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ORIGINAL PAPER

Dietary behaviors as associated factors for overweight and obesity in a sample of adolescents from Aquitaine, France

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Abstract This study aimed to identify dietary behaviors that might be considered as associated factors for overweight or obesity among French adolescents. Forty-nine of the 536 middle and high schools in Aquitaine (southwest of France) were invited to take part in the study. For each school, participating adolescents were selected using stratification by grade. A self-report questionnaire, including information about sex, age, dietary behaviors, physical and sedentary activities, and parental socioeconomic status (SES), was filled in by adolescents during class. Overweight and obesity were defined according to the age- and sex-specific body mass index cutoff points of the International Obesity Task Force. Multivariate analysis (logistic regression) was used to identify independent dietary factors associated with overweight including obesity and obesity alone (adjustment on sex, age, parental SES, and weight status and adolescents' sedentary activity). In addition to parental SES and weight status and adolescents' sedentary activity, some dietary behaviors are also independently and significantly associated with a higher prevalence of overweight including obesity: absence (OR 1.43, 0.91–2.23) or rare (OR 1.57, 1.23–2.01) breakfast intake ($p<0.01$) and absence (OR 5.03, 3.19–7.92) or rare (OR 1.90, 1.46–2.47) light afternoon meal intake ($p<0.001$). All variables were also significantly and independently associated with obesity alone. This study shows that socioeconomic factors and individual behaviors are associated with overweight or obesity. These results confirm the importance to carry out multifaceted educational actions among adolescents, by promoting physical activity and healthy food choices in order to prevent overweight and promote healthy lifestyle behaviors.

Keywords Children · Overweight · Obesity · Factors · Dietary behaviors

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Introduction

During childhood, nutritional intakes must be adequate to cover the energy needs for growth and changes in body composition, especially during adolescence when a peak of growth and puberty occurs. This increase in energy and nutrient requirements [34]

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coincides with other factors that may affect food choices and nutrient intake of adolescents and thus their nutritional status: progressive acquisition of autonomy, opposition to parents, will to experiment and to be accepted by peers, and preoccupation with self-image [20]. Nutritional deficiencies and poor eating habits established during adolescence can have long-term consequences, including chronic diseases, hyperlipidemia, and obesity [4, 16, 34].

During the last decade, several public health actions have been implemented in France to improve feeding behavior of the population. The "French National Program on Nutrition and Health[1]" was launched by the Ministry of Health in 2001 [12]. In the region of Aquitaine (southwest of France), the Program "Nutrition, prevention and health of children and teenagers in Aquitaine[2]" was started in November 2004 and aims at improving dietary behaviors of children and adolescents by promoting healthy food consumption (particularly fruits and vegetables) and physical activity. Thereby, it has contributed to the stabilization of childhood overweight prevalence in Aquitaine [26]. In the framework of this regional program, a study entitled "Physical activity, lifestyle and dietary behaviors of adolescents in Aquitaine" was lead in 2004/2005 among a sample of adolescents aged 11–18 years. A first analysis, focused on data about physical and sedentary activities, has shown that gender, age, parental overweight, and socioeconomic status (SES) as well as sedentary activity are strong risk factors for adolescent's overweight and obesity [28], which was consistent with previous findings [10, 13, 19, 25, 35]. To complete these results, a new analysis was carried out to assess if dietary behaviors were also factors associated with overweight and obesity among adolescents. This paper describes this second analysis.

Material and methods

Study design and subjects

The study was performed among a sample of adolescents from middle and high schools in Aquitaine region (southwest France) in 2004/2005. The details of the subjects' selection and method used to measure adolescents' weight and height have already been described in the first analysis published in 2010 [28].

