

ARTICLE ORIGINAL/ORIGINAL ARTICLE
**GROWTH CHARTS AND OBESITY PREVALENCE
AMONG LEBANESE PRIVATE SCHOOLS ADOLESCENTS**

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ABSTRACT • INTRODUCTION : The objectives of this study were to establish weight, height and body mass index curves and to calculate the prevalence of obesity by sex and age groups in Lebanese adolescents of private schools.

MATERIAL AND METHODS : Body weight, height and body mass index (BMI) were measured among 12299 adolescents aged 10 to 18 years from Lebanese private schools. Adolescents' growth charts were established. Obesity and at risk of obesity individuals were identified according to International Obesity Taskforce thresholds, and our numbers were compared to those of other countries.

RESULTS : Curves of weight, height and BMI were drawn. In boys, 10.1% were obese and 28.8% at risk of obesity. In girls, 4.2% were obese and 19.0% were at risk of obesity.

CONCLUSION : Lebanese private schools adolescents, particularly boys, present high prevalences of obesity and risk of obesity. Pediatricians should identify early adolescents at greater risk, in order to achieve a more favorable prognosis.

INTRODUCTION

Obesity has become the most common chronic disorder in childhood and adolescence in industrialized countries [1]. Overall, childhood and adolescent obesity substantially increases the risk of subsequent morbidity, whether or not obesity persists into adulthood. It is well established that 70 to 80% of obese adolescents will remain obese as adults [2]. Among the most common sequels of primary childhood are hypertension, dyslipidemia, diabetes mellitus, back pain and psychosocial problems. Obesity has also been linked to health outcomes in adulthood, such as increased risk of cardiovas-

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RÉSUMÉ • INTRODUCTION : Les objectifs de cette étude étaient d'établir les courbes de poids, de tailles et d'indices de masse corporelle (IMC) et de calculer la prévalence d'obésité par sexe et par groupes d'âge chez les adolescents des écoles privées libanaises.

MATÉRIEL ET MÉTHODES : Le poids corporel, la taille et l'IMC ont été mesurés chez 12299 adolescents âgés de 10 à 18 ans dans des écoles libanaises privées. Les courbes de croissance des adolescents ont été établies. Les adolescents obèses ou à risque d'obésité ont été identifiés, selon les valeurs seuils de l'*International Obesity Taskforce* ; les pourcentages obtenus ont été comparés à ceux des autres pays.

RÉSULTATS : Les courbes de poids, de tailles et d'IMC ont été tracées. Chez les garçons, 10,1% étaient obèses et 28,8% à risque d'obésité. Chez les filles, 4,2% étaient obèses et 19,0% à risque d'obésité.

CONCLUSION : Les adolescents des écoles libanaises privées, en particulier les garçons, présentent des prévalences élevées d'obésité et de risque d'obésité. Les pédiatres devraient identifier les adolescents à risque supérieur d'obésité pour un meilleur pronostic.

cular disease, diabetes and hypertension [3-4].

Two previous cross sectional surveys conducted in Lebanon showed an obesity prevalence of 30.2% in rural women and an overall higher prevalence in boys than in girls [5-6]. No study was specifically designed for children or adolescents in schools. The objectives of our study were to establish weight, height and body mass index curves and to calculate the prevalence of obesity by sex and age groups in Lebanese adolescents of private schools.

METHODS

Study design

It is a cross sectional study conducted on a sample of adolescents in private Lebanese schools, aged between 10 and 18 years, between November 2002 and May 2003.

Sampling procedure

Thirty-three private schools were chosen from the five Lebanese districts. However, only 23 agreed to

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enrol, resulting in a response rate of 0.67 : 5 in Beirut, 12 in Mount Lebanon, 3 in North Lebanon, 1 in South Lebanon, and 2 in the Bekaa.

Data collection

Body measures were taken between November 2002 and May 2003. An enquirer was trained and sent to record gender, birth date and measure weight and height of all students in the required age group, in collaboration with the school health professional. No students refused to participate since it was required by the school direction. One calibrated balance (Soehle trademark, sensitivity 500 g) and one stadiometer for height measurement (Stanley trademark, MABO microtorse, serial number 04-116) were used ; shoes were systematically removed, and measurements were made with light indoor clothing only.

Body mass index (BMI) calculated as mass in kg over height in square meters was used to evaluate obesity, since this is a practical, useful and preferred index to assess body fat [7-8].

Statistical analysis

Data entry and analysis were performed on SPSS statistical software, version 11.5. Chi² tests were used to compare prevalences within age classes and between boys and girls.

