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Prevalence of overweight and obesity in Azorean adolescents (Portugal)

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Objective: There are no data available on overweight and obesity prevalence among Portuguese adolescents living in the Azorean Islands. Therefore, the purpose of this study was to report the prevalence of overweight and obesity in a representative sample of Azorean adolescents.
Design: This study was conducted using a representative sample of 2,124 Azorean adolescents ages 15 to 18 years. Weight and height were measured and participants were classified according to the International Obesity Task Force (IOTF) and the World Health Organization (WHO) cut-offs. ***Results:*** Results showed a prevalence of overweight and obesity of 24.9% and 6.5% in girls, and 19.3% and 7.7% in boys, respectively (p = 0.008), according to the IOTF criteria, whereas the figures for the WHO criteria were 24.9% and 9.8% in girls, and 21.1% and 10.5% in boys, respectively (p = 0.123). The prevalence of overweight and obesity among Azorean adolescents is higher than that reported for Portuguese youth living in mainland Portugal, and in some age groups, these figures are doubled. ***Conclusion:*** The fact that Azorean adolescents exhibit a higher rate of obesity than their peers living in the mainland was also observed in other European countries, and therefore, strategies to promote healthy weight in this population are required.

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Key Words: adolescents; body mass index; obesity

INTRODUCTION

At a population level, the regular screening of physical activity and physical fitness levels, including body composition, should be considered a public health priority, as the lack of physical activity and/or physical fitness are implicated in the aetiology and prevalence of several non-communicable diseases, such as cardiovascular disease (CVD), diabetes, and cancer, and their risk factors (high blood pressure, raised blood sugar, and overweight), affecting the general health of the population worldwide (29).
The prevalence of obesity among children and adolescents is a major public health concern, as it is associated with both short- and long-term adverse health outcomes (27). Body fatness and a sedentary lifestyle, in the setting of a genetic predisposition, are considered the prime etiologic factors of metabolic syndrome (11, 14). Indeed, obesity and the lack of physical activity and fitness are modifiable lifestyle factors that have been associated with metabolic syndrome (MetS) in adolescents (2, 6, 8). Moreover, it is known that the emergence of metabolic syndrome parallels the rising rates of overweight and obesity observed in youth worldwide (21). Epidemiologic studies have shown that body mass index (BMI), the

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most widely recognized measure of obesity, is a powerful predictor of CVD (10).

The prevalence of overweight/obesity in Portuguese children and adolescents was reported by Sardinha et al. (26), but this study included only children and adolescents living in mainland Portugal. Corresponding studies in the Portuguese Islands of the Azores were lacking until Pereira et al. (20) reported the prevalence of overweight/obesity in Azorean children ages 6 to 10 years. Therefore, information regarding Azorean adolescents is lacking.

The Azores is one of the seven "outermost regions" of the European Union. These regions are distinguished by their low population density, their considerable distance from mainland Europe, and their considerable structural backwardness; as a result, they have received extra funding from the European Union to improve living conditions and promote economic and social development (9). The population is of European ancestry, and the economic activity is based mainly on tourism, fishing, and agriculture. The Azores, an archipelago of nine islands, have several unique social and geographical features and urban designs that differ from the mainland. All of the islands have volcanic origins and numerous landscapes with virgin forest and green fields. Most of the urban areas are small and located on the coast.

The aim of this study was to report the prevalence of overweight/obesity in a representative sample of Azorean adolescents ages 15 to 18 years. We hypothesize that the prevalence of overweight and obesity among Azorean adolescents is higher than that reported for adolescents living in mainland Portugal, as reported for other European islanders (3, 4, 12, 15, 24), and also because the Azores is a poor region of the European Union (9).

MATERIAL AND METHODS

Study Design and Sampling

Data for the present study are derived from the Azorean Physical Activity and Health Study II (APAHS II) and the Azores Growth Study. The Azorean Physical Activity and Health Study II is a longitudinal, school-based study with adolescents aimed to examine the relationships between physical activity, physical fitness, overweight/obesity prevalence, health-related quality of life, and related factors. The Azores Growth Study is also a school-based study with children and adolescents that is conducted every ten years (the first edition was in 1989) and aimed to evaluate secular trends in body size and physical fitness, and their relationship with perceived health. These school-based studies emerged from protocols established between the Azorean Government and the Portuguese Universities of Porto and Coimbra.

