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**OBESITY ASSOCIATED BEHAVIOR IN ADOLESCENTS
OF PRIVATE SCHOOLS IN LEBANON**

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Pascale SALAMEH¹, Bernadette BARBOUR¹, Carine ISSA¹, Samar RACHIDI²

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ABSTRACT • OBJECTIVE : Since adolescence obesity is becoming an international concern, our objective was to evaluate obesity-related behavior in Lebanese adolescents.

METHODS : We performed a cross-sectional study in 19 Lebanese private schools, using a random multi-stage cluster sampling process. Dietary and physical activity behaviors were assessed in 1933 adolescents aged 12 to 18 years, stressing on differences between boys and girls and obesity categories.

RESULTS : We found that boys were more obese than girls (7.2% versus 3.7% ; $p < 0.001$) ; they were less likely to adopt dietary behaviors that maintain or increase weight, such as eating lighter food (13.1% versus 20.9% ; $p < 0.001$). However, girls were less likely to perform physical activity (81% versus 71% ; $p < 0.001$). Our results are similar to those of other researchers.

CONCLUSION : In this sample of Lebanese adolescents, dietary and physical activity behaviors differed between boys and girls ; these differences could explain their obesity rates. Educational and participative scholar interventions are necessary to induce changes in adolescents' behavior, stressing on physical activity for girls and healthier eating for boys.

INTRODUCTION

Obesity has become one of the most common chronic disorders of adolescents in industrialized [1-4] and developing countries [5-6]. However, adolescent obesity substantially increases the risk of subsequent morbidity, whether or not obesity persists into adulthood [7]. Health outcomes in adulthood linked to obesity include increased risk of cardiovascular disease, diabetes and hypertension [8-9].

Among reasons for obesity in adolescence are unhealthy dietary habits, such as increased snacking, away from home food consumption and a dramatic shift toward

RÉSUMÉ : OBJECTIF : Notre objectif principal a été l'évaluation des comportements associés à l'obésité chez l'adolescent libanais, vu que l'obésité chez l'adolescent devient un problème international.

MÉTHODES : Nous avons mené une étude transversale dans 19 écoles libanaises, utilisant une procédure d'échantillonnage aléatoire en grappe à plusieurs étapes. Les comportements alimentaires et l'activité physique de 1933 adolescents âgés de 12 à 18 ans ont été évalués, en mettant en valeur les différences entre garçons et filles d'une part et catégories d'obésité d'autre part.

RÉSULTATS : Nous avons trouvé que les garçons étaient plus obèses que les filles (7,2% versus 3,7% ; $p < 0,001$), alors que les filles étaient moins actives (81% versus 71% ; $p < 0,001$) ; les garçons avaient aussi moins tendance à adopter des comportements alimentaires qui maintiennent ou diminuent le poids, tels que la consommation d'aliments allégés (13,1% versus 20,9% ; $p < 0,001$). Nos résultats sont similaires à ceux d'autres études.

CONCLUSION : Les comportements alimentaires et le niveau d'activité physique de ces adolescents libanais diffèrent entre garçons et filles et peuvent expliquer leur taux d'obésité. Des interventions éducationnelles et participatives au niveau scolaire sont nécessaires pour améliorer les habitudes de vie des adolescents, en favorisant l'activité physique chez les filles et une alimentation plus saine chez les garçons.

more fast food and sweetened beverages, high in empty calories, such as soft drinks; meanwhile, in some countries, the average number of servings per day remains far below the recommended level for fruit and vegetables. In several other countries, there is a rapid global shift toward increased availability of fast food and processed food, as well as changes in food distribution and marketing; all this is accelerating the nutrition transition [10]; examples include Jordan [11], Morocco [12], and the Arab Gulf countries [13]. Moreover, some research findings state that obese adolescents are less physically active than are normal-weight adolescents, on the basis of both total physical activity and the time spent at performing physical activities of moderate or higher intensities [14]. During adolescence, physical activity declines rapidly: the decline is steepest between the ages of 13 and 18, and is generally

Lebanese University, ¹Faculty of Public Health, Section II, Fanar, ²Faculty of Pharmacy, Hadath Campus, Beirut, Lebanon.

Correspondence: Pascale Salameh, Pharm D, MPH, PhD. Jdeidet El Meten. Chalet Suisse St. Ramza Azzam Bldg. Beirut, Lebanon.

e-mail: psalameh@ul.edu.lb
pascalesalameh1@hotmail.com

greater for male than female subjects [15-16], although the resulting physical activity for young boys will still be higher than young girls [17-18]. Despite efforts to promote more physical activity and healthy eating, and the increased availability of low-fat food, the prevalence of obesity continues to rise in many countries of the world. This may be due to the use of blanket approaches that do not meet the needs of high-risk populations. Thus, it is essential to identify modifiable risk factors that can guide the design and implementation of obesity prevention programs for different groups, particularly those related to nutrition and physical activity [19].

Lebanon is a country where a late nutrition transition is taking place [20-21]. In a previous work performed on adolescents from Lebanese private schools, we have shown that obesity prevalence was 2.5 times higher in boys (10.1%) than in girls (4.2%). There were 1.5 times more overweight boys at risk of obesity (28.8%) than girls (19.0%) ($p < 0.001$) [22-23]. Other authors similarly showed high levels of obesity risk and obesity in adolescents [24-25]; rapid appraisal of dietary behavior showed that Lebanese boys were at a higher risk of eating fast food and drinking carbonated beverages than girls [25], while low levels of physical activity were found in obese adolescents [26]. Although adolescents' behaviors may be similar in countries undergoing nutritional transition, we were searching for specificities in Lebanese adolescents, mainly because of the traditional Mediterranean diet pattern, rich in unrefined cereals, olive oil, legumes, and various vegetables, that might still influence the Lebanese population's nutritional habits [20-21, 27]. The Mediterranean diet was shown to have a negative association with obesity [28], and reduce the risk of cardiovascular diseases and cancer [29].

We thus carried out a study aiming at evaluating dietary and physical activity behavior of Lebanese adolescents in private schools, by comparing boys and girls and individuals from different obesity categories; this information would be necessary to tailor adequate preventive measures to these groups.

METHODS

Study design

A cross sectional study was conducted with a sample of adolescents in Lebanese private schools, aged between 12 and 18 years [30], between May and July 2009. We chose this age category because children older than 12 years are generally able to adequately respond to questionnaires and Lebanese schools usually include adolescents up to 18 years of age. We chose private schools to continue the work we had previously started on private schools students [22-23].

