

EXCESS WEIGHT AND HIGH BLOOD PRESSURE IN SCHOOLCHILDREN: PREVALENCE AND ASSOCIATED FACTORS

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Abstract

Introduction: Recent studies have indicated that increases in overweight and obesity rates as well as cardiovascular risk factors, such as hypertension, are occurring at younger ages. However, the causes and factors associated with these increases are still difficult to determine. **Objective:** To identify the associated factors and the prevalence of overweight and high blood pressure among schoolchildren. **Methods :** One thousand eight hundred sixty-eight students comprised the sample. The data were obtained through anthropometric measurements, blood pressure measurements, cardiopulmonary evaluations and questionnaires. Descriptive statistics, chi-square tests and Poisson regressions ($p \leq 0.05$) were used. **Results:** In this sample, 28.6% and 15.9% of the students were overweight and had high blood pressure, respectively. The males were found to be more susceptible to both of the studied risk factors. The prevalence of high blood pressure among the adolescents was 1.173 - fold greater than that among the children. In contrast, adolescence itself was a protective factor in terms of overweight (RP = 0754). The prevalence of overweight in the children with increased waist circumferences and poor cardiopulmonary aptitudes were increased by 5.5 - and 1.3 - fold, respectively. **Conclusion:** The prevalence of overweight and high blood pressure in the school population was high in the investigated city. Cardiorespiratory aptitude, increased waist circumference and family history exhibited influences on overweight and high blood pressure.

Key words: overweight, obesity, arterial pressure, risk factors, child, adolescent.

INTRODUCTION

Obesity and hypertension are growing health problems among the Brazilian and mundial populations^{1,2}. Despite the large number of studies of obesity, its causes remain difficult to determine because it is a multifactorial disease that is related to environmental factors, including lifestyle, and physiological factors, such as genetics^{3,4}.

Similarly, cardiovascular diseases are also associated with genetic factors and lifestyle, and there is evidence that the severity of atherosclerosis is directly proportional to the number of risk factors to which each subject is exposed that that these effects become more evident with advancing age^{2,5}.

However, current studies have warned of the increasing prevalence of obesity and hypertension among children and adolescents^{2, 6}. This is a troubling situation because the presences of these conditions in childhood and adolescence are strong predictors of their occurrence in adulthood^{6,7}.

Nevertheless, these conditions are modifiable risk factors and therefore should be the focus of preventive and educational actions particularly with regard to the adoption of healthy lifestyle habits because the habits acquired in childhood tend to persist into adulthood^{3,5,7}.

We emphasize the importance of conducting investigations related to obesity and high blood pressure to characterize the affected populations and direct programmes and strategies that enable the diagnosis and treatment of these populations. The objective of this study was to identify the prevalence of overweight and high blood pressure and the associated factors among schoolchildren from southern Brazil.

METHODS

A cross-sectional study was conducted with a sample of schoolchildren of both sexes between

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the ages of seven and seventeen who were enrolled in schools in the municipality of Santa Cruz do Sul, Rio Grande do Sul. The study included nineteen schools, fourteen of which were located in urban areas, and five were in rural zones. The schools were randomly selected based on stratified cluster sampling. Among the evaluated schools, ten offered only elementary education, and nine included primary and secondary education. In all of the evaluated schools, at least one class in each year and stage of education was invited to participate.

The data collection was conducted in 2011 and 2012. The survey was approved by the Research Ethics Committee with Human Beings of the University of Santa Cruz do Sul (process 2525/10), and all parents or guardians provided written consent authorizing the participation of the schoolchildren in the study. The authors declare that they have no conflicts of interest related to this study. One thousand nine hundred sixty-three schoolchildren joined the study and performed the evaluations. Due to data inconsistencies or the submission of incomplete data, 96 subjects were excluded from the study. Thus, the final number of included subjects was 1867.