The Azorean Physical Activity and Health Study II was carried out in six of the nine Azorean Islands: São Miguel, Terceira, Faial, Pico, São Jorge, and Graciosa. The Azores Growth study was conducted in São Miguel, Terceira, Faial, Pico, and Flores. The islands of São Miguel, Terceira, Faial, and Pico represent about 90 percent of the Azorean population (13). In both studies, the population was selected by means of a proportionate stratified random sampling, taking into account the location (island) and the number of students by age and sex in each school. On the islands where data was collected for both studies, each study was conducted in a different set of schools.

Data were collected in 2008 from 2,154 adolescents. Thirty subjects aged < 14.5 or > 18.4 years and/or who had missing information on the variables of interest were excluded, resulting in a total of 2,124 participants.

The sample was adjusted by a weight factor in order to balance the sample in accordance with the distribution of the Azorean population in the schools and to guarantee the real representativeness.

All participants were informed about the objectives of the studies and the parent/guardian of each participant provided written informed consent.

Measures

Height and Weight: Height was measured to the nearest millimeter in bare or stocking feet with the adolescents standing upright against a stadiometer (Holtain Ltd., Crymych, Pembrokeshire, UK). Weight was measured to the nearest 0.10 kg, with the adolescents lightly dressed, using a portable electronic weight scale (Tanita Innerscan BC 532).

Subjects were classified into non-overweight, overweight, and obese, according to age and gender-specific cut-off points established by the International Obesity Task Force (IOTF) (7) and by the World Health Organization (WHO) for body mass index (BMI) (28) in order to allow comparisons between different studies that may have used either of the cut points.

Statistical Analysis

Decimal age was calculated, and each age group was categorized by the midpoint of an age range. For example, the group of adolescents categorized as 15 years of age included all adolescents between 14.50 and 15.49 years, and so forth.

One-tailed Student's T-test compared sex differences in continuous variables. Frequencies and Chi-Square Test were calculated for BMI categories by sex.

Data were analyzed with SPSS 17.0 for Windows ($p < 0.05$).

Table 1. Participants' characteristics and prevalence of overweight and obesity according to the IOTF and WHO criteria.

	All Sample N = 2,124	**Girls** N = 1,203	**Boys** N = 921	
	mean ± SD	mean ± SD	mean ± SD	p^a
Age (years)	16.02 ± 0.95	16.03 ± 0.95	16.0 ± 0.95	0.531
Weight (kg)	61.83 ± 12.65	58.50 ± 10.69	66.19 ± 13.65	< 0.001
Height (m)	1.65 ± 0.08	1.60 ± 0.06	1.71 ± 0.07	< 0.001
BMI (kg/m^2)	22.66 ± 3.88	22.72 ± 3.71	22.59 ± 4.09	0.225
BMI (IOTF)	%	%	%	p^b
Non-overweight	70.5	68.6	73.0	
Overweight	22.4	24.9	19.3	0.008
Obese	7.1	6.5	7.7	
BMI (WHO)				
Non-overweight	66.7	65.3	68.4	
Overweight	23.2	24.9	21.1	0.123
Obese	10.1	9.8	10.5	

BMI – Body Mass Index; IOTF – International Obesity Task Force; WHO – World Health Organization; SD – Standard Deviation; [a] – compares mean values between sexes with one-tailed T-Test; [b] – compares percentages between sexes with Chi-Square Test.

RESULTS

Boys were heavier and taller than girls ($p < 0.001$). The prevalence of overweight and obesity was 24.9% and 6.5% in girls, and 19.3% and 7.7% in boys, respectively ($p = 0.008$), according to the IOTF criteria. Considering the WHO cut-offs, the prevalence of overweight and obesity were 24.9% and 9.8% in girls, and 21.1% and 10.5% in boys, respectively ($p = 0.123$) (Table 1).

The highest prevalence of overweight/obesity combined was found among the 15-year-old female group (41%) and in the 16-year-old male group (33.1%) by the WHO criteria (Figures 1a and b).

As presented in Table 2, a higher prevalence of overweight and obesity for girls was observed on the island of Flores; for boys, a higher prevalence of overweight and obesity was observed on the island of São Jorge, regardless of the cut points considered.