For every year of rounded age, percentiles were calculated, allowing curves drawing for weight in kg, height in cm and body mass index (BMI) in kg/m², according to the Lambda Mu Sigma (LMS) method described by Cole in 1992 [9].

Obesity and at risk of obesity (overweight but not yet obese) concepts were defined according to cut-off values taken from International Obesity Taskforce for BMI of children aged 2 to 18 years, where centile curves were drawn so that age 18 years passed through the widely used cut-off points of 30 and 25 kg/m² for adult obesity and overweight [10-11].

RESULTS

Descriptive statistics

5529 (45.0%) boys and 6770 (55.0%) girls were included in the study, making a total of 12299 Lebanese adolescents. Exact age was available for 12129 adolescents : 2601 (21.1%) were 10-12 years, 6238 (50.7%) were 12.5-15 years, and 3290 (26.7%) were 15.5-18 years old.

Height, weight and body mass index curves were drawn for boys and girls : In figure 1a, girls' weight seems to reach a plateau at 14 years, while that of boys continues to increase up to 17-18 years (Figure 1b). A similar plateau appears for girls' height at 14 years, while boys continue to grow in height up to 17 years (Figures 2a & 2b). BMI appears to stabilize at 13 years for girls, with large interindividual difference between 11 and 15 years (Figure 3a). For boys, BMI continues to increase up to 18 years, with lower interindividual differences (Figure 3b).

Obesity prevalence

In the total adolescents' population, there are 7.4% of obese individuals and 24.4% of individuals at risk of obesity. In figures 4a & 4b, we present obesity prevalence difference between boys and girls ; obesity prevalence is 2.5 times higher in boys (10.1%) than in girls (4.2%). Boys at risk of obesity (28.8%) are almost 1.5 times more numerous than girls (19.0%) ($p < 10^{-4}$).

In girls, there are significant differences in obesity prevalence between age groups and overweight and obesity prevalences become lower with age ($p < 10^{-4}$) : in the 10 to 12 years old girls group, there were 25.8% at risk of obesity and 6.3% obese ; these numbers became 18.7% and 3.7%, versus 13.3% and 3.4%, in girls aged 12.5 to 15 years and 15.5 to 18 years, respectively. In contrast, boys showed equivalent percentages of obesity (10.1%) and at risk of obesity (28.8%) between age groups ($p = 0.59$).

DISCUSSION

In figures 1, 2 and 3, growth charts are presented for Lebanese private schools adolescents. These charts are derived from cross-sectional data, taken from the measurements of many children at various ages. This method is usually used to derive standard growth charts [12]. However, attention should be drawn to the fact that individual children do not necessarily grow according to these standard curves. In adolescence, there may be quite large deviations from the derived percentile lines, depending on factors such as nutrition, exercise, and genetics [12]. Longitudinal studies would be expected to give more accurate curves.

Growth in several dimensions shows a significant family resemblance. Adult stature, tempo of growth, timing and rate of sexual development, skeletal maturation, and dental development are all significantly influenced by genetic factors [13] and estimates of genetic transmissibility range from 41% to 71% [14]. The overall contribution of heredity to adult size and shape varies with environmental circumstances, and the two continuously interact throughout the entire growth period [14]. Differences in growth and development also vary as a function of sex and ethnic origin [15-16]. These charts are expected to be useful for Lebanese pediatricians checking the growth of private schools adolescents. Another study is needed for those of public schools.

For obesity prevalence, our results are comparable to those reported for the American population, with 10.9% of obese and 22% at risk of obesity in children aged 6 to 17 years of age [17]. However, they are higher than those obtained for many countries such as Japan, Singapore, Taiwan, Germany and the Netherlands [18].

Furthermore, given the low sensitivity of the International Obesity Task Force cut-off values for detecting obesity [10], and the substantial variability of BMI's accuracy as an indicator of adiposity, additional caution should be taken in interpreting our results [19],