A multistage cluster sample was selected: first, a convenience sample of 20 private schools was chosen from the five Lebanese districts: 2 in Beirut, 9 in Mount Lebanon, 3 in North Lebanon, 3 in South Lebanon, and 3 in the Bekaa. In every school, an internal review board was

requested to agree on participation of the school students to the study. Only one school in Beirut refused to participate, while all others agreed to enrol. Afterwards, we randomly chose one class for every age group. We thus distributed a total of 2503 questionnaires; out of them, we could recuperate 1933 adequately filled questionnaires (77.23%). Other questionnaires (22.77%) were not adequately filled (illogical answers and/or incomplete questionnaires).

Data collection

Three field workers were trained to collect data about students in the targeted age group from the schools' health registries, in collaboration with the director and/or the school health professional. Since it was an observational study and data collection was anonymous, an oral consent from the adolescents was deemed sufficient. After oral and written explanations about the study general objectives, the selected adolescents were approached in their classrooms. Students were thus asked to complete the questionnaire on the spot. Participation was advised by the school administration and none of the students refused to participate, even though participation was not mandatory.

The dependent variable was obesity status assessed by the body mass index (BMI). BMI was calculated as weight in kg over height in meters squared.

Height and weight were self-reported, but they were also measured in a randomly selected subsample of 225 adolescents, using a calibrated balance (Soehle trademark, sensitivity 500 g) and a stadiometer for height measurement (Stanley trademark, MABO microtorse, serial number 04-118); shoes were systematically removed, and measurements were made with light indoor clothing only. These subsample anthropometric measurements were useful for validating self-reported height and weight in the rest of the sample. Body mass index was used to evaluate obesity.

The questionnaire enquired about independent variables: baseline characteristics (age, gender, dwelling region, height and weight), personal and family characteristics (obesity history), and weight satisfaction. Questions were also asked about frequency of consumption for selected food groups, eating and dieting habits, in addition to questions regarding physical behavior (recent and during childhood – see details below), attitude towards obesity and obesity-related distress.

Physical behavior

We used a standard questionnaire to measure leisure time physical activity on the basis of metabolic equivalents (MET) for reported activities and their frequency in MET-times per week; a higher score indicated greater activity [31-33]. Information was obtained about habitual leisure time physical activity, other than those performed in physical-education classes during school time. Questions included frequency of sports or recreational activities [such as bicycling (MET = 8), basketball (MET = 8), and walking for exercise (MET = 4)] and lessons [such as

swimming (MET = 6), dance (MET = 6.5), and stretching (MET = 2.5)]. That is, leisure time activities that required energy expenditure above that required for activities of daily living were considered. The physical activity score was computed by multiplying an estimate of the metabolic equivalents (MET) for each recorded activity by the weekly frequency with which it was performed and an overall average weekly score was calculated as MET*times per week [34].

Physical activity level was then standardized:

$$\text{Standard MET*times/week} = \frac{(\text{MET*times/week} - \text{Sample mean})}{\text{Standard Deviation}}$$

Afterwards, for descriptive purposes, we classified the physical activity standard variable into four categories:

- no physical activity (standard MET*hours/week < -1)
- low (standard MET*hours/week = -1 to -0.99)
- moderate (standard MET*hours/week = 0 to 0.99) and
- vigorous (standard MET*hours/week = 1 or more).

Frequency of selected food groups

The questionnaire comprised questions about the frequency of consumption of eight selected food groups; portion sizes were not evaluated. Foods were selected to be put in the Food Frequency Questionnaire if they were reported to be commonly consumed by the Lebanese population: at least once weekly for items and at least once monthly for dishes, for the majority of the Lebanese population [27-28].

For the first two groups, dishes were selected if, according to the classification of the SAIN (score of nutritional adequacy of individual foods) and LIM (score of nutrients to be limited) nutrient profiling system [35], they were considered as “unhealthy”, i.e. had a low SAIN and high LIM or “healthy”, i.e. had a high SAIN and low LIM. This classification has already been applied on different Lebanese dishes [36]. The selected dishes were thus classified into two classes:

1. LEBANESE TRADITIONAL DISHES (“healthy”) such as *Lebanese tabbouleh* (bulgur, parsley and tomatoes mixed with lemon and olive oil sauce), *yakhnet* types (legumes stew), *mjaddra* (lentils purée), *loubieh bzeit* (green beans in oil), *laban immo* (cooked yogurt with meat), *fattouch* (fresh vegetables mixed with toasted bread), *mehchi* and *kaleb khodra* (rice and meat with vegetables), *hummus bithineh* (chickpea dip), and *baba ghannouj* (eggplant dip).
2. FAST FOOD DISHES (“unhealthy”) such as *man’ouche bzaatar* (Lebanese thyme pizza), *man’oucheh bjebneh* (Lebanese cheese pizza), *shawarma* (roasted marinated meat), hot dog sandwiches, hamburger, cheeseburger, Italian pizza, pastas and spaghetti’s types, and French fries.

We also added six other classes of food that were deemed to play an important role in adolescents’ obesity [37-39]:

3. DAIRY PRODUCTS, such as milk, cheese, yogurt, *labneh* (white cheese). These food items are fre-

quently consumed with bread in Lebanon for breakfast or dinner (general observation).

4. SNACKING FOOD: we further divided them into sweet (sweets and candies, chocolate, ice cream, biscuits) and salted (kernels, potato chips and pop corn) food groups.
5. LIQUIDS: we further divided them into fruit juice (could be natural or artificial) and carbonated beverages or soft drinks (Cola, Pepsi, Crush, etc.).
6. VEGETABLES and FRUITS: they were all grouped into one class; they encompassed the most commonly raw consumed fruits (apples, oranges, pears, bananas, grapes, etc.) and vegetables (tomatoes, cucumber, lettuce, etc.) by the Lebanese population, aside from composite dishes.

Eating habits

Questions were asked about regular eating habits: meals duration and timing, meal frequency, snacking, plate emptying, and eating during psychological distress. Questions were also asked about dieting: frequency of being on a diet, calories counting, eating “light” food, taking medications to lose weight and being urged by media or family to lose weight.

Statistical analysis

Data entry and analysis were performed on SPSS statistical software, version 13.0. Self-reported height and weight in boys and girls were validated by measured height and weight in the subsample of adolescents (n = 225), and regression equations were written to estimate measured height and weight from self-reported height and weight; the predicted values were then used as corrected height and weight.