DISCUSSION

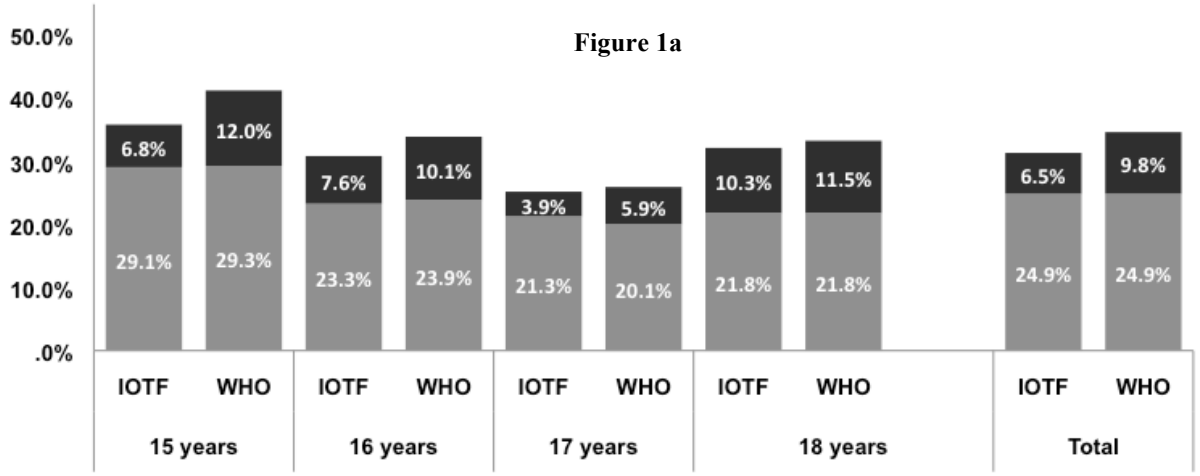
This is the first study reporting the prevalence of overweight and obesity among Azorean adolescents ages 15 to 18 years. The prevalence of overweight and obesity was 24.9% and 6.5% in girls, and 19.3% and 7.7% in boys, respectively (IOTF criteria). Similar figures for the WHO criteria were 24.9% and 9.8% in girls, and 21.1% and 10.5% in boys, respectively.

Sardinha et al. (25), in a school-based study with Portuguese children and adolescents ages 10 to18 years, found a prevalence of overweight and obesity of 17.0% and 4.6% in girls, and 17.7% and 5.8% in boys, respectively (IOTF criteria); for the WHO criteria, the prevalence of overweight and obesity was 23.1% and 9.6% in girls and 20.4% and 10.3% in boys, respectively. Although a representative sample was used, this study was confined to children and adolescents living on the mainland. Recently, among

Table 2. Sex- and age-adjusted prevalence of overweight and obesity according to the IOTF and WHO criteria, by island and sex.

Island	**São Miguel**			**Terceira**			**Faial**			**Pico**			**São Jorge**			**Graciosa**			**Flores**		
	All Sample	Girls n = 1017	Boys n = 849	All Sample	Girls n = 468	Boys n = 411	All Sample	Girls n = 110	Boys n = 116	All Sample	Girls n = 104	Boys n = 102	All Sample	Girls n = 76	Boys n = 53	All Sample	Girls n = 12	Boys n = 18	All Sample	Girls n = 24	Boys n = 24
BMI (IOTF)																					
Non-overweight	72.3	70.0	75.1	68.5	67.1	70.1	69.2	64.9	73.3	71.9	74.8	69.0	65.4	63.9	67.4	74.5	77.3	72.7	65.9	60.5	71.3
Overweight	20.3	22.5	17.6	23.4	24.3	22.3	25.6	31.6	20.0	21.7	19.3	24.1	24.0	23.0	25.6	20.0	18.2	21.2	24.3	29.1	19.5
Obese	7.4	7.5	7.4	8.1	8.5	7.6	5.1	3.5	6.7	6.4	5.9	6.9	10.6	13.1	7.0	5.5	4.5	6.1	9.8	10.5	9.2
BMI (WHO)																					
Non-overweight	65.7	63.9	67.9	59.9	58.3	61.7	62.8	57.0	68.3	66.8	68.9	64.7	61.5	63.9	58.1	74.5	77.3	72.7	56.6	52.3	60.9
Overweight	22.2	24.0	20.1	26.8	27.8	25.6	27.4	33.3	21.7	22.1	21.8	22.4	20.2	19.7	20.9	16.4	13.6	18.2	28.3	31.4	25.3
Obese	12.1	12.2	12.1	13.4	14.0	12.7	9.8	9.6	10.0	11.1	9.2	12.9	18.3	16.4	20.9	9.1	9.1	9.1	15.0	16.3	13.8

BMI – Body Mass Index; IOTF – International Obesity Task Force; WHO – World Health Organization.



