Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy

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Abstract

Objective: The study aimed to test the reliability of a nutrition questionnaire and to assess potential associations between nutrition knowledge, food consumption and lifestyle behaviours, controlling for sociodemographic factors.
Design: Cross-sectional survey.
Setting: Comprehensive school in the municipality of Butera, a rural area of Sicily, South Italy.
Subjects: The survey was conducted between March and May 2010 on 445 students (4–16 years).
Results: All constructs of the questionnaire had statistically significant Cronbach's α and Pearson's correlation coefficients, showing good internal consistency and temporal stability. After controlling for covariates, nutrition knowledge was positively associated with pasta/rice, fish, vegetable and fruit intakes, and negatively with sweets, snacks, fried foods and sugary drinks consumption. Moreover, students whose parents were in the highest educational and occupational categories reported eating significantly more fruits and vegetables and less meat, sweets, snacks, fried foods and sugary drinks. Students with higher nutrition knowledge scores were less likely to have two or more snacks daily and to spend more than 3 h in sedentary activities daily (OR = 0·89, 95 % CI 0·83, 0·97 and OR = 0·92, 95 % CI 0·86, 0·99, respectively). High parental education was associated with less frequent snacking and more frequent weekly physical activity, compared with lower categories, whereas high parental occupational category was associated with daily breakfast.
Conclusions: Improving nutrition knowledge in children and young adolescents may translate into educating them in good dietary habits. Moreover, nutrition intervention programmes should also involve parents to improve dietary quality and nutritional habits of the entire family.

Over the past decades, a growing body of scientific literature has focused on finding the association between nutrition knowledge and food consumption, leading to inconclusive results[1]. Indeed, the strength of such associations has been found to vary among the studies and is generally weak. Reasons for failure are not well understood. Although the suggestion that knowledge is one of the determinants of food choice may seem intuitive, several psychological and environmental factors might play a role in such choice, leading to a different attitude towards changing behaviour for health reasons. Thus, the findings of a study might depend on the study population.

Childhood and adolescence is a period when a diet of good nutritional quality is important to establish healthy behaviours concerning food consumption that influence adult morbidity and mortality[2]. Despite the familial environment being well known to influence the food intake of children, childhood is a crucial period of life, since children begin to learn food concepts and a lack of knowledge concerning nutrition and health can cause the onset of poor behavioural traits that have a tendency to carry over from childhood to adulthood. On the other hand, adolescents might also be strongly influenced by friends and mass media, and they may attend school

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programmes on nutrition. Thus, despite it not being well established if there is a relevant association between nutrition knowledge and dietary habits in adults, several studies have addressed the positive impact of knowledge on nutritional behaviour in children and adolescents[3–5].

The present study used a newly elaborated tool to measure nutrition knowledge, food frequency and eating behaviours, specifically developed for children and young adolescents (aged 4–16 years), to assess whether nutrition knowledge corresponds to some dietary behaviour and nutritional lifestyle habits. The study aimed to test the reliability of the questionnaire and to assess potential associations between nutrition knowledge, food consumption and lifestyle behaviours (i.e. breakfast and snacking habits, physical and sedentary activity), controlling for socio-demographic factors (such as gender, age, BMI, parents' educational and occupational categories).

Materials and methods

Participants

The survey was conducted between March and May 2010 among students attending a comprehensive school located in the municipality of Butera, a rural area of Sicily, South Italy. Given the school made up the whole population of students aged 4–14 years and older students aged 15–16 years still in secondary school (about 500 children), our sample is highly representative of a typical rural area of Sicily. Participation was voluntary and informed consent was obtained from students' parents. The study was approved by the ethics committee of the University of Catania. The administration of the questionnaire was performed in classroom during school time in the presence of a trained doctor and a referent teacher, after a short lecture and illustration of the same. It took about 20 min to complete the questionnaire.

Developing the questionnaire items pool

The choice of the questions to be included in the questionnaire was made after a review of the literature concerning nutrition knowledge, eating behaviours and lifestyle advice. Questions were collected by an accurate selection of items in already existing questionnaires or obtained on the basis of research in order to represent the entire topic to be measured. Thus, a pool of ninety-two items generated by a group of experts, composed of three doctors and two nutritionists, was obtained. In accordance with previous studies[6], the panel of experts was asked to indicate whether or not a measurement item was 'essential' to the operationalization of a theoretical construct. The content validity ratio was calculated by the formula:

$$CVR = (n_e - n/2)/(n/2),$$

where CVR = content validity ratio, n_e = number of experts indicating 'essential' and n = total number of experts.