Subjects up to twelve years of age were considered children, and those older than twelve were considered adolescents according to the criteria of the Child and Adolescent Statute⁸. Socioeconomic status was classified according to the Associação Brasileira de Empresas de Pesquisa - ABEP criteria⁹; thus, the subjects were separated into eight distinct economic classes (A1, A2, B1, B2, C1, C2, D and E). However, for this study, these classes were reduced to the following three groups: higher economic class (A1, A2, B1 and B2), intermediate class (C1 and C2) and lower class (D and E).

We conducted anthropometric measurements of weight and height (direct measurements) and subsequently calculated the body mass indices (BMI = weight/height). The BMIs were classified using the percentile (p) curves of the CDC/NCHS¹⁰ according to gender and age; thus, the schoolchildren were classified as low weight (< p 5), normal weight (\leq p 5 and < p 85), overweight (p \geq 85 and < p 95) and obese (\geq 95). In the present study, the term "excess weight" (SE) refers to the overweight and obese students, i.e., those with BMIs above the 85th percentile. Waist circumferences (WCs) were measured with an inelastic tape measure with 1-mm resolution at the narrowest part of the trunk between the ribs and the iliac crest and were subsequently classified according to criteria established by Taylor *et al*.¹¹

A single evaluator performed all of the blood pressure measurements with the student sitting at rest. Sphygmomanometers were used at the brachial perimeter of the left arm in conjunction with a stethoscope. Due to the wide range of ages assessed, we used cuffs with three different cuff sizes, i.e., paediatric, adolescent and adult. The cuff size was selected according to the age and a measurement of the circumference of the student's arm. The classifications were performed according to the percentiles for age, sex and height and were

considered normal at < the 90th percentile, borderline between the 90th and 95th percentiles and hypertensive (stages 1 and 2) above the 95th percentile in accordance with the VI Brazilian Hypertension Guidelines¹². In the present study, "high blood pressure" (HBP) was defined by a systolic (SBP) or diastolic blood pressure (DBP) above the 90th percentile, i.e., the borderline and hypertensive students included in this category.

Cardiorespiratory fitness was assessed using the 9-minute test from the PROESP-BR¹³ manual. The histories of hypertension and obesity were self-reported by the parents of the schoolchildren with reference to the existence of obesity, hypertension or both in the fathers and mothers of the schoolchildren.

The data were analysed with SPSS 20.0 (IBM, Armonk, NY, USA) for Windows using descriptive analyses (frequencies and percentages). The analyses of the associations between variables were performed using the chi-square method at a $p \leq 0.05$ significance level. To evaluate the prevalence ratios for overweight and high blood pressure, we used Poisson regressions ($p \leq 0.05$).

RESULTS

The characteristics of the subjects are shown in Table 1. One thousand eight hundred sixty-seven schoolchildren were evaluated, and there were greater percentages of females (54.4%) and adolescents (51.5%). Regarding the other factors studied, the prevalence of a low level of cardiorespiratory fitness was 37.4%, 19.1% of the students had high waist circumferences, and the prevalences of obesity and hypertension among the father, mother, or both were 10.7% and 27.6%, respectively (Table 2).

Table 1: Characteristics of the evaluated schoolchildren; n (%)

Gender	
Male	851 (45.6)
Female	1016 (54.4)
Age group	
Children	905 (48.5)
Adolescent	962 (51.5)
School type	
Private	100 (5.4)
Public	1767 (94.6)
Residence region	
Centre	365 (19.5)
Periphery	795 (42.6)
Rural	707 (37.9)
Socioeconomic class	
A and B	910 (48.7)
C	884 (47.3)
D and E	73 (3.9)
TOTAL	1867 (100)

Table 2: Prevalence of the studied variables; n (%)

CRF*	
High levels	1168 (62.6)
Low levels	699 (37.4)
WC*	
Normal	1511 (80.9)
Elevated	356 (19.1)
Obesity in Father/Mother	
No	1668 (89.3)
Yes	199 (10.7)
Hypertension in Father/Mother	
No	1352 (72.4)
Yes	515 (27.6)
TOTAL	1867 (100)

*CRF = cardiorespiratory fitness; WC = waist circumference.