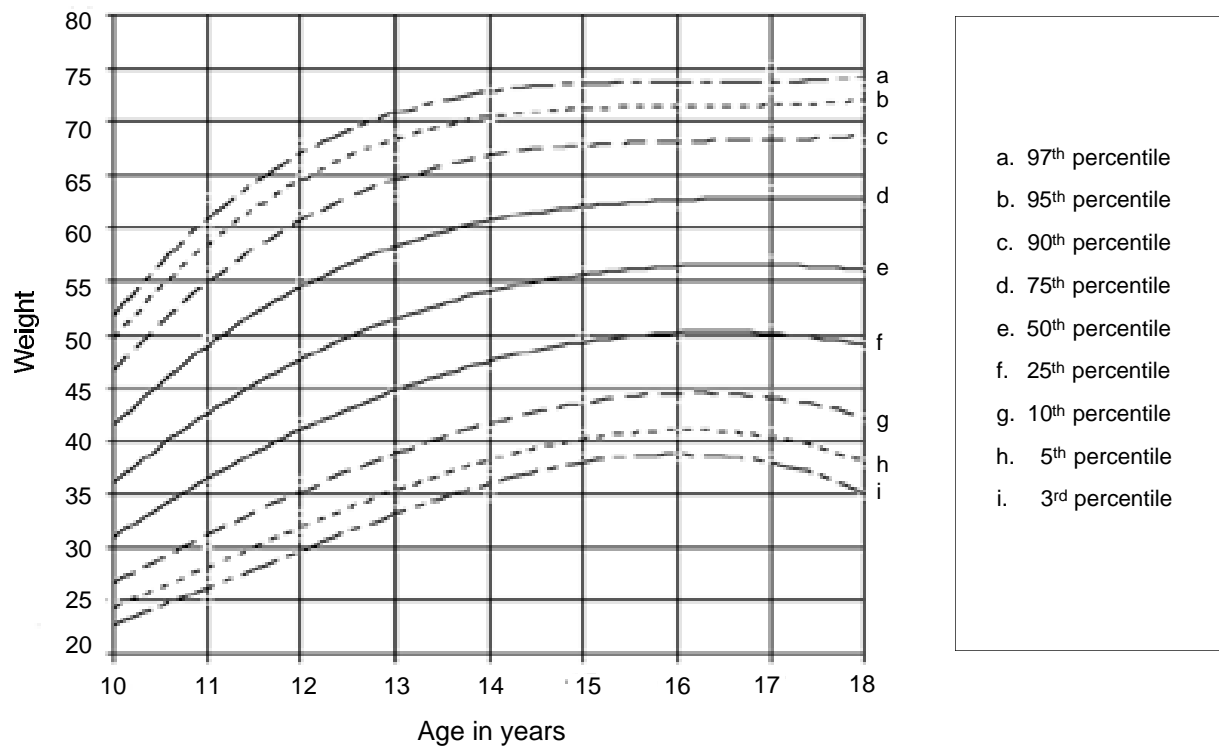


FIGURE 1a Weight in kg of Lebanese private schools girls

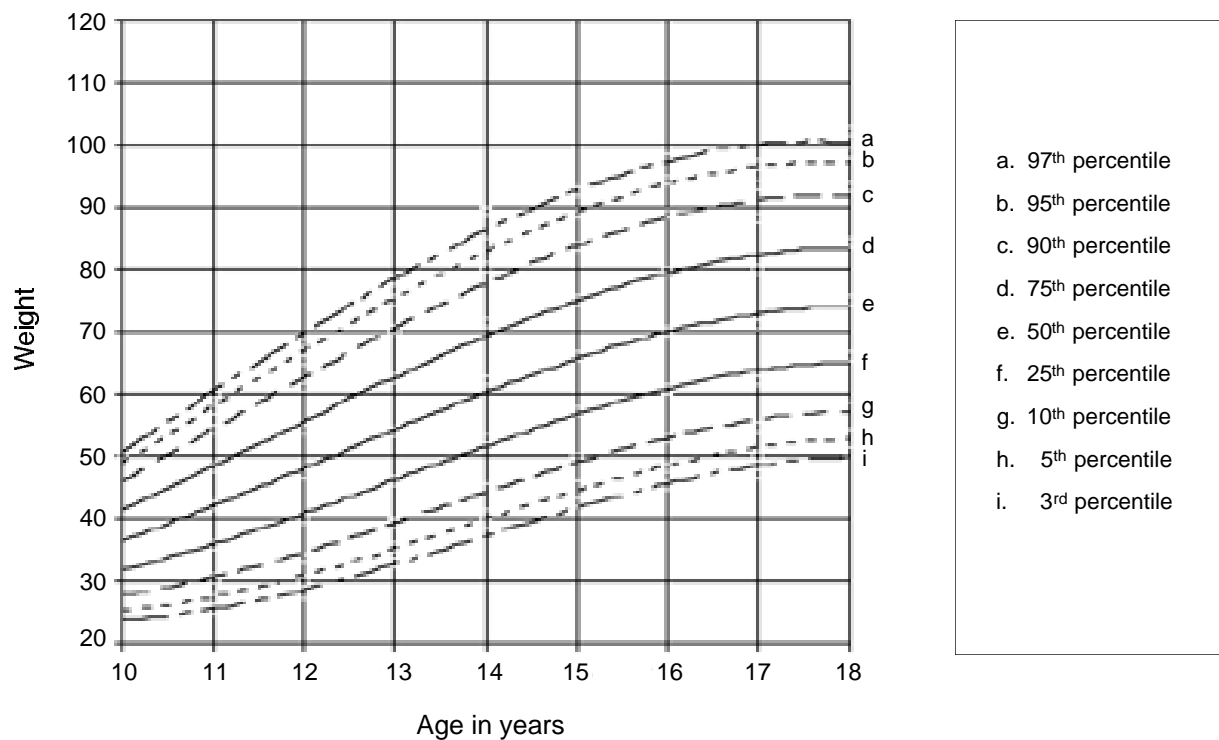


FIGURE 1b Weight in kg of Lebanese private schools boys

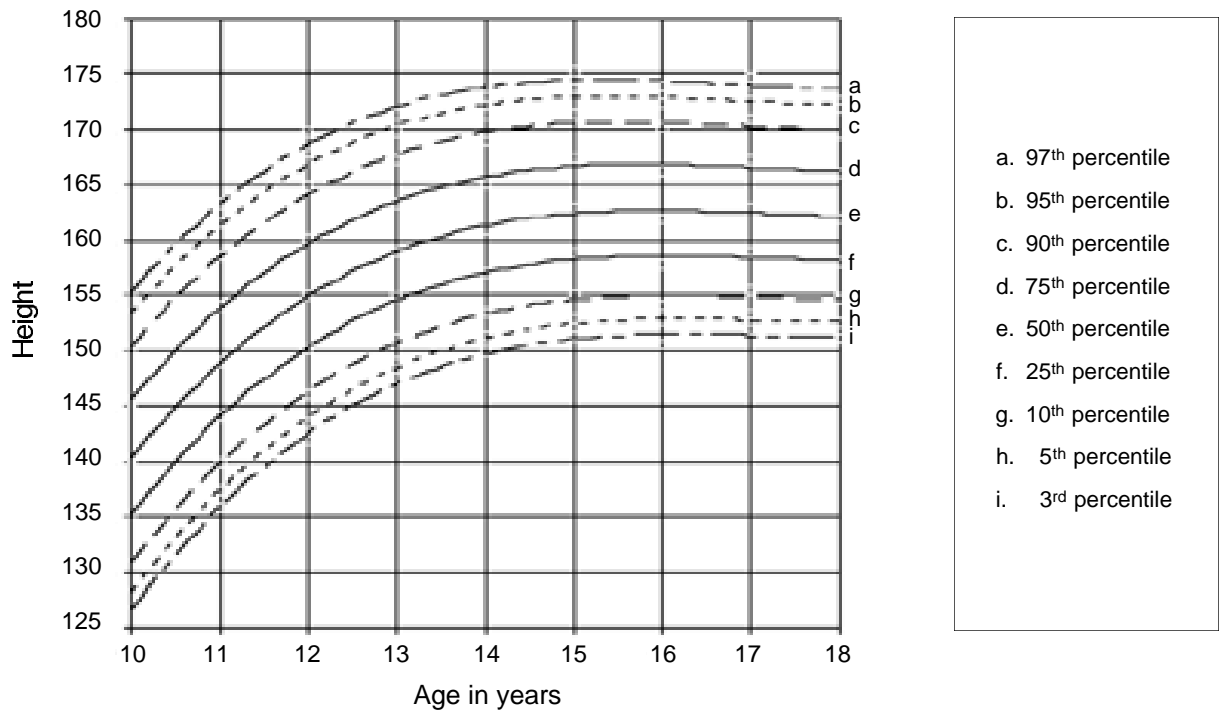


FIGURE 2a Height in cm of Lebanese private schools girls

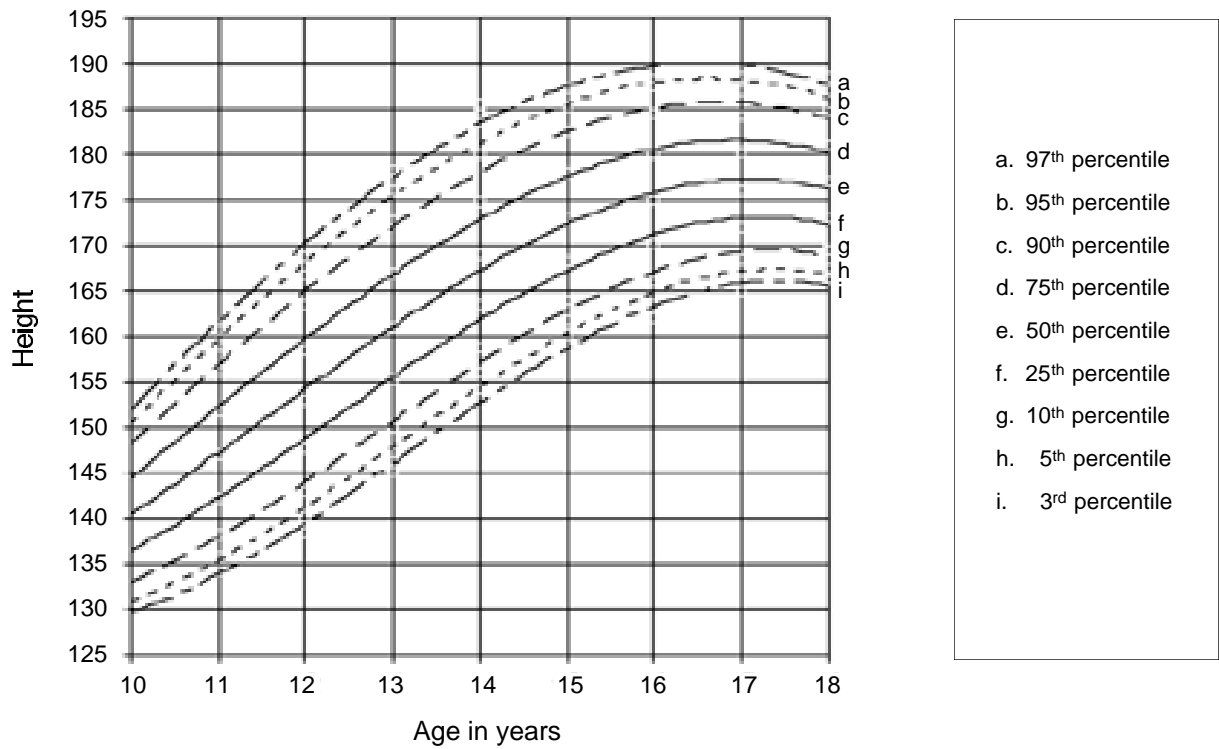


FIGURE 2b Height in cm of Lebanese private schools boys

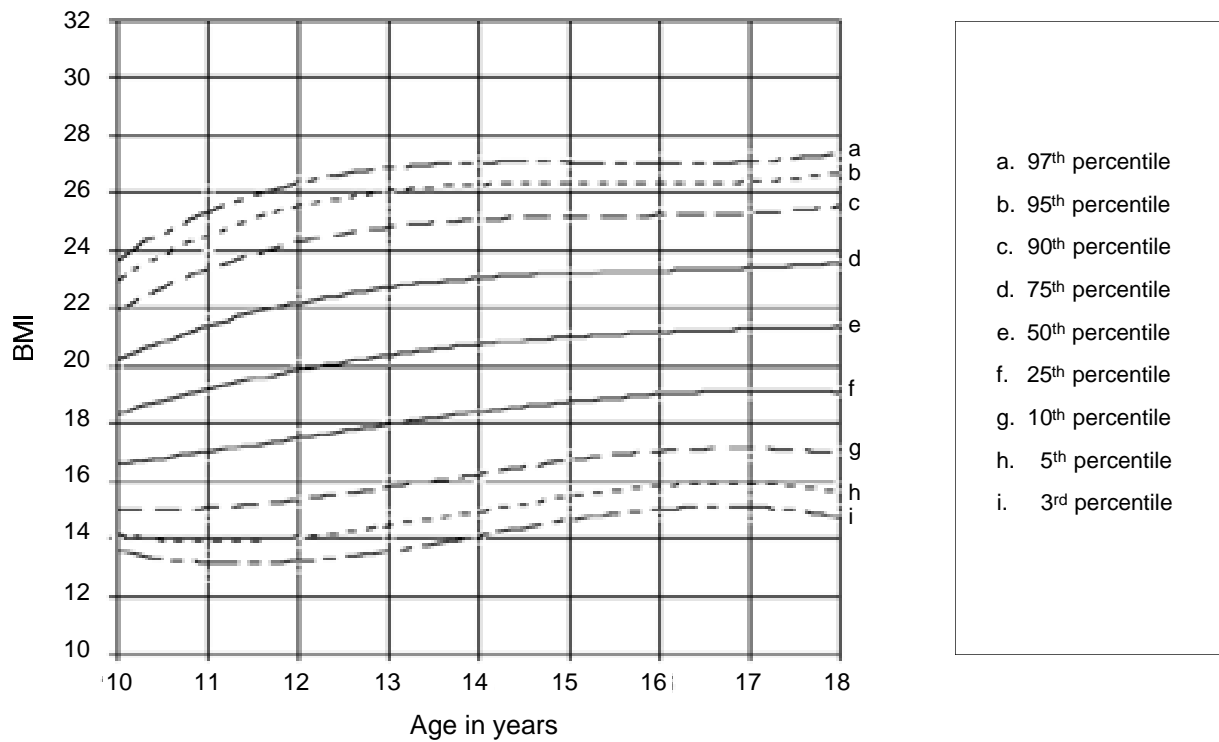


FIGURE 3a Body mass index in kg/m² of Lebanese private schools girls

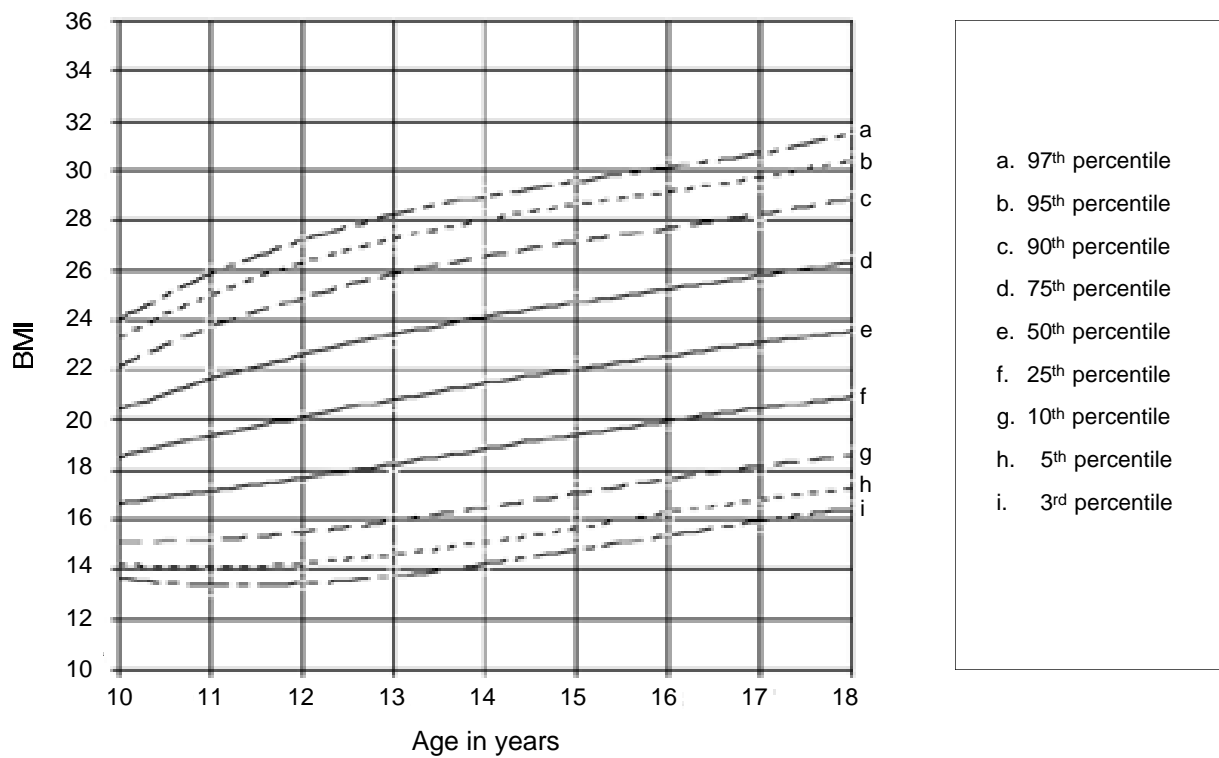