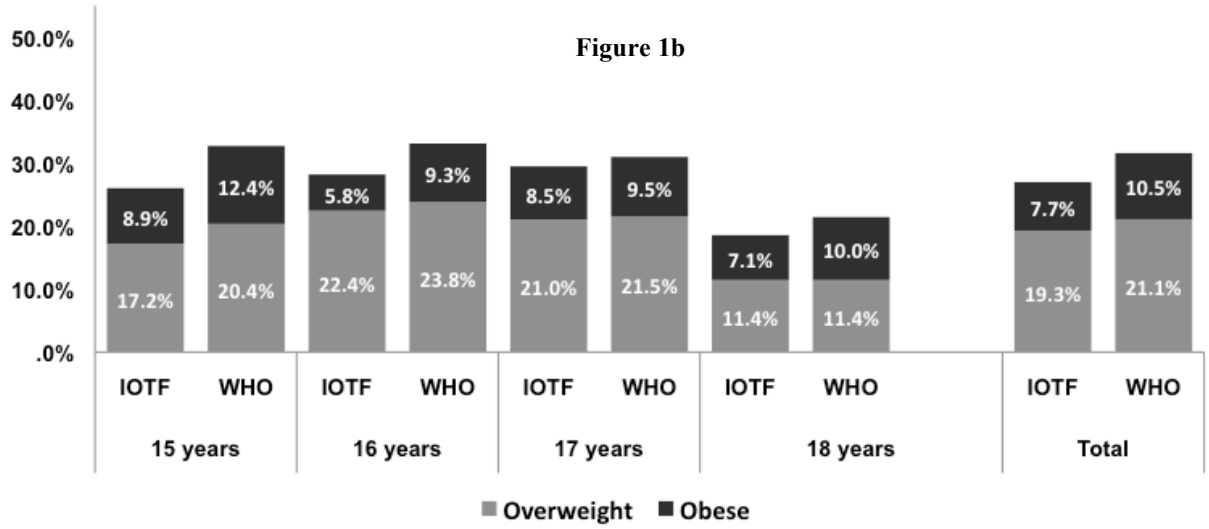


Figure 1. Prevalence of overweight and obesity in girls (1a) and boys (1b).

Azorean children ages 6 to10 years, a prevalence of overweight/obesity of 36% in girls and 29.9% in boys (IOTF criteria) (20) was reported.

Comparing our results with the study by Sardinha et al. (26), the combined prevalence of overweight/obesity among Azorean adolescents is significantly higher in both sexes and for all age groups, regardless of the criteria considered; for example, by the age of 18, the combined prevalence of overweight/obesity in Azorean girls is more than double that of their peers living in mainland Portugal (32.2% vs. 15.9%, IOTF criteria).

The fact that the prevalence of overweight/obesity is slightly higher among islanders than in those living on the mainland is interesting and is in line with a previous study of Azorean adults (24). Martinez et al. (15) also reported a higher prevalence of obesity among Spanish adults living on the Islands of Canarias, another of the outermost regions of the European Union, when compared to those living in mainland Spain. Equally, the combined prevalence of overweight/obesity found in adolescents living on the Balearic Islands (4) and on the Island of Gran Canaria (12) was higher than that observed in Spanish adolescents living on the mainland. Baratta et al. (3) also described a higher prevalence of overweight/obesity for Sicilian adolescents compared to youngsters living in mainland Italy.

Previous analysis with a subsample of the APAHS II has shown that body fat (18), low physical fitness, and lack of physical activity (16, 19), in addition to an unhealthy dietary pattern, are related to the clustering of cardio-metabolic risk factors (17), showing that among Azorean adolescents, obesity may be implicated in the prevalence of other CVD risk factors. Nevertheless, the causes of the very high prevalence of overweight/obesity in Azorean adolescents are not clarified by our study; however, we can speculate that

there may be some unique cultural and environmental features capable of influencing overweight/obesity in islanders, such as social-cultural backgrounds, values, beliefs, and life expectations. Unfortunately, no data is available for comparisons between islanders and mainlanders using these variables. Nevertheless, the hypotheses of consanguinity and endogamy may also be considered as possible explanations, since it is known that in geographically and culturally isolated communities, there is a high frequency of marriage between relatives or between those belonging to the same social group, which in turn could favor an increased genetic homogeneity (5, 22). However, while some authors found high rates of endogamy in some Azorean villages during the nineteenth century (1), others did not (23).

In conclusion, compared with other European countries, the prevalence of overweight/obesity among Azorean islanders is higher than reported for adolescents living in mainland Portugal, and in some age groups, this figure is doubled. Therefore, strategies to promote healthy weight in this population are required. Understanding which factors may act as possible determinants of these high rates should be considered as an important next step in the investigation of overweight and obesity among Azorean adolescents in order to inform future health-promotion strategies. Future studies to monitor trends over time are also necessary, taking into account the potential impact of differential secular trends in height and weight on the prevalence of nutritional status based on worldwide BMI cut-off points generated in stable populations.

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