Association of obesity with chronic disease and musculoskeletal factors

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Summary

Introduction: overweight and obesity in adolescents are major public health problems with particular interest, because of their potential association with risk factors for development of diseases. The study aimed to determine the prevalence of overweight and obesity in adolescents in southern Portugal and investigate the association with risk factors for development of cardiovascular, respiratory and musculoskeletal diseases.

Methods: the sample consisted of 966 adolescents aged 10 to 16 years. The calculation of body mass index (BMI), evaluation of blood glucose, total cholesterol and triglycerides, blood pressure, spirometry and application of low back pain (LBP) questionnaire were performed.

Results: 178 (18.4%) adolescents were overweight and 52 (5.4%) obese. None of the variables revealed a statistically significant association with overweight and obesity. The presence of high blood pressure was observed in 200 (20.7%) individuals and hypertension in 158 (16.4%) adolescents. Overweight and obese adolescents are 2.3 times more likely to develop signs of pre-hypertension and hypertension. 559 (57.9%) students had restrictive respiratory disorders and 23 (2.4%) had obstructive disorders. Those who were overweight and obese had 0.64 probability of having restrictive respiratory disorders.

Conclusions: there was a high prevalence of overweight and obesity in Portuguese adolescents and these showed a statistically significant relationship with the development of pre-hypertension and hypertension, and restrictive respiratory disorders.

Keywords: obesity, hypertension, dyslipidemias, hyperglycemia, low back pain, adolescent.

Introduction

The prevalence of overweight and obesity increased in almost all countries, indicating a growing global epidemic of childhood obesity.[1] It is estimated that about 10% of school-aged children around the world present excess of body fat with increased risk of developing of chronic non-communicable diseases,[2] such as cardiovascular diseases, type 2 diabetes mellitus, respiratory and musculoskeletal disorders.[3-6]

Insulin resistance, a pathophysiological condition that is involved in the genesis of type 2 diabetes, is present in 30% of children with obesity.[7-9] Furthermore, obese children and adolescents have 9 times more chances to develop hypertension.[9]

In addition, several studies have assessed the possibility of obesity increasing the risk for development of asthma and other obstructive respiratory diseases.[10-16] The possible mechanisms for this relationship include airway inflammation, produced by substances in adipose tissue, hormonal influences and changes in physical activity.[10]

Obesity can also cause changes in lung function, leading to restrictive respiratory disorders caused by parenchymal lung disease or disorders of the chest wall.[17,18]

In addition to the factors mentioned above, overweight and obesity are considered variables associated with musculoskeletal disorders, which may aggravate them due to increased stress applied to the bony struc-

tures sustaining heavier load requirements. Increased body fat, particularly in the abdominal region, promotes the modification of the body's center of gravity forward, which can result in lumbar hyperlordosis[19] and this change in lumbar curvature can cause pain.[20]

The aim of this study was to determine the prevalence of overweight and obesity in adolescents in southern Portugal and investigate the association with risk factors for developing chronic conditions such as hyperglycemia, dyslipidemia, hypertension, restrictive and obstructive respiratory disease and musculoskeletal disorders, such as low back pain (LBP).

METHODS

The design of this epidemiological study was observational, analytical, and cross-sectional.

Previous to collecting data, informed consent was requested to parents and guardians who were informed about the objectives and evaluations to be conducted, with all fundamental rights being guaranteed according to proper codes of ethics.

The study was approved by the Ethics Committee of the Regional Health Administration of the Algarve, the Regional Directorate of Education of the Algarve, the Directorate General for Innovation and Curriculum Development, the Ministry of Education and Science and the directors of schools that participated in the project.

Population

The population involved students enrolled in public schools from all counties of Algarve, south of Portugal, of both sexes, aged between 10 and 16 years. Considering as an estimate of population dimension the number of students between the fifth and ninth grades (26,217 students), the minimum sample size was defined as 948, considering an estimate of the annual prevalence of overweight of 20% reported in national studies[21,22] and assuming an error margin of 2.5%, with a confidence internal of 95%. The authors opted for the use of prevalence of overweight, since the values of the prevalence of thinness and obesity are lower than these.

