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Anthropometric, cardiorespiratory and biochemical profile of adolescent students of a federal institute in Rio Grande do Sul state, Brazil

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Abstract

The study aimed to determine/describe/outline the anthropometric, cardiorespiratory and biochemical profile of adolescent students of a federal institute in Rio Grande do Sul state, Brazil. Participants were 63 freshman students of an integrated high school, and body mass index, waist circumference, body fat percentage, maximum oxygen uptake, glucose, total cholesterol and triglycerides were assessed. There were significant differences between the sexes regarding the percentage of fat and maximal oxygen uptake. Also, there was a significant percentage of overweight, excess body fat and total cholesterol above the recommended levels for this age group. Thus, these results evidence the importance of developing prevention actions against weight gain, or to maintain healthy weight in this population, in order to promote health and quality of life for these students.

Key words: Adolescent. Student. Health Profile. Weight Gain.

Introduction

Adolescence, according to physiology, is defined as the sum of biological processes that aim at attaining the reproductive capacity. The hormonal mechanisms that regulate this phase lead to a significant increase of the individuals' size and weight. At this stage, there are alterations in body composition, in somatic growth, and the emergence of sexual characters, which begin at different ages. Such differences are relative to the adolescent's sex, race and the environmental and cultural characteristics that surround them. Adolescence is not just a stage of development, from the hormonal and physiological point of view, but also of psychic development, identity and habits definitions for the individual's future life.[1,2]

The term "adolescence" comes from the Latin verb "*adolescere*" (*ad* = to and *olescere*= grow up), the stage of development of the adult identity, transition to maturity, when the individual experiences body and psychological changes and discoveries, with the physical development preceding the psychological. It is characterized by intense growth and development, marked by striking anatomical, physiological and social changes.[3-6]

In adolescence, individuals experience the best health indices, which can be maintained and/or improved, depending on how they perceive and value their health. Therefore, the nutritional and epidemiological transition occurring in adolescence has been pointed as a strategic period for the prevention of diseases and health promotion, directly influencing the quality of life of this population. An early detection of diseases, proper treatment and rehabilitation should be based on integrated actions, and at the same time, present articulated strategies for preventive and curative actions. Addressing adolescents' health implies thinking of biological, social and behavioral changes and the most diverse ways of experiencing adolescence, which will culminate on the adults' future conception. Treating adolescents properly means preventing costly expenditures and diseases to the future of the country.[7,8]

Overweight and obesity in childhood can already be considered an epidemic, encompassing developed and developing countries and affecting both boys and girls similarly, and is associated with more frequent health problems and increasingly high costs. Obesity in adolescence can result in increased blood pressure, dyslipidemia, diabetes, besides psychological, emotional and relationship disorders. All these problems culminate in higher morbidity and mortality rates in adulthood, especially due to the development of cardiovascular diseases.[9-11]

The World Health Organization states that effective measures for controlling obesity should include preventive and health-promoting approaches in childhood and adolescence, in order to avoid its permanence or aggravation in adulthood. To this end, it is necessary to identify the individuals at higher risk of developing complications from overweight and adopt measures to protect them.[12,13]

In this context, this study aimed to outline the anthropometric, cardiorespiratory and biochemical profile of adolescent students of a federal institute located in the state of Rio Grande do Sul.

Method

This is a cross-sectional study involving 63 freshman students admitted in 2012 to technical courses integrated to the high school of the *Instituto Federal Farroupilha Campus São Vicente do Sul (IFF-SVS)*, who voluntarily agreed to participate in the survey. The parents or legal guardians signed the Informed Consent Form (ICF). The courses that participated in the study were Maintenance and Support to Information Systems and Farming.

The sample consisted of 19 female students (30.2%) and 44 male students (69.8%). Inclusion criteria were as follows: being enrolled for the first time in the first grade of integrated technical courses at said federal institute and submitting the ICF signed. Exclusion criteria were as follows: age higher than 18 years and having pathologies that could interfere with the nutritional, cardiorespiratory and biochemical assessment, such as morbid obesity and/or respiratory problems. No student who returned the ICF signed was more than 18 years old or had any disease that would impede him/her from participating in the study; therefore, at this stage no student was excluded.