This formula yields values which range from +1 to −1; positive values indicate that at least half of the experts rate the item as essential. The mean CVR across items may be used as an indicator of overall test content validity.

This process reduced the number of items to fifty-four divided into six broad sections as described below.

1. *Food consumption frequency.* This section consisted of twelve questions aimed at assessing the frequency of consumption of foods and beverages, paying specific attention to the major food groups. Respondents were asked how many times they consume the foods, scoring the frequency in ten option categories ('seldom/never', '1 per month', '2–3 per month', '1 per week', '2–3 per week', '4–6 per week', '1 per day', '2–3 per day', '4–5 per day' and '6 or more per day').
2. *Meal habits.* This section consisted of seven items designed to investigate children's qualitative preferences and food choices at meals.
3. *Breakfast and snaking habits.* The entire section, consisting of four items, examined frequency character-istics associated with breakfast and snacking habits.
4. *Influences on food choice.* This section aimed at assessing if parental control and television viewing (especially during meals) may influence children's and adolescents' nutritional habits or consumption of not normally advertised food. It contained nine items addressing factors influencing respondents' eating habits and food consumption.
5. *Lifestyles and physical activity.* This section consisted of six questions with three or four response categories assessing the frequency of physical activity, television viewing or computer use, smoking habits, and attitude to spending leisure time in activities involving move-ment or rest.
6. *Nutrition knowledge.* This last section contained twenty-two questions focusing on a few topics meant to influence respondents' food choices and eating habits: food nutrients, food contents, healthy foods and drinks, and energy expenditure. Questions provided four possible options with a single correct answer and an additional answer, 'Not sure,' to discourage missing data.

Questions on personal data were finally added to collect information about students' class, age, gender, weight and height. BMI evaluation, based on self-reports of weight and height, was used to assess overweight and obesity rates according to Cole *et al.*'s classification[7]. In order to investigate familial socio-cultural status, parents' educational and occupational status was investigated and the highest category among the mother and father was taken into account for the analysis. Younger children were helped by a trained doctor to fill in this section of the questionnaire.

The reliability of the questionnaire was tested on a pilot sample of ninety-three students recruited from the same

school. The sample was based on a cluster design with the school class as a basic unit of sampling to ensure recruiting a similar number of students per age group. Participants were encouraged to report any confusion with the questionnaire and were assured of complete anonymity. The teacher and the doctor were asked to note and report any difficulties and questions raised during the questionnaire compilation.

The test–retest reliability has been measured by administering the questionnaire on two different occasions. We assumed that a time interval of 2 weeks between the two administrations was long enough to avoid recall bias and short enough to avoid changes in the studied attributes.

The questionnaire developed in this work is available in the Supplementary Materials.

Statistical analyses

Baseline characteristics are presented as absolute and relative frequencies of occurrence or mean and standard deviation as appropriate. Differences between groups were tested by the χ^2 test for categorical variables, while for continuous variables parametric (Student's t) and non-parametric (Mann–Whitney U) tests were computed after controlling for homogeneity of variance (Levene test).

Internal consistency was measured by computing Cronbach's α coefficient[8]. The closer α is to one, the higher is the reliability estimate of the instrument. According to classical test theory principles, the minimum requirement for internal consistency is recommended as 0.60[9]. In addition, we computed Pearson's correlation coefficient as a measure of temporal stability. Cronbach's α and Person's correlation coefficients were computed for the total score of each section with the exception of the sections assessing food consumption frequency and meal habits, because these sections are not scaled (rather similar to an FFQ) and there is no total score. Therefore, we evaluated the temporal stability of each item of both these sections. Moreover, we additionally divided the section concerning nutrition knowledge in four constructs (food nutrients, food contents, healthy foods and drinks, and energy expenditure) and computed Cronbach's α for each of them.

To graphically plot food consumption according to nutrition knowledge level, weekly food consumption was calculated and a scale was developed according to relative quartiles of nutrition knowledge scores to facilitate ranking. To test if a significant difference occurred between mean weekly consumption of foods according to nutrition knowledge ranks, Student's t test and the Mann–Whitney U test were again computed as appropriate.