BMI (kg/m²) was then used to evaluate obesity (normal weight, at risk of obesity and obese), since this is a practical, useful and preferred index to assess body fat [40-41]. Cut-off values taken from the International Obesity Taskforce for BMI of children aged 2 to 18 years were used to define obesity and at risk of obesity (overweight but not yet obese) categories, corresponding respectively to the widely used cut-off points of 30 and 25 kg/m² for adult obesity and overweight [42]. In this study, overweight individuals encompass both obese and at risk of obesity categories, i.e. individuals with BMI higher than normal according to age; this variable was used in case of a need of a dichotomous variable (overweight versus normal weight).

In all statistical analyses, *p*-values lower than 0.05 were considered significant. Simple regression equations were generated to validate the self-reported height and weight values by measured ones from the validation sample; correlation coefficients along with their associated *t*-test were performed in that case. This allowed us to correct self-reported measures in the rest of the study results. Regression equations obtained from the subsample of 225 adolescents with measured height and weight were the following:

- In boys:
 Measured height = 0.982 self-reported height + 2.928
 ($r = 0.995$; $p < 0.001$).
 Measured weight = 1.004 self-reported weight + 0.584
 ($r = 0.995$; $p < 0.001$).
- In girls:
 Measured height = 0.954 self-reported height + 7.350
 ($r = 0.987$; $p < 0.001$).
 Measured weight = 0.960 self-reported weight + 2.752
 ($r = 0.985$; $p < 0.001$).

Chi-squared tests were used to compare percentages of nominal variables between groups of comparison (namely sex and BMI status categories), while Somers' d test was performed for ordinal variables, such as food consumption and physical activity frequencies and BMI status. For quantitative variables, Student test was used to compare means between boys and girls, while the ANOVA was used to compare between BMI categories. Non parametric tests were used to compare discrete or non normal variables distribution across categories: Wilcoxon rank-sum or Mann Whitney test to compare between boys and girls, and Kruskal-Wallis to compare between BMI categories.

On the other hand, a stepwise descendant multivariate logistic regression was carried out, with overweight as a dependent variable. Independent variables were all other variables evaluated in this study that gave a p -value < 0.20 in bivariate analysis. Factors taken into account were fast food frequency consumption, Lebanese dishes consumption, fruit juice consumption, soft drinks (i.e. carbonated beverages) consumption, eating rapidly, seeking for eating light food, emptying own dish, eating when psychologi-

cally distressed, ever being on a diet, ever taking drugs to lose weight, urged by media to lose weight, urged by family to lose weight, physical activity, weight satisfaction, age, family obesity, childhood obesity, chronic disease known to cause obesity and sex.

RESULTS

Baseline characteristics

Significant differences were found in baseline characteristics (Table I): A higher percentage of boys was obtained in Beirut and the South and a lower percentage in the Bekaa ($p < 0.001$). Boys were equally divided in age groups, while girls were more clustered in the 15-16 years group ($p < 0.001$). More boys than girls reported to be obese during childhood. However, no differences were found for diseases that favor the onset of obesity and the number of obese persons in the family.

Significant differences were found between boys and girls mean BMI ($p < 0.001$). Concerning their BMI status, a total of 35.1% of the boys and 19.4% of the girls were at risk of obesity, and 7.2% of the boys and 3.7% of the girls were obese ($p < 0.001$); despite this, girls were less satisfied with their weight than boys. There were also significantly higher percentages of obesity and at risk of obesity in the lower age group ($p = 0.05$); however, these values varied between boys and girls and among age categories: there were no differences in obesity status between age categories in boys ($p = 0.769$), while obesity and risk of obesity increased with age category in girls ($p = 0.002$). (Figure 1)

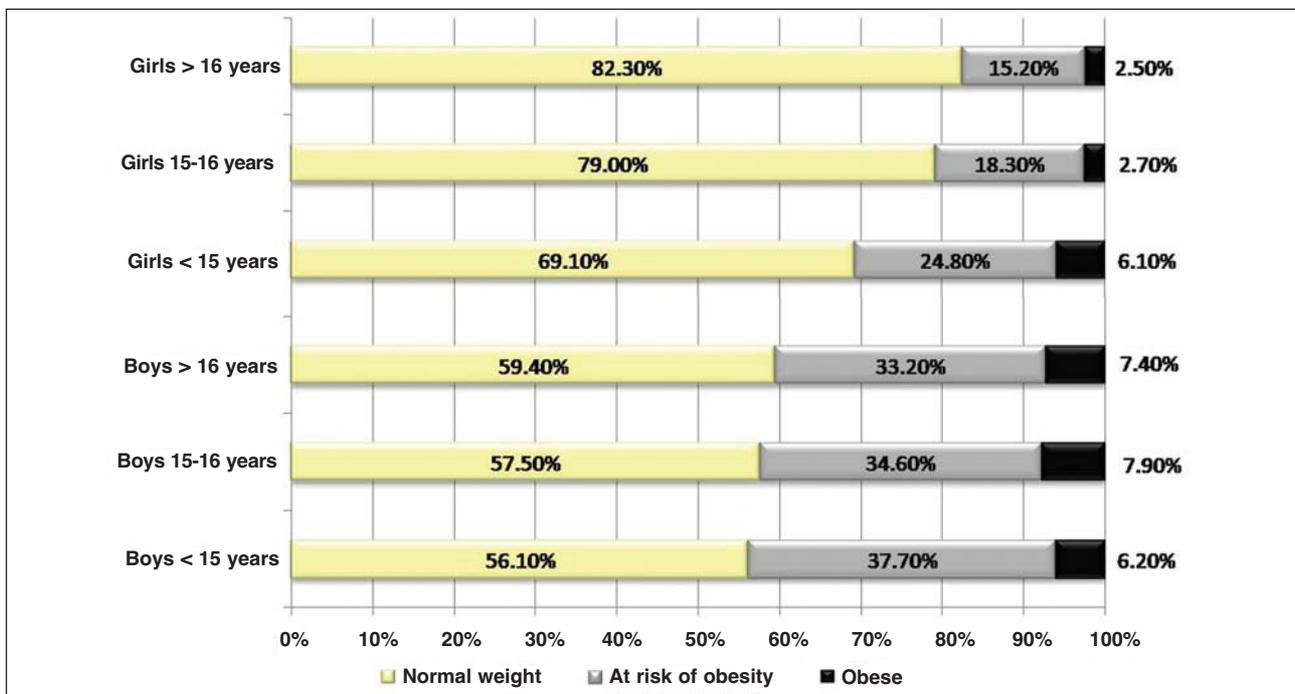


FIGURE 1. Obesity status distribution between boys and girls by age classes.