The prevalence of excess weight was 28.6% (16.1% overweight and 12.5% obese), and excess weight was significantly more common among the males, the children, between the periphery, those with low levels of cardiorespiratory fitness, those with increased waist circumferences and those with fathers and/or mothers who were obese (Table 3). The students with increased waist circumferences and low levels of cardiorespiratory fitness exhibited excess weight prevalence that was elevated by 5.5- ($p < 0.001$) and 1.3-fold ($p = 0.013$), respectively. The adolescents were less likely to have excess weight than the children ($PR = 0.754$).

Among all students, 15.9% were identified as having high blood pressure (7.3% borderline and 8.6% hypertensive). The prevalence of this condition was significantly higher in males, the adolescents, the students with high WCs and the students with fathers and/or mothers with hypertension. Additionally, high blood pressure was

Table 3: Prevalence of overweight and obesity according to the studied variables and prevalence ratios for excess weight (overweight and obesity)

Variables	BMI*		p**	PR (CI95%)*	p
	Overweight	Obesity			
Gender					
Male	142 (16.7)	126 (14.8)	0.011	1	0.133
Female	158 (15.6)	107 (10.5)			
Age group					
Children	178 (19.7)	146 (16.1)	<0.001	1	0.002
Adolescent	122 (12.7)	89 (9.0)			
School type					
Private	14 (14.0)	10 (10.0)	0.575	1	0.707
Public	286 (16.2)	223 (12.6)			
Residence region					
Centre	58 (15.9)	27 (7.4)	<0.001	1	0.290
Periphery	151 (19.0)	108 (13.6)			
Rural	91 (12.9)	98 (13.9)			
Socioeconomic class					
A and B	146 (16.0)	117 (12.9)	0.552	1	0.944
C	141 (16.0)	103 (11.7)			
D and E	13 (17.8)	13 (17.8)			
CRF*					
High levels	83 (11.9)	39 (5.6)	<0.001	1	0.013
Low levels	217 (18.6)	194 (16.6)			
WC*					
Normal	184 (12.2)	29 (1.9)	<0.001	1	<0.001
Elevated	116 (32.2)	204 (57.3)			
Obesity of Father/Mother					
No	250 (15.0)	189 (11.3)	<0.001	1	0.185
Yes	50 (25.1)	44 (22.1)			
TOTAL	300 (16.1)	233 (12.5%)			

* BMI = body mass index; PR = prevalence ratio; CI95%: 95% confidence interval; CRF = cardiorespiratory fitness; WC = waist circumference.

** chi square test: $p < 0,05$.

also more prevalent among the students with high BMIs and more prevalent among the obese children compared with overweight children and among the overweight children compared to the normal weight schoolchildren. High blood pressure differences were

not found according to the type of school, region of residence, economic class or cardiorespiratory fitness. The adolescents exhibited a prevalence of high BP that was 1,173 ($p < 0.001$) times greater than that of the children (Table 4).

Table 4: Prevalence of high blood pressure according to the studied variables and prevalence ratios for high blood pressure