Subjects were selected among adolescents attending public middle and high schools. Schools were selected using a sampling procedure in order to be representative of middle and high schools of the Aquitaine region, by taking into account the district, the schools' geographical area, as well as teachers' willingness to participate in the study. Thus, 49 of the 536 middle and high schools in Aquitaine were invited to participate in the study. For each school, adolescents were selected using stratification by grade, to constitute a panel of middle and high school class students (the distribution of adolescents in the sample within each district was consistent with the distribution of students in middle and high schools in Aquitaine). The prevalence of overweight and obesity was studied according to sex, age, physical activity, and sedentary behavior.

A 99-item self-report questionnaire was completed by adolescents during class, under the supervision of physical education teachers. It included information about sex, age, dietary behaviors, physical and sedentary activities, and parental SES.

Before the beginning of the investigation, an approval from the local education authority of Aquitaine was obtained. Prior consent for participation was obtained from adolescents and their parents. Then, questionnaires were transmitted without the adolescents identity, thus no ethics committee approval was required as the data analyzed were anonymous.

Definitions

Weight status

Weight and height were measured and recorded for each adolescent by school nurses, using the same tools and a standardized method. Body mass index (BMI) was calculated as weight/height² (in kilograms per square meter). The international age- and gender-specific child cutoff points of the International Obesity Task Force (IOTF) [7] were used to define overweight and obesity. At the age of 18, the IOTF values for "overweight" and "obese" correspond to a BMI of 25 and 30 kg/m², respectively.

[1] www.mangerbouger.fr or http://www.sante.gouv.fr/nutrition-programme-national-nutrition-sante-pnns.6198.html
[2] www.nutritionenfantaquitaine.fr

Parental socioeconomic status (Parental SES)

The SES of father and mother were assessed according to their professional occupation. Three work categories were defined: "high" (managers, executives, and independent professionals); "medium" (craftsmen, tradesmen, shopkeepers, proprietary business owners, office workers, employees, farmers, and landholders); and "low" (manual workers, retired, unemployed, etc.). The SES of the household was assessed by combining both parents' status: high if at least one parent had a high status; medium if at least one had a medium status and none had a high status; and low if both parents had a low status.

Dietary behaviors

Data collected on dietary behaviors tended to focus on the rhythms of meals and not on their composition. Indeed, collected information concerned breakfast intake (everyday/not everyday/never), light afternoon meal intake (always/sometimes or often/never), and nibbling (never/sometimes/often or always).

Sedentary behavior

Sedentary activity was estimated by weekly time of screen viewing. The adolescents were asked to report separately how many hours they spent watching television, using a computer, and playing video games on a usual school day and a usual weekend day. Usual weekly time of screen viewing was calculated and summed to create a total cumulative weekly time spent on screen viewing that we called "sedentary behavior." Then, sedentary activity level was divided into two classes using the median of the sample: "<22 h/week" and "≥22 h/week."

Weight status of parents

This item was filled in by adolescents themselves and was formulated as follows: "Does your father have an overweight problem?" (yes/no) and "Does your mother have an overweight problem?" (yes/no).

Statistical analysis

Data were analyzed using the Statistical Analysis Systems (SAS) software package version 9.1 (SAS Institute Inc., Cary, NC, USA). Univariate analysis examined the association of variables concerning adolescents or parents with overweight (obesity included) and obesity alone as dependent variables, using χ^2 tests to determine statistical significance. A p value <0.05 was considered statistically significant. Variables found to be significant at the univariate stage at p value <0.25 were then included into a multivariate analysis (logistic regression) using the same dependent variables.

Results

Out of the 49 middle and high schools invited to take part in the study, 6 declined to participate (response rate 88 %). Questionnaires were filled in by 2,533 students. In order to have homogeneous age groups, 148 (5.8 %) adolescents aged less than 11 or more than 18 years old were excluded: 2,385 adolescents aged 11–18 years (1,213 boys and 1,172 girls) were included. Characteristics of adolescents, parental SES and weight status, and adolescents' sedentary activity and dietary behaviors are described in Table 1. According to the IOTF references, 325 adolescents (13.6 %) were overweight including obesity: 280 (11.7 %) were overweight and 45 (1.9 %) were obese.