P -value for differences between boys' age categories = 0.769. P -value for differences between girls' age categories = 0.002.

TABLE I
BASELINE CHARACTERISTICS OF LEBANESE ADOLESCENTS

CHARACTERISTICS	Males	Females	<i>p-value*</i>	Normal weight	Obesity		<i>p-value*</i>
	N = 965 (100%)	N = 968 (100%)			At risk N = 518	Obese N = 103	
REGION							
Bekaa	98 (10.2%)	175 (18.1%)	< 0.001	178 (66.9%)	79 (29.7%)	9 (3.4%)	0.15**
Mount Lebanon	406 (42.1%)	398 (41.1%)		527 (66.8%)	223 (28.3%)	39 (3.4%)	
North Lebanon	190 (19.7%)	172 (17.8%)		253 (70.1%)	90 (24.9%)	18 (5.0%)	
South Lebanon	127 (13.2%)	113 (11.7%)		159 (66.8%)	65 (27.3%)	14 (5.9%)	
Beirut	144 (14.9%)	110 (11.4%)		166 (66.4%)	61 (24.4%)	23 (9.2%)	
AGE CLASSES							
< 15 years	289 (30.0%)	278 (28.7%)	< 0.001	354 (62.4%)	178 (31.4%)	35 (6.2%)	0.05**
15-16 years	318 (33.0%)	442 (45.7%)		532 (70.0%)	191 (25.1%)	37 (4.9%)	
> 16 years	357 (37.0%)	247 (25.5%)		397 (68.8%)	149 (25.8%)	31 (5.4%)	
OBESSE PERSONS IN THE FAMILY							
None	599 (62.1%)	567 (58.6%)	0.21	838 (65.3%)	273 (52.7%)	35 (34.0%)	< 0.001
1-2 persons	291 (30.2%)	309 (31.9%)		359 (28.0%)	193 (37.3%)	42 (40.8%)	
> 2 persons	75 (7.8%)	92 (9.5%)		86 (6.7%)	52 (10.0%)	26 (25.2%)	
HAS A DISEASE FAVORING OBESITY							
	28 (2.9%)	28 (2.9%)	0.99	16 (1.2%)	32 (6.2%)	7 (6.8%)	< 0.001
OBESITY DURING CHILDHOOD							
	229 (23.8%)	193 (20.0%)	0.04	209 (16.3%)	160 (30.9%)	47 (45.6%)	< 0.001
IS SATISFIED WITH OWN WEIGHT							
Not at all	223 (23.1%)	274 (28.3%)	< 0.001	241 (18.8%)	184 (35.6%)	65 (63.1%)	< 0.001
More or less	278 (28.8%)	334 (34.5%)		402 (31.3%)	179 (34.6%)	22 (21.4%)	
Yes	464 (48.1%)	359 (37.1%)		640 (49.9%)	154 (29.8%)	16 (15.5%)	
ACTUAL OBESITY							
Normal weight	547 (57.8%)	736 (76.9%)	< 0.001				
At risk of obesity	332 (35.1%)	186 (19.4%)					
Obese	68 (7.2%)	35 (3.7%)					
MEAN BODY MASS INDEX (SD)							
	23.10 (3.73)	21.62 (3.44)	< 0.001	20.46 (2.34)	25.37 (1.80)	30.61 (2.39)	< 0.001

*Chi-square test performed

**Row percentages are shown for these cross-tabulations; for others, column percentages are shown.

Obese and at risk of obesity adolescents declared significantly higher rates of diseases associated with obesity, family history of obesity and obesity during childhood, and lower satisfaction with own weight ($p < 0.001$) (Table I). Reported diseases associated to obesity included Cushing syndrome, hypothyroidism, severe asthma treated by steroids and digestive disease treated by steroids.

Selected food groups' consumption by Lebanese adolescents

Table II represents selected food groups' consumption by Lebanese adolescents: Boys reported to eat and drink more frequently milk and dairy products, fast food products (Hamburger, pizza, etc.), drink carbonated beverages or soft drinks (Coke, etc.) and fruit juice compared with girls. However, they ate less frequently vegetables and fruits. No significant difference in consumption frequency of Lebanese traditional dishes, sweets and candies, potato chips and popcorn was found between boys and girls, across all age groups ($p > 0.05$).

As for differences between BMI categories, there was a significant trend towards a higher consumption of fast food products, Lebanese traditional dishes and gaseous soft drinks with increased obesity ($p < 0.05$); however, no significant differences were found for other food groups, namely milk and dairy products, sweets and candies, potato chips and pop corn, fruit juice or fruits and vegetables.

Eating habits of Lebanese adolescents

Results for the eating habits are presented in Table III. Boys reported more frequently to eat more rapidly than girls; they ate more than girls during the evening, and took more time to feel satiety ($p < 0.001$). They tried more often than girls to empty their plates, and they ate more between meals ($p < 0.001$). On the contrary, girls seek for eating light food, they tried to count calories, they had more often been on a diet, and they were more urged by the media or the family to lose weight. Nevertheless, compared with boys, girls would eat advertised food more frequently,