Inclusion criteria involved students who were present on the data collection days, who had brought the parental or guardian consent and wanted to participate.

A stratified random sample was used, based on counties, assuming that we can have geographical heterogeneities. Within each county and if there was more than one school in the county, schools were selected randomly. After that, classrooms were randomly selected, until the desired number of students per school was obtained.

The dimension of samples by counties was proportional to the number of students enrolled in each county in a public school, considering three classes of counties: small (<1,000 students), medium (1,001-2,000 students) and large (>2,000 students). Different dimension samples were required for each one (40, 70 and 100 students, respectively).

Measurements

Body mass index (BMI)

For body weight measurement, the authors used a Seca 780 digital scale, with a 150 kg capacity and 100 g precision. Weight measurements were performed using a 200 cm stadiometer. In both measurements, students were standing upright, with no shoes and coats, according to standard procedures.[23]

BMI was calculated and the adolescents were classified as underweight, normal weight, overweight and obese, according to the limits proposed by Cole et al.[3,24]

Glucose, total cholesterol and triglycerides

Blood collection was performed in the morning, with students fasting for at least 8 hours.

Blood glucose values followed the standards established by the American Diabetes Association for adolescents in fasting state[5] and the reference values for total cholesterol and triglyceride levels were based on American College of Sports Medicine.[25]

Systemic blood pressure

Before the measure of systemic blood pressure, the students were seated five minutes to obtain baseline values. The determination of arterial pressure was applied through two measurements with two-minute intervals, by the same evaluator, the average being calculated.

Hypertension in childhood was defined when the systolic or diastolic blood pressure were located above the 95th percentile and the pre-hypertension values were higher than 90 and lower than 95th percentile.[5,26]

Spirometry

For spirometry, the authors used Spirodoc (MIR) equipment that evaluated FEV_1 (forced expiratory volume in 1 second), the FEV_1/FVC (forced vital capacity) ratio and FEF 25-75% (flow measured between 25 and 75% of the total expired volume).

Students held a deep inspiration, followed by a brief period of apnea and immediately (with her/his mouth on the mouthpiece of the equipment) made a rapid and forced expiration.

Airway obstruction was characterized by a reduction in FEV_1 less than 80%, FEV_1/FVC ratio less than 75%, FEF 25-75% less than 70% and FVC may be normal or reduced.[25,27]

Restrictive respiratory disorders of the airways were characterized by a reduction in FEV_1 less than 80%, the FEV_1/FVC ratio could be normal or above 70% and FVC showed values lower than 80%.[25,27]

Low back pain questionnaire
This questionnaire has been validated by Coelho et al.[28] and involved questions about the sociodemographic characteristics of the population, physical activities at school and outside, the weekly time spent with electronic games and watching TV and the presence of LBP in the last year.

Data analysis
The first approach was taken through a statistical description of the usual techniques of descriptive and analytical statistics for all variables of this study. After this, the various associations between variables were analyzed using statistical inference, namely the Chi-square independency test.

The influence of variables pre-hypertension and hypertension, restrictive and obstructive respiratory disorders, gender and age group in individuals with overweight and obesity was assessed using binary logistic regression models. The models Enter e Forward LR and the Omnibus, Hosmer, Lemeshow and Nagelkerke tests were used, and odds ratios (OR) crude and adjusted and respective confidence intervals were presented.

Due to some small numbers and in order to satisfy the requirements of applicability of Chi-square Independency test, the variables BMI classification, ethnicity, glucose, cholesterol, triglycerides, blood pressure and weekly hours playing games and watching television were grouped.

The statistical analysis was performed with the Statistical Package for Social Sciences (SPSS) version 19.0. Statistical significance was set at 0.05.