Multiple linear regression modelling was used to study the relationship between weekly food consumption and nutrition knowledge scores (both considered as continuous variables) and to assess if nutrition knowledge was an independent predictor of food consumption

adjusting for covariates such gender, age, BMI and parental educational and occupational categories. Multivariate regression models were performed to test if nutrition knowledge was an independent predictor for specific lifestyle habits, adjusting for the same covariates. Lifestyle behaviours investigated in the survey were breakfast, snacking, physical and sedentary activity habits. $P \leq 0.05$ was considered significant for all statistical tests conducted. All analyses were performed using the SPSS statistical software package release 17.0.

Results

Sample characteristics

A total of 472 participants were recruited for the survey. Missing questionnaires were almost exclusively due to absent students. Of the 472 questionnaires collected, twenty-seven had missing, incomplete or inconsistent answers, resulting in a total of 445 questionnaires eligible for the analysis.

Demographics are presented in Table 1. The mean age of participants was 8.73 (sd 2.94) years (range 4–16 years). Gender was approximately equal in representation, with boys accounting for slightly more of the participants (51.8%). There were no substantial differences between girls and boys although the former were significantly more likely to be overweight or obese ($P < 0.001$).

Questionnaire reliability

Cronbach's α values indicated acceptable internal consistency for each of the four sections of the questionnaire taken into account (Table 2). All constructs had values above 0.7; the only exception was the section regarding lifestyles, with Cronbach's α equal to 0.676 indicating moderate internal consistency of this section. Internal consistency was also assessed for each construct of the section regarding nutrition knowledge, finding Cronbach's α values equal to 0.807 (food nutrients), 0.769 (food content), 0.639 (healthy foods and drinks) and 0.671 (energy expenditure; data not shown).

Pearson's correlation coefficients were calculated between test and retest for the four sections of the questionnaire and resulted in high reliability, with correlation coefficients ranging from a minimum of 0.699 (lifestyles section) to a maximum of 0.874 (nutrition knowledge; Table 2). All correlation coefficients were statistically significant with $P < 0.001$.

Pearson's correlation coefficients of each item assessing frequency of food consumption and meal habits are shown in Table 3. All Pearson's correlation coefficients were statistically significant with $P < 0.001$. In the section regarding food consumption, correlation coefficients ranged between 0.430 (question about water consumption) and 0.885 (question about pasta and rice consumption), resulting in good temporal stability with the exception of the item

Table 1 Demographic characteristics of the study population: children and young adolescents (*n* 445) aged 4–16 years living in a rural area of Sicily, South Italy, 2010

	Total (*n* 445)		Males (*n* 230)		Females (*n* 215)		
	Mean or *n*	SD or %	Mean or *n*	SD or %	Mean or *n*	SD or %	*P*
Age (years)	8·73	2·94	8·78	2·99	8·67	2·89	0·71
Age group (*n*, %)							0·765
<6 years	82	18·4	45	19·6	37	17·2	
6–10 years	174	39·1	87	37·8	87	40·5	
>10 years	189	42·5	98	42·6	91	42·3	
BMI (kg/m^2)	19·69	2·34	18·85	2·26	18·52	2·40	0·138
BMI classification* (*n*, %)							<0·001
Underweight and normal weight	212	47·6	89	38·7	123	57·2	
Overweight	183	41·1	113	49·1	70	32·6	
Obese	50	11·2	28	12·2	22	10·2	
Parents' education (*n*, %)							0·514
None or primary	2	0·4	0	0	2	0·9	
Secondary	150	33·7	76	33·0	74	34·4	
High school	179	40·2	94	40·9	85	39·5	
University	114	25·6	60	26·1	54	25·1	
Parents' occupation (*n*, %)							0·619
Unskilled professions	17	3·8	8	3·5	9	4·2	
Partially skilled professions	83	18·7	39	17·0	44	20·5	
Skilled professions	188	42·3	96	41·7	92	42·8	
Specialized/managerial	157	35·4	87	37·8	70	32·6	

*According to Cole *et al.*'s classification[7].

Table 2 Internal and test–retest reliability of the sub-sample for questionnaire reliability (*n* 93)

Section	Internal reliability (Cronbach's α)	Test–retest reliability (Pearson's correlation coefficient)*
Breakfast and snack habits	0·774	0·769
Influences on food consumption	0·711	0·801
Lifestyle	0·676	0·699
Nutrition knowledge	0·780	0·874

*All *P* were <0·001.

concerning water consumption. In the section concerning meal habits, correlation coefficients ranged between 0·701 and 0·850, again showing good temporal stability.