TABLE II
FOOD CONSUMPTION IN LEBANESE ADOLESCENTS

WEEKLY FOOD CONSUMPTION	Males	Females	<i>p-value*</i>	Normal weight	Obesity		<i>p-value*</i>
	N = 965 (100%)	N = 968 (100%)			At risk	Obese	
			-	N = 1283	N = 518	N = 103	
MILK AND DAIRY PRODUCTS							
None	111 (11.5%)	110 (11.4%)	0.003	156 (12.2%)	49 (9.5%)	11 (10.8%)	0.10
One to three times/week	295 (30.6%)	372 (38.4%)		448 (34.9%)	172 (33.2%)	38 (37.3%)	
Four to seven times/week	545 (56.5%)	478 (49.4%)		668 (52.1%)	288 (55.6%)	53 (52.0%)	
More than seven times/week	13 (1.3%)	8 (0.8%)		11 (0.9%)	9 (1.7%)	0	
FAST FOOD PRODUCTS							
None	46 (4.8%)	34 (3.5%)	0.01	54 (4.2%)	20 (3.9%)	3 (2.9%)	0.001
One to three times/week	639 (66.2%)	715 (73.9%)		927 (72.3%)	352 (68.0%)	57 (55.3%)	
Four to seven times/week	273 (28.3%)	215 (22.2%)		299 (23.3%)	141 (27.2%)	40 (38.8%)	
More than seven times/week	7 (0.7%)	4 (0.4%)		3 (0.2%)	5 (1.0%)	3 (2.9%)	
LEBANESE TRADITIONAL DISHES							
None	69 (7.2%)	71 (7.3%)	0.55	91 (7.1%)	36 (6.9%)	10 (9.7%)	0.003
One to three times/week	479 (49.6%)	492 (50.8%)		679 (52.9%)	241 (46.5%)	37 (35.9%)	
Four to seven times/week	411 (42.6%)	400 (41.3%)		508 (39.6%)	238 (45.9%)	53 (51.5%)	
More than seven times/week	6 (0.6%)	5 (0.5%)		5 (0.4%)	3 (0.6%)	3 (2.9%)	
SWEETS AND CANDIES							
None	41 (4.3%)	33 (3.4%)	0.19	56 (4.4%)	13 (2.5%)	2 (1.9%)	0.36
One to three times/week	405 (42.0%)	382 (39.5%)		518 (40.4%)	216 (41.9%)	40 (38.8%)	
Four to seven times/week	504 (52.3%)	545 (56.4%)		696 (54.3%)	281 (54.5%)	59 (57.3%)	
More than seven times/week	14 (1.5%)	6 (0.6%)		12 (0.9%)	6 (1.2%)	2 (1.9%)	
POTATO CHIPS AND POPCORN							
None	50 (5.2%)	58 (6.0%)	0.58	70 (5.5%)	28 (5.4%)	2 (1.9%)	0.14
One to three times/week	467 (48.4%)	466 (48.1%)		635 (49.5%)	239 (46.2%)	52 (50.5%)	
Four to seven times/week	435 (45.1%)	440 (45.5%)		570 (44.4%)	245 (47.4%)	46 (44.7%)	
More than seven times/week	12 (1.2%)	4 (0.4%)		8 (0.6%)	5 (1.0%)	3 (2.9%)	
SOFT DRINKS (carbonated beverages)							
None	70 (7.3%)	88 (9.1%)	< 0.001	113 (8.8%)	39 (7.5%)	3 (2.9%)	0.02
One to three times/week	359 (37.2%)	457 (47.3%)		554 (43.2%)	216 (41.7%)	39 (37.9%)	
Four to seven times/week	519 (53.8%)	414 (42.8%)		604 (47.1%)	252 (48.6%)	59 (57.3%)	
More than seven times/week	17 (1.8%)	8 (0.8%)		11 (0.9%)	11 (2.1%)	2 (1.9%)	
FRUIT JUICES							
None	62 (6.4%)	63 (6.5%)	< 0.001	76 (5.9%)	36 (6.9%)	9 (8.8%)	0.13
One to three times/week	419 (43.4%)	520 (53.8%)		652 (50.9%)	232 (44.8%)	45 (44.1%)	
Four to seven times/week	474 (49.1%)	380 (39.3%)		549 (42.8%)	244 (47.1%)	47 (46.1%)	
More than seven times/week	10 (1.0%)	3 (0.3%)		5 (0.4%)	6 (1.2%)	1 (1.0%)	
VEGETABLES AND FRUITS							
None	52 (5.4%)	28 (2.9%)	0.001	55 (4.3%)	20 (3.9%)	4 (3.9%)	0.48
One to three times/week	273 (28.3%)	232 (24.0%)		341 (26.6%)	122 (23.6%)	34 (33.0%)	
Four to seven times/week	627 (65.0%)	698 (72.1%)		874 (68.1%)	369 (71.2%)	63 (61.2%)	
More than seven times/week	13 (1.3%)	10 (1.0%)		13 (1.0%)	7 (1.4%)	2 (1.9%)	

*Somers' d ordinal test performed. Column percentages are shown for all.

particularly during moments of psychological distress (Table III).

On the other hand, there was a significantly increased trend of eating rapidly, slow feeling of satiety, eating "light" foods, plate emptying, and eating when psychologically distressed with increasing obesity; moreover, the higher the obesity, the higher the frequency of ever being

on a diet and taking drugs to lose weight, and the frequency of urge by media and family to lose weight ($p < 0.001$) (Table III).

Physical activity level of Lebanese adolescents

Table IV describes the levels of leisure time physical activity in the Lebanese adolescents.

