eating and, lastly, supporting the adolescents in the adoption of healthy lifestyle.

ACKNOWLEDGMENTS

APPENDIX 1

The questionnaire must be completed in each section; you must answer each item with only one choice; it is important that you complete it by yourself; don't leave any item without an answer. If you have any doubt don't hesitate to ask the dietician or the teacher.

Your answers will remain anonymous and the data collected will be used only for research.

Section 2. Eating Habits
2.1 Do you eat breakfast?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

2.2 Which beverage do you consume at breakfast?
- ☐ milk/milk and coffee/cappuccino/yogurt
- ☐ fruit juice
- ☐ tea/coffee
- ☐ chocolate

2.3 At breakfast you eat:
- ☐ biscuits/cakes/crackers/ breakfast cereals/bread
- ☐ fruit
- ☐ sausages and cheese
- ☐ pizza/focaccia/toast

2.4 Do you eat at least 2 portions (g 200) of fruit every day?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

2.5 Do you eat at least 2 portions (g 200) of vegetables every day?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

2.6 Do you usually eat a cake or a dessert at meals?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

2.7 Do you usually drink wine or beer at meals?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

2.8 Do you usually eat breakfast, lunch and dinner every day?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

2.9 Your diet:
- ☐ is different every day
- ☐ is different only sometimes during a week
- ☐ is different only during the weekend days
- ☐ is very monotonous

2.10 Your diet is based mainly on:
- ☐ high protein content foods (meat, fish, eggs, cheese, dried legumes)
- ☐ high fat content foods (sausages, focacce, fried potatoes, cakes with butter and cream)
- ☐ high carbohydrate content foods (bread, pasta, rice, potatoes, biscuits)
- ☐ different foods every day

2.11 Your snacks are based mainly on:
- ☐ fruit/fruit juice/fruit and milk shakes/yogurt

☐ biscuits/crackers/bread/stick bread
☐ fried potatoes/pop corn/krapfen/peanuts/soft drinks
☐ sweets/chocolate/ice cream/cakes

2.12 Which beverages do you usually drink between meals?
☐ mineral water
☐ soft drinks (cola, orange, soda, iced tea, tonic water, etc.)
☐ wine/beer
☐ fruit/fruit juice/fruit and milk shakes

2.13 Do you drink at least 1 glass of milk or do you eat at least 1 cup of yogurt every day?
☐ always
☐ often
☐ sometimes
☐ never

2.14 Do you drink at least 1–1,5 L of mineral water every day?
☐ always
☐ often
☐ sometimes
☐ never

Section 3. Physical Activity and Lifestyle

3.1 Do you usually practice a physical activity?
☐ always during the entire year
☐ only in some seasons
☐ sometimes
☐ never

3.2 How many hours do you practice it?
☐ 1h–2h in a week
☐ 3h–4h in a week
☐ more than 4h in a week
☐ no hour

3.3 What do you prefer to do during free time?
☐ walking
☐ watching TV/listening to music /using the computer/ reading a book
☐ practicing a sport
☐ shopping

3.4 How many hours do you spend on the computer or watching TV?
☐ 1h–2h a day
☐ 3h–4h a day
☐ 5h–6h a day
☐ more than 6h a day

3.5 The physical activity that you practice at school:
☐ is tiring
☐ is boring
☐ stimulates you to practice sports even out of school
☐ makes you feel well

3.6 Your lifestyle is:
☐ very sedentary
☐ sedentary
☐ moderately active
☐ very active

Section 4. Healthy and Unhealthy Dietary Habits and Food

4.1 According to you, which is a healthy diet?
☐ a diet rich in different foods
☐ a diet whose foods are rich in protein (meat, fish, eggs, cheese, dried legumes)
☐ a diet without any fats
☐ eating fish very often