Factors associated with overweight (including obesity)

Univariate analysis

All variables included in the univariate analysis were significantly associated ($p<0.05$) with higher risk of overweight (including obesity): male gender, low or medium parental SES, absence (never) or rare (not everyday) breakfast intake, absence (never) or rare (sometimes/often) light afternoon meal intake, a high level of sedentary activity (≥22 h/week), younger age (11–14 years), and having at least one overweight parent (Table 2). Frequent (often/always) nibbling was associated with a slight decrease of overweight prevalence.

Multivariate analysis

All variables included in the univariate analysis were included in the multivariate complete model (Table 3). After performing the logistic regression among adolescents who had no missing data for all these variables (N=2,211), the association between overweight

Table 1 Characteristics of a sample of adolescents (N=2,385) from middle and high schools in the Aquitaine region, France

Variables		
	N	%
Gender	2,385	
Girls	1,172	49.1
Boys	1,213	50.9
Age	2,385	
11–14 years old	1,292	54.2
14–18 years old	1,093	45.8
Adolescents' weight status	2,385	
Normal weight	2,060	86.4
Overweight	280	11.7
Obesity	45	1.9
Breakfast intake	2,350	
Everyday	1,175	50
Not everyday	996	42.4
Never	179	7.6
Light afternoon meal intake	2,385	
Never	109	4.6
Sometimes/often	1,268	53.2
Always	1,008	42.3
Nibbling	2,366	
Never	523	22.1
Sometimes	1,148	48.5
Often/always	695	29.4
Sedentary activity	2,385	
<22 h/week	1,182	49.6
≥22 h/week	1,203	50.4
Parents' socioeconomic status	2,157	
High	548	25.4
Medium	1,037	48.1
Low	572	26.5
Weight status of parents	2,352	
Neither parent overweight	1,842	78.3
≥1 parent overweight	510	21.7

(including obesity) and all variables remains significant, except for the nibbling.

Factors associated with obesity

Univariate analysis

Variables significantly associated with a higher prevalence of obesity were: absence (never) or rare (not everyday) breakfast intake, absence (never) or rare (sometimes/often) light afternoon meal intake, high level of sedentary activity (≥22 h/week), and having at least one overweight parent (Table 2).

Multivariate analysis

In addition to variables significantly associated with overweight in the univariate analysis (p<0.05), variables with a p value <0.25 were included in the multivariate complete model: gender and the SES of the household (Table 3). After performing the logistic regression among adolescents who had no missing data for all these variables (N=2,221), a higher prevalence of obesity was still associated with absence (never) or rare (not everyday) breakfast intake, absence (never) or rare (sometimes/often) light afternoon meal intake, high level of sedentary activity (≥22 h/week), and having at least one overweight parent.

Discussion

This study shows that parental SES and weight status and adolescents' sedentary activity are variables associated with overweight and obesity, confirming the results previously reported by Thibault et al. [28]. In addition, we found that some dietary behaviors, i.e. absence or rare breakfast and light afternoon meal intake, are also independently and significantly associated with a higher prevalence of overweight or obesity. These results highlight the importance of the breakfast and also the light afternoon meal to provide adequate and balanced nutritional amounts during adolescence.

Adolescents having breakfast everyday have a lower risk to be overweight or obese than those who have breakfast not everyday or even never. It is now recognized that regular breakfast consumption may have potential impact on the composition of the overall diet and contribute to reduce the risk of overweight and obesity, but also of other chronic diseases [1, 11, 21, 22, 29, 31].