TABLE III
EATING HABITS OF LEBANESE ADOLESCENTS

EATING HABIT	Males N = 965 (100%)	Females N = 968 (100%)	p-value*	Normal weight N = 1283	Obesity		p-value**
					At risk N = 518	Obese N = 103	
EATS SLOWLY	408 (42.3%)	527 (54.4%)	< 0.001	664 (51.8%)	225 (43.4%)	33 (32.0%)	< 0.001
EATS RAPIDLY	557 (57.7%)	441 (45.6%)		619 (48.2%)	293 (56.6%)	70 (68.0%)	
TIMING OF MAXIMAL FOOD CONSUMPTION							
Morning	40 (4.1%)	85 (8.8%)	< 0.001	89 (6.9%)	28 (5.4%)	5 (4.9%)	0.07
Noon	621 (64.4%)	641 (66.2%)		843 (65.7%)	338 (65.3%)	62 (60.2%)	
Evening	304 (31.5%)	242 (25.0%)		351 (27.4%)	152 (29.3%)	36 (35.0%)	
MAXIMAL FOOD CONSUMPTION WITH							
Family	358 (37.1%)	344 (35.5%)	0.16	468 (36.5%)	200 (38.6%)	27 (26.2%)	0.88
Friends	170 (17.6%)	146 (15.1%)		207 (16.1%)	79 (15.3%)	20 (19.4%)	
Alone, without television	211 (21.9%)	213 (22.0%)		324 (25.3%)	130 (25.1%)	32 (31.1%)	
Alone, watching television	226 (23.4%)	265 (27.4%)		284 (22.1%)	109 (21.0%)	24 (23.3%)	
FEELS SATIETY WHEN EATING							
After 5 minutes	119 (12.3%)	191 (19.7%)	< 0.001	574 (44.7%)	210 (40.5%)	38 (36.9%)	0.02
After 10 minutes	376 (39.0%)	458 (47.3%)		320 (24.9%)	146 (28.2%)	23 (22.3%)	
After 20 minutes	291 (30.2%)	203 (21.0%)		216 (16.8%)	74 (14.3%)	15 (14.6%)	
More than 20 minutes	179 (18.5%)	116 (12.0%)		173 (13.5%)	88 (17.0%)	27 (26.2%)	
SEEKS FOR EATING "LIGHT" FOOD							
Never	604 (62.7%)	424 (43.8%)	< 0.001	723 (56.4%)	248 (49.0%)	43 (41.7%)	< 0.001
Sometimes	234 (24.3%)	341 (35.3%)		369 (28.8%)	158 (30.6%)	40 (38.8%)	
Always	126 (13.1%)	202 (20.9%)		190 (14.8%)	111 (21.5%)	20 (19.4%)	
TRIES TO COUNT CALORIES							
	187 (19.4%)	334 (34.5%)	< 0.001	343 (26.8%)	137 (26.4%)	33 (32.0%)	0.65
TRIES TO EMPTY HIS/HER PLATE							
	818 (84.9%)	716 (74.1%)	< 0.001	978 (76.4%)	444 (85.9%)	90 (87.4%)	< 0.001
EATS IF PSYCHOLOGICALLY DISTRESSED							
	319 (33.1%)	401 (41.5%)	< 0.001	440 (34.3%)	212 (40.9%)	54 (52.4%)	< 0.001
IS ENCOURAGED TO EAT ADVERTISED FOOD							
	484 (50.3%)	541 (55.9%)	0.01	679 (53.0%)	267 (51.6%)	67 (65.0%)	0.46
LIKES TO EAT BETWEEN MEALS							
Never	174 (18.0%)	158 (16.3%)	< 0.001	232 (18.1%)	84 (16.2%)	15 (14.6%)	0.14
Sometimes	305 (31.6%)	408 (42.2%)		476 (37.1%)	196 (37.9%)	31 (30.1%)	
Always	486 (50.4%)	401 (41.5%)		575 (44.8%)	237 (45.8%)	57 (55.3%)	
HAS EVER BEEN ON A DIET							
	159 (16.5%)	291 (30.1%)	< 0.001	218 (17.0%)	169 (32.8%)	59 (57.3%)	< 0.001
NUMBER OF DIETS FOR LOSING WEIGHT							
1-2 diets	121 (76.6%)	204 (70.1%)	0.14	173 (79.7%)	111 (66.1%)	38 (63.3%)	0.001
> 2 diets	37 (23.4%)	87 (29.9%)		44 (20.3%)	57 (33.9%)	22 (36.7%)	
HAS EVER TAKEN MEDICATIONS TO LOSE WEIGHT							
	29 (3.0%)	40 (4.1%)	0.19	27 (2.1%)	29 (5.6%)	13 (12.6%)	< 0.001
IS URGED BY MEDIA TO LOSE WEIGHT							
	302 (31.4%)	468 (48.4%)	< 0.001	472 (36.9%)	228 (44.0%)	61 (59.2%)	< 0.001
IS URGED BY FAMILY TO LOSE WEIGHT							
	246 (25.6%)	359 (37.2%)	< 0.001	275 (21.5%)	259 (50.2%)	68 (66.7%)	< 0.001

*Chi-square test performed. **Somers'd ordinal test performed. Column percentages are shown for all.

Boys declared to have a higher frequency of leisure time physical activity than girls during their childhood and actually. They also reported a higher frequency and intensity of physical activity compared to girls ($p < 0.001$); their physical activity level was almost three times more reported to be vigorous compared with girls (Table IV).

Obese adolescents were less likely to be described as active children; they were also more likely to declare not habitually performing any sport ($p < 0.01$). There was around 50% more reporting of the absence of physical activity in obese individuals versus others (36% versus 24%; $p = 0.02$); obese individuals also reported less moderate and vigorous activity compared with at risk of obesity and normal weight children, while individuals at risk

of obesity reported the highest percentage of vigorous physical activity (Table IV).

Multivariate analysis

In Figure 2, different factors that were significantly ($p < 0.05$) associated with overweight (higher than normal BMI) were reported: lower age (ORa = 1.63), male sex (ORa = 4.41), plate emptying (ORa = 1.68), childhood obesity (ORa = 1.72), family obesity (ORa = 1.44), fast food (ORa = 1.26), Lebanese traditional dishes (ORa = 1.27) and fruit juice consumption frequency (ORa = 1.20), and less weekly physical activity (ORa = 1.18) were independent factors related to overweight. Moreover, overweight was found to correlate with obesity associated chronic diseases