FIGURE 3a Body mass index in kg/m² of Lebanese private schools boys

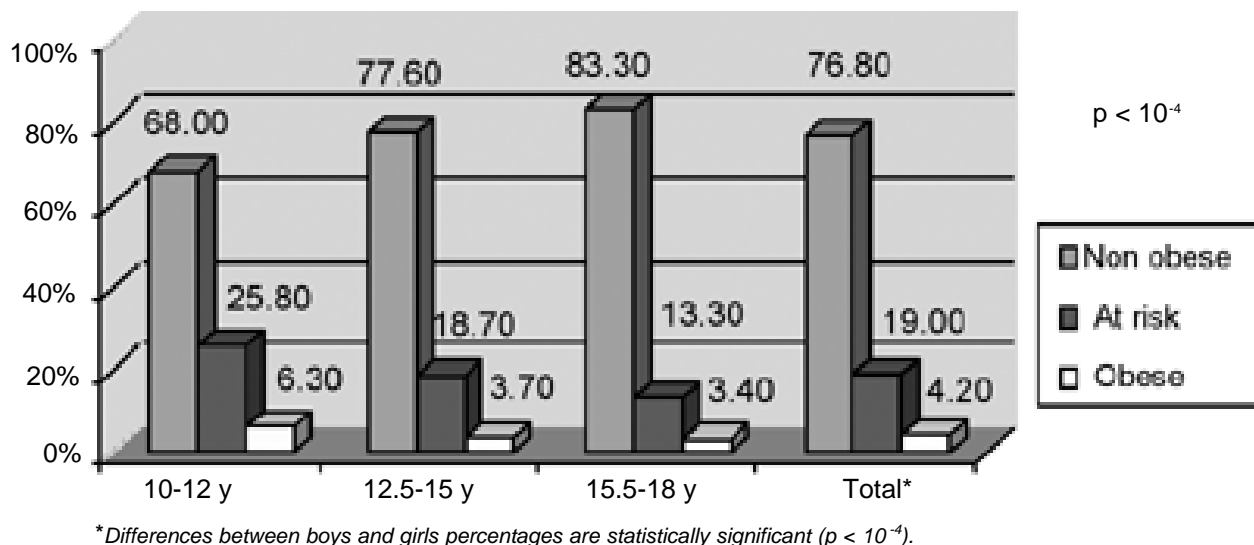


FIGURE 4a Percentages of obesity and at risk of obesity in girls

particularly for boys and lower BMI adolescents [20] : sensibly higher results would be expected if BMI measures would be replaced by more sensitive measures ; this would put our Lebanese private schools adolescents at one of the highest points of the international ladder regarding obesity and at risk of obesity prevalence. The causes of this dramatic increase in obesity may be genetic, physiologic and/or