RESULTS
The minimum number set to the sample to a precision error of 2.5% was exceeded, with a sample of 966 students, aged between 10 and 16 years (12.24 ± 1.53 years), where 437 (45.2%) were male and 529 (54.8%) female.

Table 1 presents the results of the associations between weight status and the variables analyzed in this study.

On the analysis of blood glucose, 2 students (0.2%) refused to participate due to fear of the sting. For logistical reasons, the capillaries levels of total cholesterol and triglycerides were not assessed in the whole sample. Total cholesterol levels were evaluated in 929 students. The

assessment of the capillary triglyceride levels was performed in 432 adolescents.

Table 2 shows the results obtained for the event of excess weight and obesity, based on logistic binary regression models. In the adjusted model, the values obtained in Omnibus, Hosmer and Lemeshow and Nagelkerke tests for the characteristics of the sub-sample overweight and obesity, adjusted for the variables of blood pressure, values of spirometry, age group and gender, were respectively: p<0.001, p=0.114 and R2=0.86, being considered mathematically valid models for the realization of analysis.

The high blood pressure variable was correlated with overweight and obesity, where adolescents classified as overweight or obese had 2.3 times (95% CI: 1.72-3.18, p<0.001) more probability of developing signs of pre-hypertension and hypertension, and 0.64 times (95% CI: 0.47-0.87, p<0.001) more chances to have restrictive respiratory disorders.

DISCUSSION
This study revealed a high prevalence of overweight and obesity (23.8%) in a representative sample of 966 southern Portugal adolescents. Sardinha et al.,[21] who evaluated 22,048 Portuguese individuals aged 10 to 18 years in 2008, found a prevalence of overweight and obesity of 22.6%. Another national study by Ferreira,[22] realized in 2007-2008, obtained higher values than this study, being 30.4% with overweight and obesity in 5,708 students aged 10 to 18 years, while the study by Marques-Vidal et al.,[29] held in Lisbon between the years 2000 and 2002, evaluated 5,013 individuals aged 10 to 18 years and obtained a prevalence of overweight and obesity of 46.9%.

Regarding data from studies conducted in other countries, the study by Kovalskys et al.[30] evaluated 1,588 adolescents from 10 to 11 years in Argentina and obtained values of prevalence of overweight and obesity of 27.9%. Similar results were obtained by Shields et al.[31] who evaluated 8,661 Canadian children and adolescents, aged between 2 and 17 years, in 2004, and found a prevalence of 26%. The study by Pellegrini et al.[32] obtained a lower prevalence of 15.3% in 33,728 Brazilian adolescents aged between 11 and 17 years, and the results by Stigler et al.,[33] who assessed 1,818 individuals from India with mean ages between 13.9 and 15.8 years, revealed a prevalence of overweight and obesity of only 13.7%.

All the above studies used BMI to assess weight status according to the criteria established by the International Obesity Task Force (IOTF),[3] the same used in the present study. The reasons for the observed differences between the values of the prevalence of overweight and obesity can be explained by virtue of the populations that

TABLE 1 Associations between weight status and the study variables.