Nutrition knowledge levels

Findings regarding the association between demographics and nutrition knowledge are reported in Table 4. Means and standard deviations of nutrition knowledge scores are shown to highlight demographic differences. Higher nutrition knowledge scores were significantly associated with being underweight or normal weight ($P = 0.003$), older ($P < 0.001$) and having parents in a higher educational ($P < 0.001$) and occupational category ($P < 0.001$).

Regarding the percentage of correct answers according to different constructs, among the group of questions concerning food nutrients the best basic knowledge was found on the item regarding the definition of vitamins (56·9% correct answers) and the worst on the item about balanced diet (37·5% correct answers). Knowledge about food contents was found to be generally acceptable, with about half of the students responding correctly to all items with the exception of the one regarding pasta and bread content (42·7% correct answers). The construct concerning healthy foods and drinks had the highest

variation of correct answers, ranging between 59·3% for the question about difference between fruit and juice and 37·1% for the one about yoghurt and yoghurt cake. Finally, the percentage of correct answers in the construct on energy expenditure did not vary among items, with almost half of the students responding correctly to all questions, although correct answers to the question regarding food intake according to energy expenditure reached 57·8% (data not shown).

Nutrition knowledge and food consumption

Weekly food consumption according to quartile of nutrition knowledge score is plotted in Fig. 1. Being in the higher quartile of nutrition knowledge score was associated with significantly higher consumption of pasta/rice ($P = 0.001$), vegetables ($P < 0.001$) and fruit ($P < 0.001$) and significantly lower consumption of sweets ($P < 0.001$), snacks ($P < 0.001$), fried foods ($P < 0.001$) and sugary drinks ($P = 0.004$). The effect was more clearly directly linear for vegetables and fruit and inversely for meat, sweets, snacks, fried foods and sugary drinks, rather than for the other food categories.

As diet varied significantly with nutrition knowledge, it was possible that the association between knowledge

and some food consumption was caused by their both being correlated with demographic characteristics. After controlling for covariates such gender, age, BMI, parents' education and occupational categories, nutrition knowledge was independently positively associated with pasta/rice, fish, vegetables and fruit intakes, and negatively associated with sweets, snacks, fried foods and sugary drinks consumption (Table 5). The stronger associations were found between nutrition knowledge

and fish ($\beta = 0.630$), vegetables ($\beta = 0.203$), fruit ($\beta = 0.129$) and sweets ($\beta = -0.168$) intake. Moreover, educational level and occupational level were independently associated with the consumption of several foods (Table 5). Those in the highest educational and occupational categories reported eating significantly more fruits ($\beta = 0.253$ and $\beta = 0.228$, respectively) and vegetables ($\beta = 0.226$ and $\beta = 0.328$, respectively); while those in the highest educational category reported less meat ($\beta = -0.188$), snacks ($\beta = -0.304$), fried foods ($\beta = -0.422$) and sugary drinks ($\beta = -0.438$). Among the other covariates analysed, BMI was found to consistently interact with sugary drinks consumption ($\beta = 0.158$), and age with fruit ($\beta = 0.066$) and vegetables ($\beta = 0.097$) consumption.

Nutrition knowledge, lifestyle and dietary behaviours

In order to see whether nutrition knowledge was an independent predictor of lifestyle and dietary behaviours such as breakfast and snacking as well as physical and sedentary activity frequencies, multiple regression modelling was used. Regression analysis revealed that nutrition knowledge was independently associated with snacking and sedentary activity. Students with higher nutrition knowledge scores were less likely to have two or more snacks daily and to spend more than 3 h in sedentary activities daily (OR = 0.89, 95 % CI 0.83, 0.97 and OR = 0.92, 95 % CI 0.86, 0.99, respectively; Table 6). Moreover, the multivariate model revealed that also age, gender, educational category and occupational category were independently associated to some nutritional and lifestyle behaviours (Table 6). In brief,

Table 3 Test–retest reliability for the twelve-item section on food frequency consumption and seven-item section on meal habits (n 93)