4.2 According to you, which is the healthiest eating behaviors?
☐ drinking 2 glasses of milk/eating 2 cups of yogurt every day
☐ preferring cooked vegetables to uncooked vegetables
☐ eating always cheese instead of meat
☐ when you eat snacks, preferring fruit/fruit juice/ biscuits and crackers

4.3 According to you, which is a healthy food?
☐ a food rich in protein
☐ a food rich in calories
☐ a microbiologically tested food
☐ a food without preservatives and additives

4.4 According to you, which is the healthiest food?
☐ washed vegetables ready to eat
☐ a canned food
☐ a food very rich in dressing
☐ a fried food

4.5 According to you, which is the healthiest cooking method?
☐ cooking on a grill/in boiled water
☐ frying/braising
☐ cooking in the oven without fats
☐ cooking in a pan with fats

Section 5. Self-Efficacy

5.1 Do you think you are able to choose anything by yourself?
☐ yes
☐ no
☐ I don't know

5.2 Do you think you are able to use advice aimed at improving your well-being?
☐ yes
☐ no
☐ I don't know

5.3 Do you think you are able to modify your diet, if needed?
☐ yes
☐ no
☐ I don't know

5.4 Do you think you are able to loose or to gain weight, if needed?
- ☐ yes
- ☐ no
- ☐ I don't know

5.5 Do you think you are able to use nutrition advice aimed at improving your dietary habits?
- ☐ yes
- ☐ no
- ☐ I don't know

5.6 Do you think you are able to use nutrition advice aimed at improving your health status?
- ☐ yes
- ☐ no
- ☐ I don't know

5.7 Do you think you are able to practice a constant physical activity in order to improve your well-being?
- ☐ yes
- ☐ no
- ☐ I don't know

5.8 Do you think you are able to practice a constant physical activity in order to improve your physical aspect?
- ☐ yes
- ☐ no
- ☐ I don't know

Section 6. Barriers to Change

6.1 Do you have some influence on cooking food at home?
- ☐ yes
- ☐ no

6.2 Do you know which foods must be restricted to reduce dietary intake of fats and cholesterol?
- ☐ yes
- ☐ no

6.3 Do you know which foods must be restricted to reduce dietary intake of sugar?
- ☐ yes
- ☐ no

6.4 Do you know which foods must be eaten to increase dietary intake of fibre?
- ☐ yes
- ☐ no

6.5 Do you know which benefits you could gain by eating a healthy diet?
- ☐ yes
- ☐ no

6.6 Do you know how to improve your diet?
- ☐ yes
- ☐ no

6.7 Do you know how much you must eat to satisfy your energy requirement?
- ☐ yes
- ☐ no

6.8 Do you know how important it is not to be influenced by your friends in choosing your food?
- ☐ yes
- ☐ no

6.9 Do you think that your family would support your efforts in improving your food habits?
- ☐ yes
- ☐ no

Section 7. Nutrition Knowledge

7.1 Which food contains carbohydrates?
- ☐ meat
- ☐ butter
- ☐ bread
- ☐ cheese

7.2 Which food does not contain dietary fibre?
- ☐ wholemeal bread
- ☐ beans
- ☐ white bread
- ☐ meat

7.3 Which food is less rich in fat?
- ☐ hamburger with mayonnaise
- ☐ grilled meat
- ☐ focaccia
- ☐ sandwich with salami

7.4 Which food is the richest in protein?
- ☐ dry legumes
- ☐ sole fish
- ☐ spaghetti with tomato sauce
- ☐ apple

7.5 Which food is the richest in calories?
- ☐ bread
- ☐ potatoes
- ☐ fruit salad
- ☐ tiramisù (an Italian cake very rich in fat and sugar)

7.6 Which substance contains more energy?
- ☐ protein
- ☐ carbohydrates
- ☐ fat
- ☐ alcohol

7.7 What are the functions of vitamins and minerals?
- ☐ to put on muscular tissue
- ☐ to lose body fat
- ☐ to catalyse biochemical reactions in the body
- ☐ to provide energy