TABLE IV
PHYSICAL ACTIVITY FREQUENCY OF LEBANESE ADOLESCENTS

PHYSICAL ACTIVITY	Males N = 965 (100%)	Females N = 968 (100%)	p-value	Normal weight N = 1283	Obesity		p-value
					At risk N = 518	Obese N = 103	
WAS AN ACTIVE CHILD	727 (75.7%)	719 (74.4%)	0.51*	992 (77.6%)	372 (72.0%)	59 (57.3%)	< 0.001*
FREQUENCY IN CHILDHOOD							
None	250 (25.9%)	278 (28.7%)	< 0.001*	341 (26.6%)	142 (27.4%)	38 (36.9%)	0.34*
One to three times weekly	500 (51.8%)	558 (57.6%)		715 (55.7%)	278 (53.7%)	51 (49.5%)	
Four times weekly or more	215 (22.3%)	132 (13.6%)		227 (17.7%)	98 (18.9%)	14 (13.6%)	
ACTUAL FREQUENCY							
None	181 (18.9%)	279 (29.1%)	< 0.001*	292 (22.9%)	125 (24.3%)	36 (36.0%)	0.31*
One to three times weekly	536 (56.0%)	507 (52.8%)		714 (56.0%)	272 (52.9%)	46 (46.0%)	
Four times weekly or more	240 (25.1%)	174 (18.1%)		268 (21.0%)	117 (22.8%)	18 (18.0%)	
ACTUAL NUMBER OF HOURS							
None	181 (19.0%)	279 (29.4%)	< 0.001*	292 (23.1%)	125 (24.5%)	36 (36.4%)	0.35*
1-2 hours weekly	215 (22.6%)	270 (28.5%)		335 (26.5%)	121 (23.7%)	25 (25.3%)	
3-6 hours weekly	305 (32.0%)	263 (27.7%)		385 (30.5%)	154 (30.2%)	22 (22.2%)	
> 6 hours weekly	251 (26.4%)	136 (14.3%)		250 (19.8%)	110 (21.6%)	16 (16.2%)	
TV WATCHING HOURS							
None	-	-	0.37*	-	-	-	0.80*
1-3 hours daily	545 (57.2%)	566 (59.3%)		734 (58.0%)	302 (59.2%)	53 (51.5%)	
> 3 hours daily	407 (42.8%)	389 (40.7%)		531 (42.0%)	208 (40.8%)	50 (48.5%)	
DOES NOT WALK TO SCHOOL	727 (75.4%)	731 (75.5%)	0.96*	968 (75.4%)	393 (75.9%)	73 (70.9%)	0.72*
MOST REPORTED SPORTS							
Basketball	290 (30.1%)	142 (14.7%)	< 0.001*	256 (20.0%)	147 (28.4%)	24 (23.3%)	0.004*
Football	179 (18.5%)	19 (2.0%)		137 (10.7%)	52 (10.0%)	8 (7.8%)	
Jogging	103 (10.7%)	234 (24.2%)		234 (18.2%)	79 (15.3%)	20 (19.4%)	
Stretching	114 (11.8%)	159 (16.4%)		197 (15.4%)	64 (12.4%)	6 (5.8%)	
Other sports	96 (9.95%)	132 (13.64%)		162 (12.63%)	51 (9.84%)	9 (8.74%)	
None	183 (19.0%)	282 (29.1%)		297 (23.1%)	125 (24.1%)	36 (35.0%)	
PHYSICAL ACTIVITY LEVEL							
Median [Interquartile range]	9 [5-18]	7 [0-14]	< 0.001 [▼]	8 [2.5-16]	8 [2.5-16]	7 [0-16]	0.07 [▼]
No physical activity	181 (19.0%)	280 (29.5%)	< 0.001*	293 (23.2%)	125 (24.5%)	36 (36.4%)	0.51*
Low physical activity	299 (31.4%)	366 (38.6%)		469 (37.2%)	159 (31.2%)	27 (27.4%)	0.02**
Moderate physical activity	192 (20.2%)	193 (20.4%)		252 (20.0%)	111 (21.8%)	18 (18.2%)	
Vigorous physical activity	280 (29.4%)	109 (11.5%)		248 (19.7%)	115 (22.5%)	18 (18.2%)	

*Somers' d ordinal test performed ▼Mann-Whitney test performed **Chi-square test performed. Column percentages are shown for all.

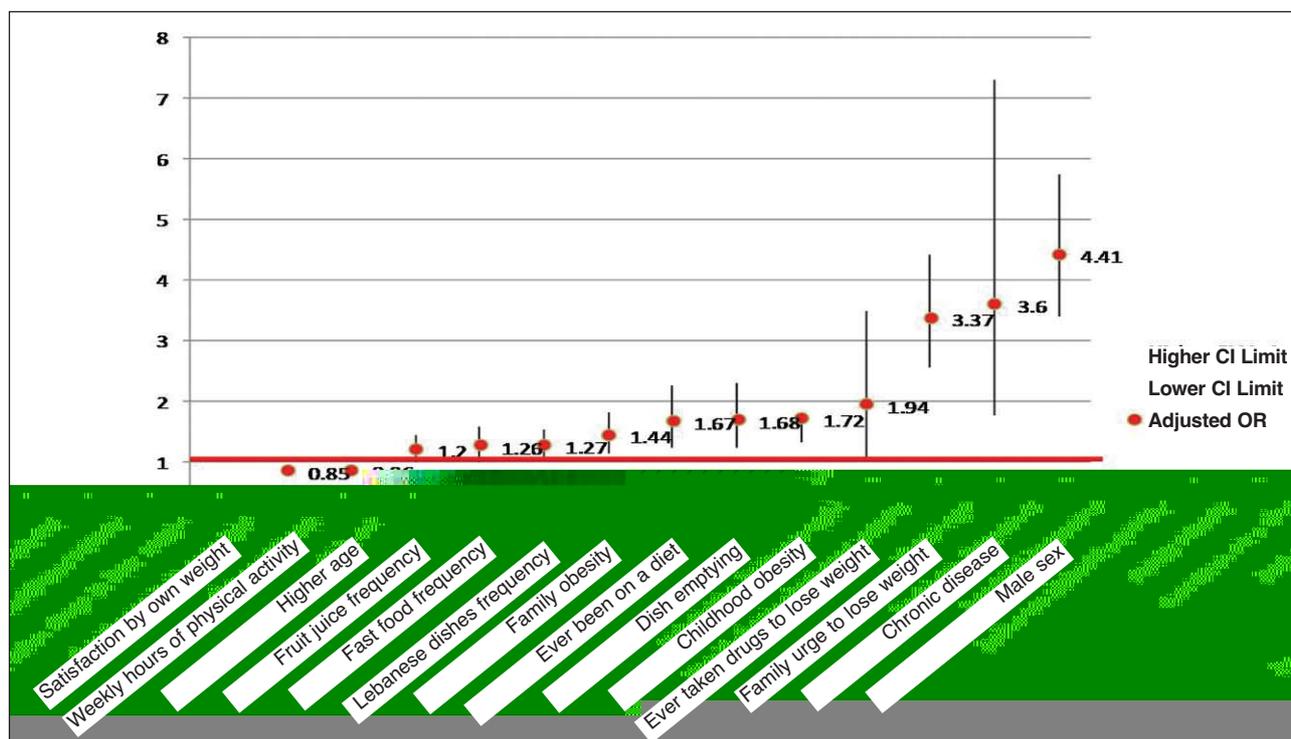


FIGURE 2. Multivariate analysis: overweight significant determinants in Lebanese adolescents by stepwise backward logistic regression. Factors taken into account were fast food frequency consumption, Lebanese dishes consumption, soft drinks consumption, eating rapidly, seeking for eating light food, plate emptying, eating when psychologically distressed, ever being on a diet, urged by media to lose weight, urged by family to lose weight, number of hours of sports per week, weight satisfaction, dwelling region, age, sex, family obesity, childhood obesity and chronic disease known to cause obesity.

(OR = 3.60), family urge to lose weight (ORa = 3.37), weight dissatisfaction (ORa = 2.94), ever being on a diet (ORa = 1.67) and ever taking drugs to lose weight (ORa = 1.94).