Questionnaire item	Test–retest reliability (Pearson's correlation coefficient)
Consumption frequency of	
Pasta or rice	0·885
Meat or chicken	0·710
Fish	0·655
Cheese	0·603
Eggs	0·656
Vegetables	0·609
Fruits	0·766
Sweets	0·752
Snacks	0·864
Fried foods	0·684
Sugary drinks	0·873
Water	0·430
Meal habits	
Most frequent foods at breakfast	0·810
Most frequent fast food	0·701
Most frequent snack	0·843
Where eat breakfast	0·850
With whom eat breakfast	0·736
With whom eat lunch	0·767
With whom eat dinner	0·781

Table 4 Distribution of nutrition knowledge scores according to demographic characteristics of the study population: children and young adolescents (n 445) aged 4–16 years living in a rural area of Sicily, South Italy, 2010

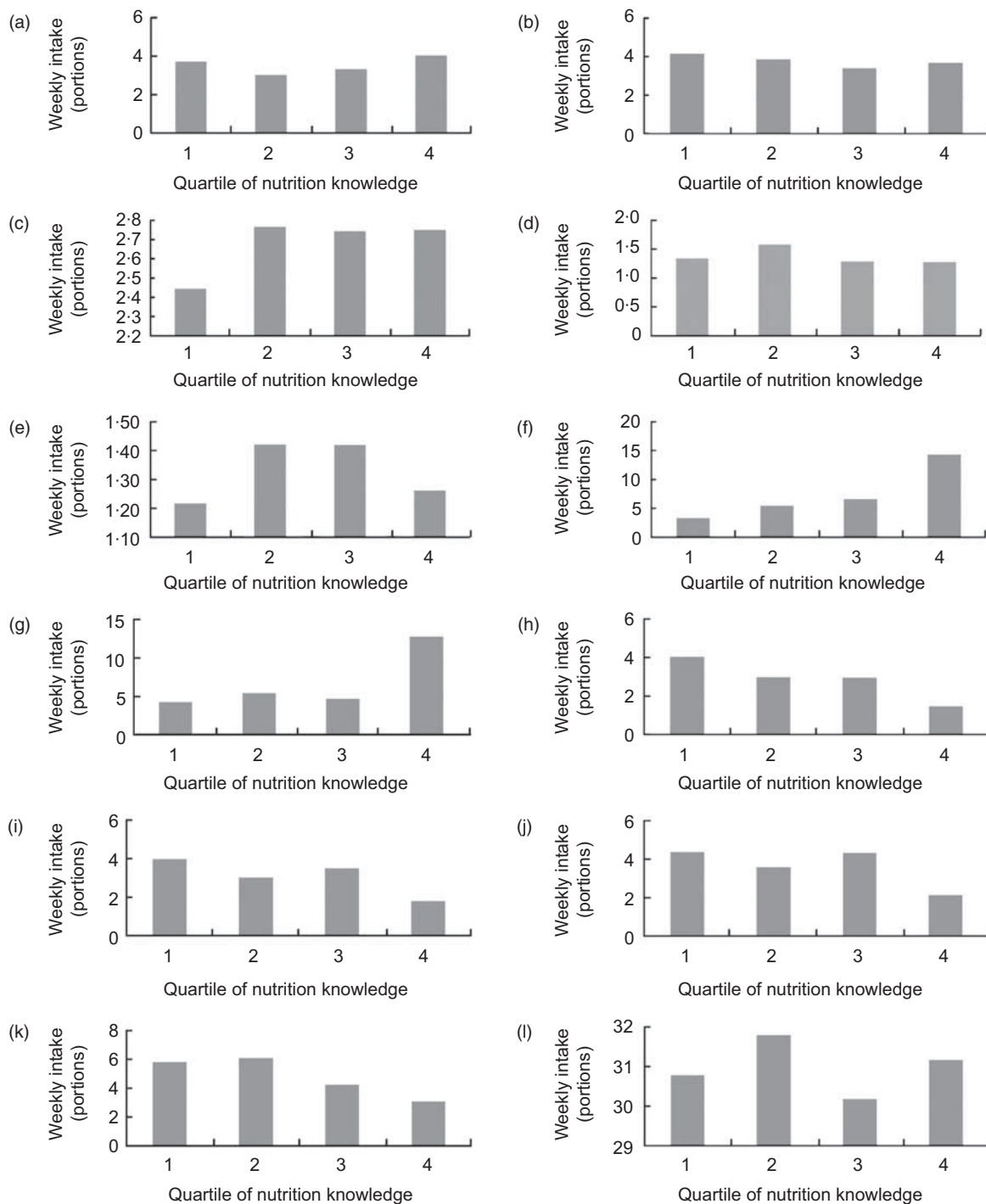|	Nutrition knowledge score		
Variable	Mean	SD	P
Gender			0·819
Male	9·9	2·9	
Female	10·0	3·4	
Age group			<0·001
<6 years	8·5	2·8	
6–10 years	9·8	3·4	
>10 years	10·6	2·9	
BMI classification			0·003
Underweight and normal weight	10·5	3·3	
Overweight	9·4	2·9	
Obese	9·5	3·2	
Parents' education			<0·001
None or primary	8·5	4·9	
Secondary	8·3	2·6	
High school	9·8	3·0	
University	12·3	2·6	
Parents' occupation			<0·001
Unskilled professions	7·7	2·1	
Partially skilled professions	8·9	2·7	
Skilled professions	9·7	3·2	
Specialized/managerial	11·0	3·1	