Of 161 ICFs delivered, 67 returned signed, of which two students were not present at the day of data collection; blood drawing was not possible in one of the students, and a female student did not agree to perform the Cooper test. Therefore, four students were excluded from the study. In March, the researcher measured the weight, height and waist circumference of the students. In April, blood was collected from the students after 12-hour fasting. Afterward, the students ate breakfast, waited for at least 30 minutes, and then proceeded to the measurement of skinfold thickness and performance of Cooper test.

For nutritional assessment, the following anthropometric variables were studied: body mass index (BMI=kg/m^2), waist circumference (WC) and percentage of body fat (% BF),observing the criteria and recommendations prescribed by Heyward (2004).[14] The BMI values were identified according to the WHO curves, 2007/NCHS, 1977,[15] observing sex and age, and classified as defined by WHO.[16] Three weight categories were set: low weight (percentile >5), eutrophy (percentiles between ≥ 5 and 85) and overweight (percentile ≥85).

The waist circumference (WC) values were classified according to the table of percentiles for children and adolescents developed by Taylor et al.,[17] overweight being considered for values above percentile 80. The percentage of body fat (% BF) was determined by the triceps skinfold thickness

(TST) and subscapular skinfold thickness (SST); based on the sum of both skinfold thicknesses, overweight was classifed as percentile >90, according to the method described by Frisancho,[18] and % BF was determined according to Lohman et al.[19]

Cardiorespiratory fitness, assessed by the maximum oxygen uptake (VO_{2max}), was measured via the Cooper test, performed at the institution's athletics track, consisting of continuous running on a free 500-meter track for 12 minutes, observing, during the application of the test, the criteria proposed by Cooper.[20] VO_{2max} was calculated by the formula [VO_{2max} = (m – 504.9)/44.73], where "m" indicates the distance in meters that each individual was able to complete.[21,22] Such measurements were performed by UNISC's volunteers, previously trained and skilled.

The institution's doctor prescribed biochemical tests for glucose (G), total cholesterol (TC) and triglycerides (TG), and UNISC's skilled volunteers and professionals and a hired nurse collected blood from the students for the biochemical analyses. Prior to blood collection, the subjects were instructed to fast for 12 hours, and not to perform physical exercises during the 12 hours that preceded blood collection. Ten milliliters of blood were drawn from the brachial vein; the sample was placed in tubes with an anticoagulant and then centrifuged to obtain the plasma samples for analysis at UNISC's laboratories.

According to the standards defined and simplified by WHO and the Brazilian Diabetes Society, the individuals who presented fasting blood sugar levels ≥ 126mg/dl were considered diabetics; the individuals whose blood sugar levels were less than 100mg/dl (normal) and with impaired glucose tolerance (IGT), i.e., those whose blood glucose levels were between 100 and 126mg/dl,[23] were considered nondiabetics. For determination of dyslipidemias, we used the lipid reference values proposed for 2 to 19 years old individuals by the I Brazilian Guideline for Atherosclerosis Prevention in childhood and adolescence. Optimal TC values were considered for scores less than 150mg/dl (OC); limit values, scores between 150 and 169mg/dl (LC); and considered with augmented cholesterol, TC levels higher than 170mg/dl (AC). Regarding triglycerides, values >100mg/dl were considered optimal (OT); limit values, between 100 and 129mg/dl (LT); and augmented triglyceride (AT), ≤ 130mg/dl.[24,25]

Continued variables were presented as means and standard deviation. Data were compiled in electronic spreadsheet (Excel, Microsoft Office 2000) and then analyzed by the Statistical Package for Social Sciences for Windows (SPSS - version 20.0).

The project from which the study originated was approved by the Research Ethics Committee of the University of Santa Cruz do Sul (UNISC), under protocol no. 2.960/11, and authorized by the managing director of IFF-SVS.

Results

Of 63 adolescents assessed, 69.8% were male, the majority in the age range of 14 to 15 years (14.6 ± 0.789), all of them enrolled in the first year of the high school of IFF-SVS (Table 1).

Table 1. Demographic characteristics of freshman students of IFF-SVS high school. São Vicente do Sul-RS, Brazil, 2012.