An original finding of this study is the influence of light afternoon meal on corpulence. We found that adolescents who never or sometimes have a light afternoon meal have a significantly higher risk of becoming overweight or obese. The protective effect of this meal has already been described [2], but, to our knowledge, no other study previously showed an

Table 2 Prevalence and factors associated with overweight (including obesity) and obesity in a sample of adolescents (N=2,385) in Aquitaine (France)—univariate logistic regression analysis

	Overweight (obesity included)				Obesity			
	N	%	OR (95 % CI)	*p* value	N	%	OR (95 % CI)	*p* value
Gender				<0.01				0.07
Girls	134	11.4	1.00		16	1.4	1.00	
Boys	191	15.8	1.45 (1.14–1.83)		29	2.4	1.77 (0.96-3.28)	
Age				<0.001				0.28
11–14 years old	205	15.9	1.000		28	2.2	1.00	
15–18 years old	120	11.0	65 (0.51–0.83)		17	1.6	0.71 (0.39–1.31)	
Breakfast intake				<0.01				0.02
Every day	130	11.1	1.00		13	1.1	1.00	
Not everyday	163	16.4	1.57 (1.23–2.01)		28	2.8	2.58 (1.33–5.02)	
Never	27	15.1	1.43 (0.91–2.23)		4	2.2	2.04 (0.66–6.34)	
Light afternoon meal intake				<0.001				<0.01
Always	36	33.0	1.00		11	1.1	1.00	
Sometimes/Often	199	15.7	1.90 (1.46–2.47)		28	2.2	2.05 (1.014–4.13)	
Never	90	8.9	5.03 (3.19–7.92)		6	5.5	5.28 (1.91–14.57)	
Nibbling				0.02				0.27
Never	82	15.7	1.00		9	1.7	1.00	
Occasionally	168	14.6	0.92 (0.69–1.23)		27	1.1	1.38 (0.64–2.95)	
Often/always	75	10.8	0.65 (0.46–0.91)		9	1.3	0.75 (0.29–1.90)	
Sedentary activity				<0.01				<0.01
<22 h/week	135	11.4	1.00		11	0.6	1.00	
≥22 h/week	190	15.8	1.45 (1.15–1.84)		34	6.6	3.10 (1.56–6.14)	
Parents' socioeconomic status				<0.001				0.19
High	82	15.0	1.00		10	1.8	1.00	
Medium	173	16.7	1.68 (1.27–2.22)		26	2.5	1.96 (0.94–4.08)	
Low	51	8.9	1.66 (1.14–2.41)		7	1.2	1.77 (0.67–4.68)	
Weight status of parents				<0.001				<0.01
Neither parent overweight	222	12.0	1.00		28	1.5	1.00	
≥1 parent overweight	101	19.8	1.80 (1.39–2.34)		17	3.3	2.23 (1.21–4.12)	

independent association between afternoon meal and obesity.

According to school timetables in France, the experts of the French National Program on Nutrition and Health recommend that children and adolescents should have a light afternoon meal. Indeed, in France, school usually starts at 8 a.m. and ends at 5 p.m., with a lunch break between noon and 1 p.m. Therefore, a light meal intake after school (around 5 p.m.) reduces time between lunch and dinner and thus allows a better distribution of caloric intake and limits nibbling before dinner [2, 18]. The protective effect of the light afternoon meal could be linked to the growing evidence relating that a high meal frequency is inversely associated with childhood obesity [1, 30].

The light afternoon meal should provide 10 % of total daily energy intake. It is recommended to consume fruits (low glycemic index), dairy products or complex carbohydrates (bread), and to limit the consumption of sweet or fat food [17]. For children and adolescents, the light afternoon meal should be considered as a fourth meal (with breakfast, lunch, and dinner) and should not be confused with snacking or nibbling, which are unstructured and non-recommended intake.

The association between the absence or a rare light afternoon meal intake and a higher risk of overweight or obesity found in our study confirms the relevance of French recommendations, spread by the French National Program on Nutrition and Health [12] and the

Table 3 Factors associated with overweight (obesity included) and obesity in a sample of adolescents in Aquitaine (France)—multivariate logistic regression analysis