7.8 According to you, what is a "balanced diet"?
- ☐ a diet rich in protein
- ☐ a diet poor in fat
- ☐ a diet without carbohydrates
- ☐ a diet containing all nutrients in proper quantities

7.9 According to you, what is "daily energy expenditure"?
- ☐ energy consumed in the whole day
- ☐ energy consumed during sleep
- ☐ energy consumed only for physical activity

☐ energy consumed for maintaining body temperature at 37°C

7.10 What are "biological foods"?
☐ foods grown without any use of chemical fertilizer
☐ foods grown in greenhouse
☐ foods without additive and preservatives
☐ foods grown in a ground far from the highway

7.11 What are "transgenic foods"?
☐ foods imported from foreign countries
☐ foods in which different fragments of DNA have been included
☐ foods without potentially pathogenic germs
☐ foods without toxic substances

Section 8. Food Safety Knowledge

8.1 A food intoxication is:
☐ a disease caused by lack of vitamins
☐ a disease caused by the consumption of foods contaminated by pathogenic germs
☐ a disease caused by an excessive consumption of food
☐ a disease caused by assumption of a chemical toxin

8.2 Which of the following are caused by food intoxication?
☐ vomit, diarrhoea, fever
☐ only vomit and diarrhoea
☐ it depends on the type of causative germ
☐ fever, sore throat and cough

8.3 Which of the following are most responsible for food intoxication?
☐ inadequate preservation
☐ contamination of food prior to cooking
☐ manipulation of cooked food immediately prior to consumption
☐ inadequate washing of plates and pots

8.4 Which of the following foods are mostly implicated in the onset of food intoxication?
☐ eggs and cream
☐ vegetables
☐ frozen meat
☐ biscuits

8.5 Which of the following behaviors can cause cross-contamination of foods?
☐ use of the same utensils for cooked and raw foods
☐ washing one's hands after having handling raw foods and before handling cooked foods
☐ using different surfaces for cooked and raw foods
☐ keeping cooked and raw foods separated

8.6 How can you transmit Salmonella?
☐ by coughing on the food
☐ by touching foods without having washed your hands
☐ by sneezing on the food
☐ by smoking while preparing the food

8.7 Which is the optimum temperature for bacterial growth?
☐ from 0°C to +4°C

☐ from +4°C to +60°C
☐ beyond 60°C
☐ under −5°C

8.8 Do cold temperatures kill pathogenic germs which may be present in foods?
☐ rarely
☐ no, on the contrary it facilitates growth
☐ no, it inhibits growth
☐ yes, always

8.9 Does heat kill germs?
☐ yes, always
☐ no, never
☐ yes, above 40°C
☐ yes, above 60°C

8.10 Which of the following diseases can be transmitted by ingestion of contaminated foods?
☐ hepatitis A
☐ AIDS
☐ pneumonia
☐ the flu

Section 9. Food Safety and Behavior in Hygiene Practices

9.1 When you buy packaged food, do you check the expiry date?
☐ always
☐ often
☐ sometimes
☐ never

9.2 Do you read the instructions for use and for preservation written on the packaged foods?
☐ always
☐ often
☐ sometimes
☐ never

9.3 Do you wash your hands before eating and before touching foods?
☐ always
☐ often
☐ sometimes
☐ never

9.4 Do you usually wash fruit that must not be peeled before eating?
☐ always
☐ often
☐ sometimes
☐ never

9.5 After drinking a glass of milk, do you usually put the milk in the fridge?
☐ always
☐ often
☐ sometimes
☐ never

9.6 If you realize you have left the milk out of the fridge during the night, what do you do?
- ☐ you throw it away
- ☐ you tell your mother to throw it away
- ☐ you put it in the fridge again
- ☐ you drink it

9.7 If the butcher touches ham with his hands, do you eat it?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

9.8 Do you eat canapés that have been left lying out for a long time at the bar?
- ☐ always
- ☐ often
- ☐ sometimes
- ☐ never

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