Variables	BP*		p**	PR (CI95%)*	p
	Borderline	Hypertensive			
Gender					
Male	81 (9.5)	79 (9.3)	0.001	1 0.963 (0.884 – 1.049)	0.388
Female	55 (5.4)	81 (8.0)			
Age group					
Children	19 (2.1)	50 (5.5)	<0.001	1 1.173 (1.075 – 1.281)	<0.001
Adolescent	117 (12.2)	110 (11.4)			
School type					
Private	5 (5.0)	6 (6.0)	0.393	1 1.011 (0.812 – 1.259)	0.920
Public	131 (7.4)	154 (8.7)			
Residence region					
Centre	32 (8.8)	22 (6.0)	0.070	1 1.019 (0.889 – 1.167) 1.008 (0.880 – 1.155)	0.788 0.904
Periphery	46 (5.8)	78 (9.8)			
Rural	58 (8.2)	60 (8.5)			
Socioeconomic class					
A and B	77 (8.5)	70 (7.7)	0.225	1 1.002 (0.915 – 1.098) 0.989 (0.790 – 1.229)	0.961 0.926
C	56 (6.3)	82 (9.3)			
D and E	3 (4.1)	8 (11.0)			
BP*					
LW*/Normal	88 (6.6)	72 (5.4)	<0.001	1 1.079 (0.948 – 1.229) 1.165 (0.970 – 1.400)	0.251 0.102
Borderline	26 (8.7)	34 (11.3)			
Hipertensive	22 (9.4)	54 (23.2)			
WC*					
Normal	100 (6.6)	94 (6.2)	<0.001	1 1.047 (0.896 – 1.225)	0.561
Elevated	36 (10.1)	66 (18.5)			
CRF*					
High levels	52 (7.4)	47 (6.7)	0.088	1 0.990 (0.904 – 1.084)	0.826
Low levels	84 (7.2)	113 (9.7)			
Hypertension of Father/Mother					
No	83 (6.1)	101 (7.5)	<0.001	1 1.052 (0.958 – 1.115)	0.286
Yes	53 (10.3)	59 (11.5)			
TOTAL	136 (7.3)	160 (8.6)			

*BP = blood pressure; PR= prevalence ratio; CI95%: 95% confidence interval; BMI= body mass index; LW= low weight; WC= waist circumference; CRF= cardiorespiratory fitness.**chi square test: $p < 0,005$.

DISCUSSION

This study found a prevalence of excess weight of 28.6% (16.1% overweight and 12.5% obese), and excess weight was more prevalent among the male students. A previous study in this city revealed that the prevalence of overweight are increasing among boys and decreasing among girls¹⁴. Several studies corroborate to our results and have reported tendencies for overweight rates that are higher among male children and adolescents^{1,15-17}. In a study conducted in Minas Gerais, the male gender exhibited a 1.86-fold increase in the risk of excess weight¹⁸. A previous study by Ribeiro *et al.*¹⁹ revealed that girls are at a reduced risk of overweight (PR = 0.81).

The age range was significantly related to the prevalence of excess weight in this study; specifically, the children more prone to this risk factor than the adolescents. Similarly, a study conducted in Spain found that the prevalence of overweight was significantly higher among students

of aged 8-13 years compared with adolescents aged 14 to 17 years¹⁷. Another found that adolescents in China and Russia²⁰ were 0.4 and 0.3 times less likely, respectively, to fall into the overweight or obese range than children. Similarly, in our study, adolescents were at a lower risk for overweight (PR=0.754). A previous study in Canada found that the prevalence of overweight and obesity was similar across age groups²¹. In contrast to our findings, a study by Ribeiro *et al.*¹⁹ found that children are at a reduced risk of excess weight (PR = 0.54).

Regarding the economic variables, no significant differences were found according to the type of school or economic class of the school children, although the results revealed that the prevalence of overweight was higher among the lower classes and among the public school students. Similar results were found in a study conducted in the US in which children from lower socioeconomic levels exhibited the highest prevalence of overweight. However, in this same study, the opposite inverse relationship was observed in China;

i.e., the children and adolescents of high socioeconomic status exhibited greater prevalence of overweight and obesity²⁰.

The data from our study seem to differ from those of the majority of the existing studies in the literature regarding these issues. However, Alves *et al.*³ provided a warning about the inconsistencies of the relationship between excess weight and economic level, which do not follow a set pattern. A study in Singapore revealed that the risk of overweight was significantly higher among the highest economic classes (A-B) and among private schools⁵. In a study conducted in Espírito Santo, students from higher income homes were found to be 1.78-fold more likely to be overweight compared with low-income students²².

In a previous study conducted in Pernambuco, no significant association between overweight and family income was observed³. However, research conducted in northeastern Brazil corroborates our study in that the prevalence of excess weight was found to be higher among the lower classes; however, this difference was not significant. Nevertheless, in this same study, differences were identified by between public and private schools; the prevalence of excess weight was greater in the private schools⁴.