	Overweight (obesity included)		Obesity	
	OR (95 % CI)	*p* value	OR (95 % CI)	*p* value
Gender				
Girls	1.00	0.001	1.00	0.07
Boys	1.54 (1.19–2.00)		1.80 (0.95–3.43)	
Age		<0.001	Not in final model	
11–14 years old	1.00			
15–18 years old	0.52 (0.40–0.68)			
Breakfast intake				0.04
Every day	1.00	0.03	1.00	
Not everyday	1.43 (1.09–1.88)		2.30 (1.14–4.65)	
Never	1.07 (0.64–1.77)		1.06 (0.29–3.93)	
Light afternoon meal intake				
Always	1.00	<0.001	1.00	<0.01
Sometimes/often	1.82 (1.37–2.42)		1.81 (0.88–3.72)	
Never	6.38 (3.84–10.62)		5.20 (1.81–14.90)	
Nibbling				
Never	1.00	0.08	Not in final model	
Occasionally	0.89 (0.65–1.21)			
Often/always	0.66 (0.45–0.96)			
Sedentary activity				0.01
<22 h/week	1.00	0.03	1.00	
≥22 h/week	1.33 (1.02–1.72)		2.52 (1.25–5.10)	
Parents' socioeconomic status				0.35
High	1.00	<0.001	1.00	
Medium	1.74 (1.30–2.34)		1.74 (0.82–3.66)	
Low	1.61 (1.09–2.40)		1.47 (0.54–3.94)	
Weight status of parents				0.03
Neither parent overweight	1.00	<0.001	1.00	
≥1 parent overweight	1.91 (1.45–2.53)		2.04 (1.08–3.87)	

Program Nutrition, Prevention and health of children and teenagers in Aquitaine [27].

The unexpected association between the absence of nibbling and overweight in the univariate analysis does not persist after adjusting data on adolescent's characteristics and their dietary behaviors (multivariate analysis). It may also be surprising to find no association between nibbling and the risk of being overweight or obese. This could be the consequence of previous interventions aiming at limiting snacking and suppressing or improving the composition of food supply at school. Overweight or obese adolescents are now aware of nutritional recommendations and of the negative effects of nibbling between the four recommended meals. This may have changed the way to answer the questionnaire and decreased the recognition of nibbling by overweight adolescents.

A limitation of this study is that our results do not allow us to conclude about causality between some factors and overweight or obesity prevalence. However, it seems reasonable to think that some environmental factors such as parental SES are risk factors of overweight and obesity and not consequences. Moreover, because of the absence of data about meal composition, results could not be adjusted for total energy intake, and thus, the apparently protective effect of breakfast and light afternoon meal should be interpreted with caution.

Several studies have shown that French adolescents have a low fruit and vegetable consumption, an

unbalanced distribution of energy intake (too much fat and protein, not enough complex carbohydrates), and an excessive consumption of sweet products [3, 6]. Indeed, adolescence is a transition period between childhood and adulthood and is a risk period concerning dietary habits: meals or intake rhythms may become irregular, with low quality composition, and eating disorders (anorexia nervosa, bulimia, etc.) may appear [32]. These behaviors may induce adverse nutritional conditions. Although nutritional problems at adolescence do not appear to be more severe than at other ages, they may have a strong deleterious impact on future health [15, 23].

Our findings highlight the importance of implementing educational program, such as the French National Program on Nutrition and Health and the Aquitaine program. Indeed, it seems necessary to carry out multifaceted educational actions among adolescents, by promoting physical activity and healthy food choices (such as breakfast intake, fruit and vegetable consumption, and limiting consumption of sweet and fatty food) in order to prevent overweight and promote healthy lifestyle behaviors [8, 9, 33]. These educational actions might be implemented in early childhood in order to reduce the emergence of unhealthy eating behaviors. These could be effective measures to stop or even reverse the present increase of overweight prevalence [15, 24]. At the same time, prevention of overweight should pay attention to the nutrition integrity of schools and school nutrition policies [14].

Indeed, the coherence of food supply in schools with the recommendations is a necessary first step to improve eating habits of adolescents and then their nutritional status. It should particularly help to reduce the prevalence of obesity in adolescents [5].

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Conflict of interest There are no conflicts of interest.

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