environmental, physical activity and diet changes in particular, which are the major components of the energy balance equation [21].

One possible explanation for these numbers is the sample restriction, since higher socioeconomic status of private schools would allow higher adoption of unhealthy nutritional habits (fast food, energy-dense snacks, sweets, etc.) and lower consumption of traditional healthy Mediterranean food (cereals, vegetables and fruits). In fact, it is a general observation in Lebanon that children of higher socioeconomic status have higher opportunities of eating in fast food restaurants, higher caloric density and more attractive food than those of lower socioeconomic status, the latter being more prone to eat less expensive and less fatty home made platters.

The rapid rise in adolescent obesity has also been accompanied by increasing availability and appeal of sedentary leisure pursuits [21]. Private schools adolescents have the possibility to sit longer in front of their personal television, videogames or computers. Studies have shown that television viewing is related to gain of fat and obesity : Robinson showed that an intervention to reduce television, videotapes and videogames use in a group of children was successful in reducing BMI and other anthropometric measures compared with controls [22].

Our results are consistent with the general tendency in developing countries of an increasing prevalence of obesity in parallel with increasing socioeconomic status [23], in contrast with western countries [24]. In our

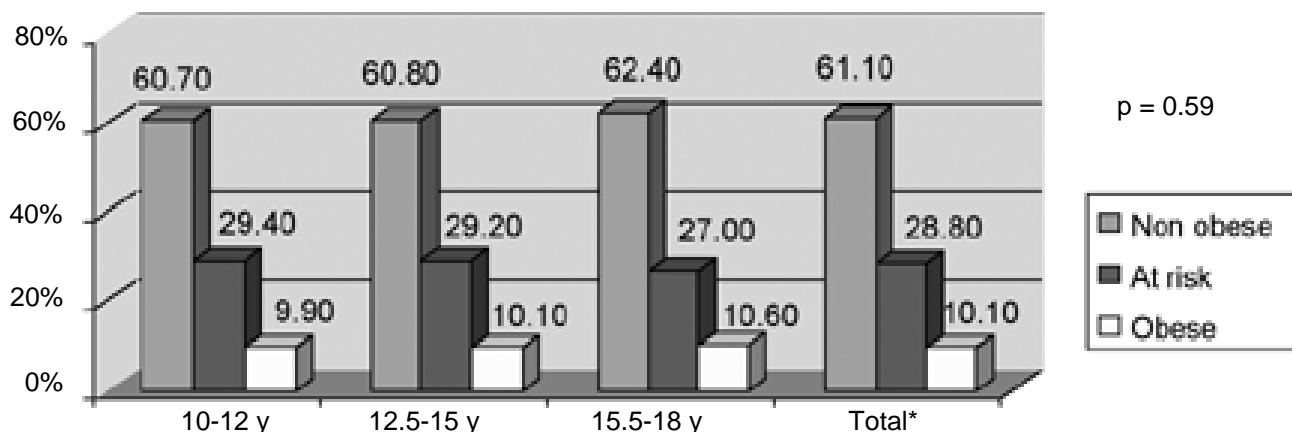
study, this was more acutely demonstrated for Lebanese boys than for girls, particularly when girls became adolescents.