However, with respect to socioeconomic variables, residence in the periphery found to be associated with significantly higher prevalence of overweight and obesity compared with the central and rural areas of the Santa Cruz do Sul municipality. In a study conducted in the Brazilian northeast⁴, school in areas of better economic conditions exhibited a higher prevalence of excess weight than those in the north and west; this result contrasts our finding that prevalence of excess weight was greater among the students from underprivileged economic regions.

The prevalence of overweight and obesity was higher among the students whose fathers and/or mothers were obese among those with low levels of cardiorespiratory fitness and high WCs. The students with high waist circumferences and low levels of cardiorespiratory fitness presented excess weight prevalence that was elevated by 5.589- ($p < 0.001$) and 1.307-fold ($p = 0.013$), respectively. A study conducted in Santa Cruz do Sul and another conducted in the Espírito Santo state revealed that students with low levels of cardiorespiratory fitness exhibit higher frequencies of overweight and obesity than those with satisfactory cardiorespiratory fitnesses^{23,24}. However, the study conducted in Espírito Santo revealed that male and female students with low levels of cardiorespiratory fitness exhibited 9.98- and 4.81-fold increases in the risk of excess weight, respectively.

In a study conducted in Argentina, excess weight was also found to be associated with obesity in the parents²⁵. Additionally, a study conducted in São Paulo found an association between the prevalence of excess weight among the parents and overweight among the children; these prevalences were 9.3% among the students whose parents did not have excess weight, 17.6% among those who

had one parent with this condition and 26.1% among those with two parents carrying excess weight²⁶. In a study conducted in the municipality of Capão da Canoa (RS), the prevalence of overweight and obesity was significantly higher among the students whose fathers, mothers or both were obese. The risk of excess weight among schoolchildren with at least one parent who is overweight is increased by approximately 50%²⁷. In a study conducted in Espírito Santo, schoolchildren with mothers with BMIs greater than 25.0 kg/m² were found to be at a 2.04-fold increased risk of excess weight²².

Regarding blood pressure, the presence of high blood pressure was 15.9% among the students of Santa Cruz do Sul including 7.3% and 8.6% of schoolchildren who were classified as borderline and hypertensive, respectively. Another study in the same municipality revealed that the prevalence of high pressure is increasing among students¹⁴.

Regarding overweight, the prevalence of HBP was significantly higher among the males. Similar results have been reported in studies conducted in n Minas Gerais¹, Tunisia²⁸, Paraíba¹⁵ and South Africa⁶. Previous research in Alagoas⁵ and Piauí⁷ revealed no significant differences between genders. In contrast to the excess weight results observed in this study, the prevalence of HBP was higher among the adolescents than the children. These adolescents exhibited a prevalence of HBP that was 1,173-fold ($p < 0.001$) greater than that of the children. A study conducted in Canada reported that the prevalence of high systolic blood pressure increased with age²¹.

Regarding the variables related to economic class, neither the school type nor the housing region exhibited a relationship with the prevalence of hypertension in schoolchildren. In contrast, in Caxias do Sul (RS), significant differences related the type of school have been observed; the private schools were found to have a prevalence of high blood pressure that was nearly twice that of the public schools. Additionally, the children with higher socioeconomic statuses were 2.6 times more likely to have elevated blood pressure²⁹. A study conducted in Minas Gerais and another conducted in three large Brazilian cities revealed increases in the risk of high systolic blood pressure of 3.95- and 2.48-fold, respectively, among the students of public schools^{18,19}. A study conducted in Alagoas⁵ reported no association between hypertension and the type of school; however, an association between hypertension and membership in the highest economic classes was observed. In a study conducted in Paraíba, adolescents in the intermediate and lower income classes were 1.73- and 3.10-fold more likely, respectively, to have higher blood pressure than students in the highest economic classes¹⁵.