	Total % (n)	Female % (n)	Male % (n)
Sampling	100 (63)	30.2 (19)	**69.8 (44)**
Age (years) *	14.6 ± 0.789	14.5 ± 0.697	14.7 ± 0.829
Age range			
14-15 years old	**84.2 (53)**	89.5 (17)	81.8 (36)
16-17 years old	15.8 (10)	10.5 (2)	18.2 (8)

* Mean ± standard deviation.

Table 2 shows details of the students' anthropometric, cardiorespiratory and biochemical characteristics, with data expressed in mean and standard deviation, with data significance calculated between the female and male groups. BMI and %BF were higher for the female students, and VO_{2max} was higher for male students. Significant differences in %BF and VO_{2max} variables were also observed for male and female students.

Table 2. Anthropometric, cardiorespiratory and biochemical characteristics of freshman students of IFF-SVS high school. São Vicente do Sul-RS, Brazil, 2012.

Variables	Total (n=63) $\bar{x}$ ± SD	Female (n=19) $\bar{x}$ ± SD	Male (n=44) $\bar{x}$ ± SD
Anthropometric			
BMI	21.3 ± 3.4	22.6 ± 2.9	20.9 ± 3.6
WC	74.9 ± 9.1	73.5 ± 8.4	75.5 ± 9.5
%BF	22.8 ± 8.1	28.6 ± 5.6	20.3 ± 7.8
Cardiorespiratory			
VO2max.	30.2 ± 8.6	21.2 ± 4.0	34.1 ± 7.0
Biochemical			
Glucose	88.0 ± 7.8	85.9 ± 8.8	88.9 ± 7.2
Cholesterol	149.9 ± 25.4	158.5 ± 24.2	146.2 ± 25.3
Triglycerides	42.5 ± 19.7	49.3 ± 19.8	39.6 ± 2.8

BMI – body mass index; WC – waist circumference; % BF – percentage of body fat.

When classifying the students' anthropometric characteristics through the percentiles (Table 3), one can see that most of the students were classified as eutrophic, with higher percentage of eutrophic girls in all variables, despite overweight shown in 31.6% of the girls. It is worth noting that, according to the waist circumference, 29.5% of the boys were overweight.

Table 3. Anthropometric characteristics of freshman students of IFF-SVS high school, classified according to the percentiles. São Vicente do Sul-RS, Brazil, 2012.

Variables	Total % (n)	Female % (n)	Male % (n)
BMI LW	9.5 (6)	0 (0)	13.6 (6)
Eutrophy	68.3 (43)	68.4 (13)	68.2 (30)
OW	22.2 (14)	31.6 (6)	18.2 (8)
WC Eutrophy	71.4 (45)	73.7 (14)	70.5 (31)
OW	28.6 (18)	26.3 (5)	29.5 (13)
% BF Eutrophy	88.9 (56)	94.7 (18)	86.4 (38)
OW	11.1 (7)	5.3 (1)	13.6 (6)

BMI – body mass index; WC – waist circumference; %BF – percentage of body fat. LW – low weight; OW – overweight.

The students' biochemical scores are described in Table 4 and show that 97.3% of the students, of both sexes, had glucose values as recommended by WHO and the Brazilian Diabetes Society. Although there was no occurrence of diabetes, 6.3% of the students, most of them male, had impaired glucose tolerance. Regarding total cholesterol, 50.8% of the students were within the limits considered healthy, and despite this result, 31.6% of the female students and 31.8% of male students were within the limit cholesterol values (LC). Concerning triglycerides, all students (100%) had optimal scores.

Table 4. Biochemical characteristics of freshman students of IFF-SVS high school, classified according to the reference values for the age. São Vicente do Sul-RS, Brazil, 2012.

Variables		Total % (n)	Female % (n)	Male % (n)
Glucose	NG	**93.7 (59)**	**94.7 (18)**	**93.2 (41)**
	IGT	6.3 (4)	5.3 (1)	6.8 (3)
	DM	0 (0)	0 (0)	0 (0)
Cholesterol	OC	**50.8 (32)**	**42.1 (8)**	**54.5 (24)**
	LC	**31.7 (20)**	**31.6 (6)**	**31.8 (14)**
	AC	17.5 (11)	26.3 (5)	13.6 (6)
Triglycerides	OT	**100 (63)**	**100 (19)**	**100 (44)**
	LT	0 (0)	0 (0)	0 (0)
	AT	0 (0)	0 (0)	0 (0)

NG – normal glucose; IGT – impaired glucose tolerance; DM – diabetes mellitus; OC – optimal cholesterol; TC – limit cholesterol; AC – augmented cholesterol; OT – optimal triglycerides; TT – limit triglycerides; AT – augmented triglycerides.