Fig. 1 Weekly food consumption according to quartile of nutrition knowledge score in children and young adolescents (*n* 445) aged 4–16 years living in a rural area of Sicily, South Italy, 2010. (a) Pasta/rice (*P* = 0·001, *P* for trend = 0·111); (b) meat (*P* = 0·015, *P* for trend = 0·011); (c) fish (*P* = 0·21, *P* for trend = 0·119); (d) cheese (*P* = 0·84, *P* for trend = 0·26); (e) eggs (*P* = 0·226, *P* for trend = 0·697); (f) vegetables (*P* < 0·001, *P* for trend < 0·001); (g) fruit (*P* < 0·001, *P* for trend = 0·001); (h) sweets (*P* < 0·001, *P* for trend < 0·001); (i) snacks (*P* < 0·001, *P* for trend < 0·001); (j) fried foods (*P* < 0·001, *P* for trend < 0·001); (k) sugary drinks (*P* = 0·004, *P* for trend = 0·001); (l) water (*P* = 0·695, *P* for trend = 0·914)

being female, older and having a higher BMI were associated with physical activity, while BMI was also associated inversely with having breakfast daily and directly with frequent snacking. Regarding parents' socio-cultural level, being in the highest education category was associated with less frequent snacking and more frequent weekly physical activity, while being in the highest occupational category was associated with daily breakfast.

Table 5 Linear regression analysis results of weekly food consumption *v.* demographic characteristics and nutrition knowledge: children and young adolescents (*n* 445) aged 4–16 years living in a rural area of Sicily, South Italy, 2010

	Covariates*											
	Gender (female)		Age		BMI		Parents' education		Parents' occupation		Nutrition knowledge	
Food consumption	β	P	β	P	β	P	β	P	β	P	β	P
Pasta/rice	−0·026	0·819	0·042	0·101	−0·036	0·253	**−0·347**	<0·001	−0·019	0·819	**0·047**	0·022
Meat	0·124	0·125	−0·006	0·735	0·002	0·926	**−0·188**	0·007	−0·055	0·360	−0·002	0·879
Fish	−0·114	0·242	0·008	0·706	−0·002	0·946	−0·108	0·200	**0·165**	0·023	**0·630**	<0·001
Cheese	0·079	0·426	0·019	0·413	0·026	0·352	0·018	0·834	0·073	0·327	−0·023	0·203
Eggs	0·037	0·693	−0·026	0·219	0·050	0·056	−0·049	0·543	−0·101	0·146	0·020	0·232
Vegetables	0·189	0·117	**0·097**	<0·001	**−0·066**	0·049	**0·226**	0·029	**0·328**	<0·001	**0·203**	<0·001
Fruit	**0·300**	0·030	**0·066**	0·036	**−0·083**	0·031	**0·253**	0·033	**0·228**	0·027	**0·129**	<0·001
Sweets	−0·061	0·573	0·004	0·855	**0·068**	0·024	−0·074	0·826	0·096	0·234	**−0·168**	<0·001
Snacks	−0·165	0·207	−0·019	0·523	**0·091**	0·013	**−0·304**	0·007	0·030	0·758	**−0·090**	<0·001
Fried foods	−0·205	0·169	−0·008	0·808	**0·088**	0·035	**−0·422**	0·001	0·041	0·715	**−0·066**	0·016
Sugary drinks	−0·103	0·556	−0·038	0·341	**0·158**	0·001	**−0·438**	0·004	0·071	0·583	**−0·080**	0·012

Statistically significant coefficients are indicated in **bold** font.
*All variables included in the model simultaneously.