The prevalence of high blood pressure was also significantly higher among the students with high BMIs and WCs and among those whose fathers and/or mothers had hypertension. However, regarding cardiorespiratory fitness, there were no differences in the prevalence of HBP between the students with high and low levels of

cardiorespiratory fitness. Similarly, in a study conducted in the Espírito Santo state, no relationship between blood pressure differences and poor physical fitness were found²².

A study conducted in the municipality of Santa Cruz do Sul revealed that schoolchildren with low levels of cardiorespiratory fitness were more likely to have high blood pressure than those with good levels of cardiorespiratory fitness, albeit, this difference was not significant²³. A previous study conducted in Caxias do Sul (RS) found higher levels of cardiorespiratory fitness to be a protective factor against high blood pressure (OR=0.794)²⁹. Regarding the presence of hypertension in the parents, a study conducted in Argentina corroborates our findings; i.e., the adolescents with hypertensive mothers and fathers were 1.38-fold and 1.32-fold more likely to have hypertension, respectively²⁵.

The relationship between high blood pressure and overweight is clearly defined in the existing literature; several studies have found that high BMIs^{1,2,16,28} and high WCs^{2,29} are associated with high blood pressure. Overall, in the reviewed studies, the risk of high blood pressure among schoolchildren with excess weight are elevated by between 1.50- and 4.9-fold^{1,16,19,27-29}.

Furthermore, among students with WCs, the risk of high blood pressure is elevated by 3.84-fold². In a study conducted in Paraíba with overweight and

obese children and adolescents, 70.5% of students were found to have high blood pressure; among these students, only 6% had high systolic blood pressure, 33% had high diastolic pressure, and 31.5% had both. However, higher systolic blood pressure values were observed in the children with severe obesity and increased waist circumferences³⁰.

The prevalence of overweight and high blood pressure was increased among the schoolchildren from the investigated city, which demonstrates the need for the control and prevention of these conditions.

CONCLUSION

We concluded the factors that were associated with overweight and high blood pressure among the schoolchildren from the city of Santa Cruz do Sul were cardiorespiratory fitness, increased waist circumference and family history. Additionally, the male children and adolescents were more likely to have excess weight and altered blood pressure. Excess weight was more prevalent among the children, while high blood pressure was more prevalent among the adolescents. Finally, socioeconomic variables, such as the type of school, place of residence and economic class, did not influence the studied factors.

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Resumo

Introdução: Estudos atuais vêm apontando para o aumento das taxas de sobrepeso e obesidade e de fatores de risco cardiovasculares, como a hipertensão, em idades cada vez menores. No entanto, as causas e os fatores associados a este aumento ainda são de difícil de determinação. **Objetivo:** Identificar os fatores associados e a prevalência de excesso de peso e níveis pressóricos entre os escolares. **Método:** A amostra envolveu 1867 escolares. Os dados foram obtidos por meio de avaliações antropométricas, medidas da pressão arterial, avaliação cardiorrespiratória e aplicação de questionários. Utilizou-se estatística descritiva, qui-quadrado e regressão de Poisson ($p < 0,05$). **Resultados:** 28,6% e 15,9% dos escolares apresentaram excesso de peso e pressão elevada, respectivamente. O sexo masculino mostrou-se mais suscetível a ambos os fatores de risco estudados. Adolescentes apresentaram prevalência 1,173 vezes maior de pressão elevada que as crianças. Já, para o excesso de peso, a adolescência apresentou-se como fator de proteção ($RP = 0,754$). Escolares com circunferência da cintura elevada e aptidão cardiorrespiratória insatisfatória apresentaram prevalência de 5,5 e 1,3 vezes maior de excesso de peso, respectivamente. **Conclusão:** A prevalência de excesso de peso e pressão elevada na população escolar se mostrou alta no município investigado. Aptidão cardiorrespiratória, circunferência da cintura elevada e o histórico familiar mostraram influenciar no excesso de peso e nos níveis pressóricos elevados.

Palavras-chave: sobrepeso, obesidade, pressão arterial, fatores de risco, criança, adolescente.