DISCUSSION

This study showed that boys were more frequently overweight and obese than girls. We also found that overweight was associated with the following: non modifiable factors (lower age, male sex, chronic disease, family obesity, childhood obesity), behavioral factors (lower physical activity, higher consumption of fast food, Lebanese traditional dishes, and dish emptying), self-image factors (weight dissatisfaction and family urge to lose weight), and dieting (taking drugs to lose weight and ever being on a diet). Boys were more likely to engage in leisure time physical activity, although they ate unhealthy food more frequently than girls.

Gender differences in obesity prevalence and obesity risk were in accordance with results from previous studies in Lebanese adolescents [22-24] and American [43], Taiwanese and Fuchien [44] children and adolescents.

Our results are in line with those of other studies for factors associated with obesity in adolescents, including higher consumption of food with high energy density (such as fast food in our study) and soft drinks [37-38],

lower consumption of raw fruits and vegetables [39], parental obesity [45-46], long hours of daily television viewing [45-46], and low levels of physical activity [47]. Thus, the adolescents of our sample seem to have similar risk factors for obesity and obesity prevalences to those of other countries, and we were not able to demonstrate any specificity for Lebanese adolescents in terms of dietary behavior, physical activity and obesity. This may be due to the nature of the sample (private schools, with subsequent higher than average socioeconomic level). Interestingly, however, traditional Lebanese composite dishes consumption was associated with higher risk of overweight; this may be explained by the fact that these dishes do not have a lower energy density or a lower fat content than western foods, although they have a better nutrient profiling [36]. Moreover, their preparation method (including sodium and saturated fats content) may highly influence their nutrient profile. Additional studies are necessary to portray the effect of these dishes consumption on health.

In this study, male adolescents reported to eat highly caloric food (fast food and fruit juice in particular) more frequently than girls, and raw fruits and vegetables less frequently, although they reported a higher physical activity than girls. The fact that boys ate more energy dense food than girls but were more physically active was also reported by others [37, 48-50]. Physical activity of boys seems a natural gender-related trend in adolescents [17-

18], that may not be specifically oriented towards shape maintenance: indeed, in a multi-stratified analysis, we found that boys with high levels of physical activity and with no physical activity consumed fast food significantly more frequently than those with low to moderate levels ($p < 0.001$); this picture was not found in girls ($p = 0.206$; results not shown). Another interesting point is the fact that adolescents at risk of obesity performed more vigorous physical activity than others; this may be explained by the fact that they did an extra-effort to lose weight compared to their normal and obese peers, or because there were more boys in this group that were more physically active than girls.

In our sample, boys seemed to be less affected by the thin media body image compared with girls: the former declared more frequently being satisfied by their weight (even if they were overweight), they reported to make fewer efforts to maintain or lose weight, whereas their eating habits showed behaviors that tend to be associated with obesity such as consuming more fast food and dish emptying. Conversely, girls were more likely to try to lose weight than boys, even though they had a normal BMI. This may be due to the influence of the thin western body image reflected by the media [49-50], leading to higher obesity-related distress in girls compared to boys [51] and maybe eating disorders. Our study also showed that obese adolescents, girls in particular, were significantly more likely to engage in dieting behaviors, to restrain their eating, to take drugs to lose weight, to express concern about their weight, and to exhibit more dissatisfaction with their body image than average-weight adolescents. Additional studies will be necessary to evaluate the adequacy of such dieting behaviors and their consequences on physical and mental health of adolescents.

Although little could be made to change pre-existent non modifiable factors, preventing obesity in adolescents is of primary importance; it should be performed according to international guidelines [52], by motivating but without forcing [53-54], to avoid obesity-related distress and its negative consequences [55-58]. It should also adapt to the behavioral specificities of Lebanese boys and girls, as concluded in our study: encourage higher levels of physical activity in girls, decrease consumption of unhealthy food in boys and improve their dietary habits. The latter can be done by encouraging increased adherence to the Mediterranean diet that is available in Lebanon and has been demonstrated to be associated with lower adiposity [28]; examples include eating more unrefined cereals, legumes, vegetables, and dishes based on wild plants [21, 27-28], and less fast food based on refined cereals and sweetened beverages [28]. Other measures include internationally recognized banning of unhealthy food advertisements, increasing media literacy, educating parents and children and making healthy food and physical activity easily accessible at schools and at home [59]. Individuals with BMI higher than normal could also benefit from specific educating measures about lifestyle changes in supportive groups [59].

Some points of consideration might influence the validity of this study: the cross-sectional design of the study precludes proving temporality of the reported associations; height and weight corrections may not apply to all adolescents, and other information were self reported in the questionnaire without further objective confirmation. We also evaluated the reported frequency of food consumption and physical activity level without objective evaluation; adolescents might over- or underreport these habits. The fact that the questionnaires we used were not previously validated warrants caution in data interpretation, since their sensitivity and specificity had not been assessed. This may increase the risk of a non differential information bias, particularly directing the results towards the null and decreasing the strength of associations between variables of interest. Data on diseases associated with obesity might have also been more accurate if parents had reported on them. Moreover, the relationship between age and obesity is difficult to interpret given the cross-sectional nature of the study.

Additionally, since our school sample was a non random sample, we may also have a selection bias; however, we have no reason to believe that choosing the schools by random sampling would have changed the comparative results, since we adjusted over all baseline factors, including dwelling region; some changes would however be expected in the whole sample results, particularly due to urban versus rural differences. However, our objective was not to obtain nationwide measures. On another hand, we had no means to evaluate the reasons of missing values for some items of the questionnaire; the most probable cause would be either non motivation, or the individual being distressed and ashamed by his/her own obesity. In the latter case, our results may be underestimating obesity rates of adolescents. However, our primary objective was not to evaluate obesity prevalence, and the results we obtained were anyway similar to previous research [22-24]. Studies that take into consideration these weak points would be necessary to confirm our results, and some are needed to depict the complex behavioral patterns of adolescents from sociological and psychological points of view. Lebanese parents and environmental influences could also constitute useful research themes.

In conclusion, we found that boys had a higher prevalence of obesity and overweight than girls; they had a higher consumption of caloric food and a lower consumption of fruits and vegetables. They did fewer efforts than girls to maintain or lose weight, because they were more satisfied than girls with their weight. However, boys reported more physical activity than girls. Efforts to induce changes in their respective behaviors are necessary, focusing particularly on increasing physical activity in girls, and decreasing highly caloric food consumption in boys. Individuals with high BMI could also benefit from specific education in supportive groups.

CONFLICTS OF INTEREST

No conflict of interest to declare.

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