Variables		Thinness (28, 2.9%)	Adequate (708, 73.3%)	Overweight (178, 18.4%)	Obesity (52, 5.4%)	p-value
Gender	Male (437, 45.2%)	7 (1.6%)	340 (77.8%)	73 (16.7%)	17 (3.9%)	0.01
	Female (529, 54.8%)	21 (4%)	368 (69.6%)	105 (19.8%)	35 (6.6%)	
Age group	10-12 years (574, 59.4%)	20 (3.5%)	391 (68.1%)	122 (21.3%)	41 (7.1%)	<0.01
	13-16 years (392, 40.6%)	8 (2%)	317 (80.9%)	56 (14.3%)	11 (2.8%)	
Ethnicity	Caucasians (894, 92.5%)	24 (2.7%)	654 (73.2%)	167 (18.7%)	49 (5.5%)	0.223
	Black (68, 7%)	3 (4.4%)	53 (77.9%)	9 (13.2%)	3 (4.4%)	
	Asian origin (4, 0.4%)	1 (25%)	1 (25%)	2 (50%)	0	
Glycemia	Hypoglycemia (647, 67%)	20 (3.1%)	480 (74.2%)	113 (17.5%)	34 (5.3%)	0.428
	Adequate (315, 32.8%)	8 (2.5%)	224 (71.1%)	65 (20.6%)	(18, 5.7%)	
	Hyperglycemia (2, 0.2%)	0	2 (100%)	0	0	
Total cholesterol	Adequate (877, 94.4%)	22 (2.5%)	648 (73.9)	160 (18.2%)	47 (5.4%)	0.137
	Threshold high risk (45, 4.8%)	3 (6.7%)	26 (57.8%)	12 (26.7%)	4 (8.9%)	
	High (7, 0.8%)	1 (14.3%)	5 (71.4%)	1 (14.3%)	0	
Triglycerides	Adequate (414, 95.9%)	4 (1%)	304 (73.4%)	82 (19.8%)	24 (5.8%)	0.836
	Threshold high risk (12, 2.7%)	0	7 (58.3%)	5 (41.7%)	0	
	High (6, 1.4%)	0	6 (100%)	0	0	
Blood pressure	Hypotension (87, 9%)	3 (3.4%)	72 (82.8%)	11 (12.6%)	1 (1.1%)	0.001
	Adequate (521, 53.9%)	21 (4%)	401 (77%)	81 (15.5%)	18 (3.5%)	
	Pre-hypertension (200, 20.7%)	1 (0.5%)	142 (71%)	44 (22%)	13 (6.5%)	
	Hypertension (158, 16.4%)	3 (1.9%)	93 (58.9%)	42 (26.6%)	20 (12.7%)	
Spirometry	Adequate (384, 39.8%)	2 (0.5%)	273 (71.1%)	83 (21.6%)	26 (6.8%)	0.018
	Restrictive (559, 57.9%)	2 (8.7%)	422 (75.5%)	89 (15.9%)	24 (4.3%)	
	Obstructive (23, 2.4%)	2 (8.7%)	13 (56.5%)	6 (26.1%)	2 (8.7%)	
Time watching TV (per week)	Up to 5 hours (446, 46.2%)	12 (2.7%)	315 (70.6%)	88 (19.7%)	31 (7%)	0.809
	Between 6 to 10 hours (303, 31.4%)	9 (3%)	236 (77.9%)	49 (16.2%)	9 (3%)	
	Between 11 to 15 hours (127, 13.1%)	4 (3.1%)	91 (71.7%)	22 (17.3%)	10 (7.9%)	
	More than 15 hours (90, 9.3%)	3 (3.3%)	66 (73.3%)	19 (21.1%)	2 (2.2%)	
Time playing games/ computer (per week)	Up to 5 hours (649, 67.2%)	21 (3.2%)	465 (71.6%)	122 (18.8%)	41 (6.3%)	0.342
	Between 6 to 10 hours (184, 19%)	3 (1.6%)	150 (81.5%)	26 (14.1%)	5 (2.7%)	
	Between 11 to 15 hours (73, 7.6%)	3 (4.1%)	50 (68.5%)	15 (20.5%)	5 (6.8%)	
	More than 15 hours (60, 6.2%)	1 (1.7%)	43 (71.7%)	15 (25%)	1 (1.7%)	
Physical activity (outside of school)	Yes (627, 64.9%)	17 (2.7%)	468 (74.6%)	112 (17.9%)	30 (4.8%)	0.249
	No (339, 35.1%)	11 (3.2%)	240 (70.8%)	66 (19.5%)	22 (6.5%)	
Low back pain	Absence (510, 52.8%)	16 (3.1%)	376 (73.7%)	94 (18.4%)	24 (4.7%)	0.604
	Presence (456, 47.2%)	12 (2.6%)	332 (72.8%)	84 (18.4%)	28 (6.1%)	

* Chi-square independency tests were applied using the grouped classes defined in data analyses.