Discussion

This study aimed at outlining the anthropometric, cardiorespiratory and biochemical profile of freshman students of the IFF-SVS high school. We observed a significant percentage of students with overweight, excessive body fat and total high cholesterol values, above the recommended levels for this population. This fact is of concern because of the earliness of overweight occurrence and its effects on health.

The body mass indices and percentage of body fat in the students assessed in this study, considering standard deviations, are similar to the ones found in a study with schoolchildren in Santa Cruz do Sul-RS, Brazil,[26] which revealed BMI of 20.73±4.09 in the female students and 20.15±3.74 in the male ones, and %BF of 25.65±6.94 and 18.72±8.84 in the female and male subjects, respectively. However, it should be considered the age differences between both studies.

Higher VO_{2max} scores found for the male students, when compared to the female ones, are more frequent in the literature.[27] Cultural factors relating to the boys' practice of physical activities, as well as a higher likelihood of muscle development in male individuals, favor such diagnosis. Regarding the girls, the greatest amount of body fat may contribute to such differences, according to study performed by Cotinguiba and Sergipe.[27]

Such finding converges to our study, once we found a higher percentage of body fat in the girls. A possible explanation could be the female adolescents' tendency to gain larger amount of fat mass, due to the increased estrogen levels in puberty, while male adolescents have increased testosterone levels. As a result, the increased fat mass will reflect higher %BF.

Of the studied adolescents of both sexes, 68.3% were classified as eutrophic according to their BMI values, but the fact that 22.2% of the studied population is overweight and with excessive body mass is worrisome, once overweight and high body mass can lead to obesity. Even at this age range such situation can be related to risk factors for cardiovascular diseases, increasing obesity-related morbidities and mortality in adults.[28,29]

In a study with schoolchildren in Itapetininga-SP, Brazil,[30] aged 2 to 19 years, 22.5% of them had overweight and obesity (>P85), values that are similar to the present study. This shows that the overweight level found in this study with a sample of 63 students of the federal institute is close to the reality of other samples of studies conducted in this country.

According to the 2008-2009 Household Budget Survey (HBS)[31] conducted nationwide with 10 to 19-year children and adolescents, in female subjects overweight increased from 7.6% in the 1974-1975 survey to 19.4% in 2008-2009; for male subjects, from 3.7%, to 21.7%. Thus, the overweight scores found in this survey for female adolescents are higher, and in males, lower, if we compared to the 2008-2009 HBS.

In view of the increasing number of children and adolescents at risk of cardiovascular diseases,[32] another fact of concern is that 31.6% of female subjects and 31.8% of male subjects were classified as having limit cholesterol levels (LC). Such values were higher in the study with schoolchildren conducted in Belém-PA,[33] where LC reached 18% in female subjects and 16% in male subjects.

As can be seen, triggering risk factors for dyslipidemia have also been found in children and adolescents. Currently, the cardiovascular risk factors traditionally described for adults have been extended to the pediatric population.[34,35] Hyperlipidemia has already been considered a key factor for the occurrence of atherogenesis in children and adolescents,[36] and the continued occurrence of lipid fractions throughout adulthood has also been described, once most of the children maintain the same cholesterol levels until adulthood.[37]

Final considerations

Through the findings of this study, we can see that the anthropometric profile of the adolescents studied revealed overweight, as well as body fat, with scores higher than the ones found in other Brazilian populations studied. The cardiorespiratory profile found is consistent with the literature studied, with a higher percentage among the male students. It is worth noting that the biochemical profile characteristics of the first-year students of the FF-SVS high school were inadequate for the age, as found in the limit and augmented levels.

Given the overweight, body fat and total cholesterol levels above the recommended levels for the age, it is vitally important to implemented health-promoting actions. Because they are factors of possible intervention, educational strategies, such as actions to prevent weight gain or maintenance are ways of promoting health and the quality of life of these students.

Finally, we emphasize the need to go beyond the diagnostic phase and propose intervention alternatives, especially when we consider school as the institution responsible for formal education and dissemination of healthy behavior to this population.

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