Given the differences found in student age, we divided the cohort into two subgroups: (i) children (age 4–12 years) and (ii) young adolescents (age 13–16 years). Applying such a division in all the aforementioned analyses revealed mostly identical results to those obtained by considering the cohort as a whole. Where statistically significant differences regarding the associations between nutrition knowledge and several variables were observed, these in most cases were following the pattern of a gradually increasing or decreasing association in both children and adolescents. On the other hand, we failed in demonstrate a significant association between nutrition knowledge and BMI in adolescents (data not shown).

Discussion

In the present study the associations between nutrition knowledge, food intake and some dietary and lifestyle behaviours among children and young adolescents living in a rural area of Sicily were explored, and a positive association was found between nutrition knowledge and healthier nutritional behaviour. Demographic and social factors were also found to be independent determinants of such outcomes. Although multiple factors influence food consumption and nutritional habits in childhood and adolescence, most previous studies assessed only specific aspects (i.e. fruit and vegetable intake or breakfast habits) and only a few have investigated the associations between nutrition knowledge, consumption of several food groups and lifestyle factors simultaneously. According to our knowledge, the present study is the first one investigating such correlates in a representative sample of children and young adolescents living in a rural area of Sicily, South Italy. Also, our study was strengthened by a psychometrically reliable questionnaire on nutritional habits, lifestyle and nutrition knowledge specifically developed for children and young adolescents.

In our study, about half of the students demonstrated acceptable knowledge about energy expenditure activities and food content; they were aware of the importance of some healthy foods but knowledge about nutrient functions and macronutrients was weak. We also found that knowledge level played a relevant role in pasta/rice, fish, fruit, vegetables, sweets, snacks, fried foods and sugary drinks consumption as well as in sedentary activities and frequent snacking. Other investigators, in comparable studies, have found a positive impact of knowledge on food consumption and nutritional behaviour in children and adolescents. A survey performed in Iceland demonstrated that knowledge of fruit and vegetable recommendations had a positive impact on their consumption[3]. In an Austrian study, nutrient intake showed close coherence to the degree of nutrition knowledge[4]. In US students, eating behaviours correlated with nutrition knowledge especially in older students[5,10]. A possible relevant role of knowledge in affecting nutritional behaviour and food choices may depend on student awareness of recommendations and food constituents that might positively be related to food intake. Moreover, increasing lifestyle education, including skills necessary for understanding the importance of physical activity, might increase the frequency of such healthy behaviour. These assumptions are confirmed by several studies that provided intervention programmes aimed at increasing nutrition knowledge in children and adolescents and resulted in an association between increased knowledge and more healthy food consumption or lifestyle habits[11–13].

To describe dietary intake and food habits in young people, it is relevant to associate such eating behaviour with knowledge and to understand them with regard to personal and environmental factors in the context of a modern society[14]. Scientific studies have been conducted mostly on adolescents, rather than on children, even with contrasting results[15]. Our study found that older age was independently associated with a higher

Table 6 Multiple regression analysis results of lifestyle habits v. demographic characteristics and nutrition knowledge: children and young adolescents (n 445) aged 4–16 years living in a rural area of Sicily, South Italy, 2010

Lifestyle habit	Covariates*																	
	Gender (female)			Age			BMI			Parent's education			Occupational category			Nutrition knowledge		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Breakfast daily	1·17	0·77, 1·78	0·465	1·09	0·98, 1·20	0·096	**0·69**	**0·61, 0·80**	<0·001	1·32	0·92, 1·88	0·133	**1·43**	**1·03, 1·98**	0·031	1·06	0·98, 1·15	0·146
≥2 snacks daily	0·78	0·53, 1·17	0·244	0·92	0·84, 1·00	0·078	**1·23**	**1·09, 1·38**	0·001	**0·66**	**0·47, 0·93**	0·017	0·94	0·70, 1·26	0·680	**0·89**	**0·83, 0·97**	0·040
Physical activity ≥3 times weekly	**0·62**	**0·42, 0·93**	0·022	**1·18**	**1·07, 1·29**	0·001	**0·69**	**0·61, 0·79**	<0·001	**1·47**	**1·04, 2·07**	0·029	0·91	0·68, 1·22	0·531	1·04	0·97, 1·12	0·280
Sedentary activity >3h daily	1·31	0·86, 1·98	0·204	0·93	0·84, 1·01	0·114	1·13	1·01, 1·27	0·310	0·85	0·59, 1·22	0·386	0·78	0·58, 1·05	0·107	**0·92**	**0·86, 0·99**	0·041

Statistically significant odds ratios and 95 % confidence intervals are indicated in **bold** font.
*All variables included in the model simultaneously.

consumption of fruit and vegetables as well as having more frequent weekly physical activity. Differences between these age stages could be expected because adolescents experience several changes in social influences[16]. Moreover, being older could be associated with a higher nutrition knowledge level and, consequently, healthier dietary and lifestyle habits.