TABLE 2 Results of binary logistic regression for the event of excess weight and obesity.

Variables	Odds ratio crude (95%CI); p	Odds ratio adj** (95%CI); p
Systemic blood pressure (hypotension and appropriate*)	2.23 (1.65-3.01); p<0.001	2.34 (1.72-3.18); p<0,001
Pre-hypertension and hypertension		
Spirometry (adequate*)		
Obstructive respiratory disorder	1.35 (0.56-3.26); p=0.512	1.19 (0.48-2.96); p=0.706
Restrictive respiratory disorder	0.64 (0.47-0.87); p<0.001	0.67 (0.47-0.87); p=0.005
Age group (13-16 years*) 10-12 years	1.92 (1.39-2.65); p<0.001	--------
Gender (Male*) Female	1.39 (1.03-1.88); p>0.033	--------

*class reference; **adjusted to sex and age

have been evaluated and the socio-economic context; however, this variable was not analyzed in this study.

Blood glucose was one of the variables analyzed in this study, being observed a low prevalence of hyperglycemia in students evaluated (0.2%). Ekelund et al.[34] verified the presence of metabolic syndrome in European children, including Portuguese, and revealed a prevalence of 0.2% in individuals aged 10 years and 1.4% in those aged 15 years. However, this study found no significant association between blood glucose values with overweight and obesity, possibly due to low prevalence of elevated blood glucose levels. This study revealed a high prevalence of hypoglycemia, which in children can lead to impaired of cognitive function, affecting brain development.[35]

As for the capillary levels of total cholesterol and triglycerides, although we have not seen a statistically significant association with overweight and obesity, a high prevalence of students classified as overweight and obese had high levels of cholesterol and triglycerides (32.7 and 27.8%, respectively).

This study revealed a high prevalence of high blood pressure and hypertension (37.1%), being overweight and obesity an associated factor for its development. Similar results were obtained by Aounallah-Skhiri et al.,[36] where the values of high blood pressure were observed in 35.1% of 2,870 individuals; however, the age group differed from the present study and included individuals aged between 15 and 19 years from Northern Africa.

The results of the prevalence of pre-hypertension and hypertension obtained in this study differ from other studies in Portugal[37-39] and in other countries.[40-42] Monego and Jardim[43] revealed a prevalence of hypertension of only 5% in a sample consisting of 3,169 Brazilian individuals aged 7 to 14 years. The difference between studies may possibly be attributed to the different method of collection of these values and the characteristics of the study area. For example, a study by Santiago et al.[37] included individuals living in rural and suburban areas

not being subjected to daily stress of an urban environment, which could influence the values of blood pressure. In addition, the sample used in the study may differ in other aspects, such as the Maldonado et al.[39] study, which found a prevalence of 28% of pre-hypertension and hypertension in individuals aged 5 to 18 years, considering however that the subjects in the sample had a level of physical activity rated as above average and a prevalence of obesity less than the estimate for the population.

This study also demonstrated an association between high BMI and high blood pressure, where individuals with overweight and obesity were 2.3 times more likely to develop high blood pressure. This relationship between the presence of overweight and hypertension can be justified according with three main mechanisms: the activation of the sympathetic nervous system, renal and hormonal dysfunctions.[44]

Similar results were obtained in others studies, where BMI was positively related to high blood pressure.[37,43,45] Maldonado et al.[39] found that individuals with adequate weight had a prevalence of hypertension of 8%, so that the prevalence in overweight individuals was 14% and in obese individuals, 23%. The same association was obtained by Hirschler et al.[46], where the blood pressure values were higher in the obese group compared with the non-obese group, and hypertension was present in 25% of obese patients, and absent in the non-obese group.