In our study, the prevalence of obesity was almost the triple in boys than in girls ($p < 10^{-4}$). It is possible that the western feminine self-image and fear of obesity are more marked in Lebanese girls than boys. In fact, it has been demonstrated that girls as young as 5 years of age care more about their self-concept and associate it to weight status [2]. The same has been reported for Taiwan and Fuchien areas, where boys had higher prevalence of obesity than girls at all ages [25].

Lower age classes were significantly associated with higher obesity prevalences in girls. This may be due to a generation effect, where newer generations would be adopting new nutrition and physical activity habits and be more prone to obesity ; another possible explanation is that increasing age would be associated with increased self-image care and fear of obesity, with consequential changes in nutritional habits and physical activity in order to decrease weight. However, this age difference was not found in Lebanese boys. The latter result is in contrast with those in Taiwan and Fuchean areas, where the highest prevalence of obesity within boys was between 10 and 12 years of age [25].

Further studies are needed to explain the nutritional behavior of Lebanese adolescents, the evaluation of the impact of globalization and westernization of social habits on mentalities in the Lebanese society, in addition to interactions with genetic, hormonal, biological, psychological, and environmental factors in causing obesity. An extension of the sample to lower age children and public schools adolescents would also be needed to have a wider idea about obesity in Lebanon.

From the clinical point of view, interventions are necessary for preventing and treating both growth deficiency and obesity. Interventions aim to improve nutrition,



*Differences between boys and girls percentages are statistically significant ($p < 10^{-4}$).

FIGURE 4b Percentages of obesity and at risk of obesity in boys

reduce the risk of death or inadequate nutrition, help educate care givers, and lead to early referral for conditions manifested by growth disorders. In developing countries, Lebanon in particular, health workers should monitor growth to detect and intervene in children with evidence of malnutrition.

Prevention of obesity before adulthood is also very important, because it would be too difficult to loose weight by adulthood. Early recognition of obesity is thus necessary [26] ; it is possible by routine assessments of eating and activity patterns in children, in addition to evaluation of weight gain relative to linear growth throughout childhood. Longer periods of outdoor playing should be recommended, aiming to increase energy expenditure and acquire less body fat by the time of early adolescence [27]. According to the guidelines for childhood obesity prevention program, living actively, eating in healthful ways, and creating a nurturing environment that respects cultural food ways and family traditions should be emphasized [28]. Research will also be needed to evaluate the long-term safety and efficacy of dietary weight loss approaches [21].

In conclusion, prevalences of obesity and risk of obesity in Lebanese adolescents of private schools are high. Early recognition of excessive weight gain, education and appropriate interventions are of utmost importance.

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نمو وبدانة اليافعين اللبنانيين في المدارس الخاصة

موجز : مدخل - غاية هذه الدراسة هي لوضع مخططات الوزن والقامة ومشعر الكتلة الجسدية وحساب انتشار البدانة نسبة للجنس ولمجموعة الاعمار عند اليافعين اللبنانيين في المدارس الخاصة.

اليافعون والطرق - وزن الجسم وقياس القامة ومشعر الكتلة الجسدية اخذت مقاييسها عند ١٢٢٩٩ يافعا بعمر ١٠-١٨ عاما من المدارس الخاصة اللبنانية. منحني نمو اليافعين ثبت. اليافعون البدينون او الذين هم في خطر البدانة حددوا استنادا الى عتبات القيم الموضوعه من قبل «حملة مهمة البدانة العالمية» والنسب المئوية التي استحصلنا عليها قورنت مع نسب بلدان اخرى.

النتائج - منحنيات الوزن والقامة ومشعر الكتلة الجسدية وضحت: ١٠,٨٪ من الاطفال كانوا بدينين و ٢٨,٨٪ لديهم خطر البدانة و ٤,٢٪ من الفتيات بدينات و ١٩٪ معرضات للبدانة.

الخلاصة - يبدي يافعوا المدارس الخاصة اللبنانية وخاصة الذكور ترجيحا مرتفعا للبدانة او خطر الاصابة بالبدانة. على اختصاصيي الاطفال ان يشيروا الى اليافعين الذين لديهم الاستعداد للبدانة لتحسين الانذار عندهم مستقبلا.