Among the other demographic characteristics, our study revealed that BMI was associated with unhealthy food consumption (positively with sweets, snacks, fried foods and sugary drinks; negatively with fruit and vegetables) and lifestyle habits (such as skipping breakfast, frequent snacking and infrequent physical activity). Several studies reported similar findings. The proportion of overweight or obese students has usually been found to be lower in those taking breakfast daily[17,18] and higher among those having unhealthy dietary[19] and beverage patterns[20] and with a sedentary-snacking pattern[21].

Children have particular food choices and meal habits, such as irregular eating pattern, frequent snacking and skipping breakfast, that are typically set up in this period of life and will affect nutritional habits in subsequent adolescence. In contrast to such dynamic behavioural choices in children that would be expected to vary depending on their own will, intake of specific foods may depend on their availability in the home, which is a factor strictly associated with family lifestyle characteristics and nutritional habits. In our study, parents' educational level and occupational category, considered as a surrogate of socio-cultural level, were shown to have an influence on the consumption of specific foods. This might suggest that students from families with a lower socio-cultural level face certain barriers to complying with a healthful diet, possibly due to fewer financial resources for the purchase of healthier foods or lack of knowledge regarding nutritional recommendations for healthy eating. Socio-economic status has been examined in a large number of studies in association with children's and adolescents' food intake, indicating that parental occupation and parental education are positively associated with specific food consumption and suggesting that family circumstance factors may be a significantly important influence on dietary intake and on dietary behaviours for children and adolescents[15,22,23]. Food consumption may reflect poor home food availability[24,25] and family environment[22,23], as well as poor parental role modelling[26] and parenting style[27]. Some recent studies conducted in the European setting have assessed the relationship between fruit and vegetable consumption and food-related family lifestyle[28–30]. Finally, a higher nutrition knowledge among parents has been shown to correlate with higher fruit and vegetable consumption in children[23,31]. This supports the assumption that nutrition knowledge mediates some of the socio-economic status variation in food intake, especially for fruit and vegetables[32,33].

Findings in the current paper should be treated in the light of several limitations. First, the study design was cross-sectional. Thus, conclusions cannot be attributed to plausible causes, but rather valuable assumptions that could be used for further investigation. As with any self-reported survey, misreporting bias should be taken into account. More valid data would probably result from a design that uses multiple sources (i.e. students, teachers and parents). Moreover, only crude measures were used to collect dietary data, using a single question for each item with no reference to the portion size or amount consumed. However, given that the topics investigated in the questionnaire are quite complex and the target population for which it was designed is difficult to manage in terms of comprehension of the significance of the items because of young age, any attempt to create a 'perfect' instrument is impossible. Second, as the information on both nutrition knowledge and food consumption comes from self-reports, it is possible that there is a tendency of respondents to answer questions in a manner that will be viewed favourably by others (social acceptability bias). This can bias the interpretation of the tendencies as well as individual differences. Third, although the sample was representative of a typical rural area in Sicily, our sample is composed of children in a single area. Therefore, it does not permit generalization of the results, even though there is no reason to hypothesize differences among areas of a culturally homogeneous island such as Sicily.

Conclusions

The present findings add to other results in the literature in suggesting that nutrition knowledge is an important target for health education and has the potential to improve especially the dietary habits and lifestyle behaviours of children and young adolescents. Age has a central role in this issue, and improving nutrition knowledge in young people may translate into educating them in good dietary habits. In order to promote healthy nutritional behaviours and prevent overweight and obesity, it is important to target this population with interventions concerning their eating habits and lifestyles. Moreover, given the strong role of parental socio-economic and educational status on children's behaviour, nutrition intervention programmes should involve them as well, to improve dietary quality and nutritional habits of the entire family.

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Supplementary Materials

For Supplementary Materials for this article, please visit http://dx.doi.org/10.1017/S1368980012003965.

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