The high prevalence of pre-hypertension and hypertension in the present study and the results obtained in other studies suggest an increased prevalence of pre-hypertension and hypertension in adolescents over the years, as seen with the prevalence of overweight and obesity. That is, since overweight and obesity are increasing worldwide,[2,4] and these are related to increased levels of blood pressure, it is estimated that an increase in individuals who may develop high blood pressure in adolescence should happen. However, the association between obesi-

ty and hypertension is not yet fully explained, and new studies are required to explore the cause-effect relationship, by means of cohort studies.

This increase in the prevalence of obesity has coincided with a major change in how adolescents spend their time, which results in a decrease in the level of physical activity and an increase in sedentary behaviors.[47,48] This study revealed a prevalence of 13.8 and 22.4% of individuals who adopted sedentary habits, such as playing games or watching television, respectively; however, there wasn't a statistically significant association between these habits and overweight and obesity.

Regarding respiratory disorders, most individuals classified as overweight showed abnormalities in spirometric evaluation, as well as half of the obese individuals. In most overweight and obese students presenting respiratory disorders, these were classified as obstructive in character, such as asthma and chronic bronchitis.

Bertolace et al.[11] found no statistically significant association between increased BMI and the presence of asthma, despite having found a higher value of BMI in asthmatic patients compared with non-asthmatics. Cassol et al.,[12] on the other hand, found a positive association between obesity and the prevalence of asthma in 4,010 adolescents in southern Brazil. Vlaski et al.[16] found that being overweight was significantly associated with an increased risk of having asthma (OR: 2.36, 95% CI: 1.02-5.44, p=0.04).

Although many studies have found an association between obesity and asthma, a cause-effect relationship could not be established in most of them, furthermore, most studies defined the presence of asthma using a questionnaire assessing self-reported symptoms and not a definite diagnosis by other suitable clinical criteria.

Most students assessed by spirometry showed restrictive respiratory disorder, being included in this classification many students with overweight and obesity. Although the majority of individuals classified as overweight and obesity present obstructive respiratory disorder (34.8%), a large proportion of these also revealed restrictive respiratory disorder (28.4%). However, since the proportion of subjects with obstructive respiratory disorder was reduced, no statistical significance was obtained in the application of logistic regression. The opposite occurred with obese individuals who had restrictive respiratory disorders, who constituted a large part of the study sample.

Restrictive respiratory disorder presents as characteristics decreased lung compliance, which causes a decrease in ventilation. Alveolar hypoventilation is present in approximately 10-20% of obese individuals and includes the presence of hypoxemia accompanied by hypercapnia.[18]

However, the exact mechanism explaining why some obese individuals have hypoventilation while others do not is still unknown. There is a chance of mechanical overload, which shows that hypoventilation is secondary to mechanical limitation, resulting from a decrease in the thoraco-pulmonary distensibility, fatigue and respiratory muscle weakness, or obesity may be a factor leading to decreased lung compliance to promote changes in respiratory diaphragm and rib cage.[17,18]

In relation to musculoskeletal disorders, the presence of LBP in the last year was reported by approximately half of the students assessed (47.2%). Spinal pain is very common in children and adolescents, with a prevalence between 30 to 51%.[20] Skaggs et al.[49] evaluated 1,540 students aged between 11 and 14 years and found a prevalence of 37% of reported LBP. Data referring to Portugal, particularly in Lisbon, point to an annual prevalence of LBP of 39.4% in 208 adolescents aged between 11 and 15 years, between 2002 and 2003.[28]

The data from this study revealed that approximately 25% of students with LBP were classified as overweight or obese, but this association did not reach statistical significance. The study of Kovacs et al.[50] did not find an association between BMI and the presence of LBP, either. This fact can be explained by the influence of other risk factors mentioned above, such as change in lumbar curvature, which may be caused by a change in the center of gravity by virtue of increased abdominal circumference and the weakness of the abdominal muscles (both factors may be a result of excess weight).[19] Nevertheless, LBP in adolescent depends on multiple risk factors, being necessary the identification, interpretation and understanding.[51]

This study examined several factors that could be associated with overweight and obesity; however, only the variables hypertension and respiratory disorders showed values with statistical significance. The influence of overweight and obesity in the development of hypertension and respiratory disorders is very important from the point of view of public health, since these factors are amenable to change, making it important to identify the actual number of cases in terms of incidence and prevalence, as well as changes in weight status, and verify the associated risk factors present in the adolescent population in the Algarve region.

Further investigations that can determine the factors of cardiovascular and respiratory risk associated with overweight and obesity through analysis of cohort studies are suggested.

This study had limitations such as being conducted through a single evaluation in time, consisting of a cross-

sectional study. Thus, the blood pressure measurement was performed only once, on the day of the evaluations, and it was not possible to obtain confirmation of an accurate diagnosis. The diagnosis of hypertension is made by repeated blood pressure measurements, clinical history, physical examination, and laboratory tests. Blood pressure is characterized by variations during the day and between several days. Thus, the diagnosis of hypertension should be based on multiple blood pressure measurements performed at different times. If blood pressure is high during an assessment, repeated measurements should be carried out over months to confirm the finding.[26] Nevertheless, the investigation by McNiece et al.[42] found that the number of individuals with blood pressure above the normal limits is unchanged between the first and the third evaluation. Performing only one assessment in time was due to the difficulty of performing measurements on different days, which may compromise the educational performance of schools. The same procedure should have been done to spirometry, which should be performed at another time to confirm the change, since the technique requires cooperation between the subject and the evaluator, and the results depend on both the technique and personal factors.[52]

CONCLUSION

The data from this study revealed a high prevalence of overweight and obesity in a representative and stratified sample of 966 adolescents living in the south of Portugal, and these showed a statistically significant relationship with the development of pre-hypertension and hypertension and restrictive respiratory disorders.

ACKNOWLEDGMENTS

RESUMO

Associação da obesidade com fatores de risco para doenças crônicas e musculoesqueléticas

Introdução: o sobrepeso e a obesidade em adolescentes são atualmente considerados problemas de saúde pública, com interesse decorrente de sua associação a fatores de risco para o desenvolvimento de doenças.
Objetivo: determinar a prevalência de sobrepeso e obesidade em adolescentes do sul de Portugal e investigar os fatores associados ao desenvolvimento de doenças cardiovasculares, respiratórias e musculoesqueléticas.

Métodos: a amostra foi constituída por 966 adolescentes com idade entre 10 e 16 anos. Foi calculado o índice de massa corporal (IMC) e foram realizadas avaliações de glicemia, colesterol total, triglicerídeos, pressão arterial, espirometria, além da aplicação de um questionário para avaliar a presença de lombalgia.
Resultados: cento e setenta e oito (18,4%) adolescentes apresentaram sobrepeso e 52 (5,4%) eram obesos. Nenhuma das variáveis analisadas revelou associação estatisticamente significativa com sobrepeso e obesidade. Duzentos (20,7%) adolescentes apresentaram pressão arterial elevada e 158 (16,4%), hipertensão. Os adolescentes com sobrepeso e obesidade revelaram 2,3 vezes mais chances de desenvolver pré-hipertensão e hipertensão. Quinhentos e cinquenta e nove (57,9%) alunos apresentaram doenças respiratórias restritivas e 23 (2,4%), distúrbios obstrutivos, sendo que os indivíduos com sobrepeso e obesidade apresentaram 0,64 de probabilidade de desenvolver doenças respiratórias restritivas.
Conclusão: observou-se uma elevada prevalência de adolescentes portugueses com sobrepeso e obesidade. Essas variáveis demonstraram uma relação estatisticamente significativa com o desenvolvimento de pré-hipertensão e hipertensão arterial e com doenças respiratórias restritivas.

Palavras-chave: obesidade, hipertensão, dislipidemias, hiperglicemia, dor lombar, adolescente.

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