

Overweight and obesity are not associated to high blood pressure in young people sport practitioners

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Abstract *The aim of this study was to analyze the association between overweight and obesity with high blood pressure (HBP) according to sports practice in young people. Took part in this study 636 young people aged 10 to 17 years of Londrina, Parana State, Brazil. Sex, age, parental education, sedentary behavior, sports practice, nutritional status and blood pressure were analysed. Poisson regression was used to estimate the prevalence ratio (PR) and 95% confidence intervals. Overweight and obesity young people showed higher prevalence of HBP compared to eutrophics when analysed the total sample (25,7 e 29,5 vs 15,2%) and non sport practitioners (29,7 e 33,3 vs 15,1%), which did not occur with sports practitioners (17,1 e 18,2 vs 15,5%). Positive associations were found between overweight and obesity with HBP in total sample (PR = 1,60, 1,02-2,52 and 1,93, 1,15-3,25) and on non sport practitioners (RP = 1,80, 1,05-3,14 and 2,15, 1,10-4,16). For young people sports practitioners were not found associations between overweight and obesity with HBP (PR = 1,01, 0,36-2,82 and 1,09, 0,48-2,48). Weight excess was not associated with HBP in young people sports practitioners, suggesting cardiovascular protection in young people with overweight and obesity.*

Key words *Adolescent, Motor activity, Nutritional status, Hypertension*

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Introduction

High blood pressure (HBP) is an important health risk because it increases the likelihood of being affected by cardiovascular disease in adults¹ and presents the highest risk fraction attributed to mortality². HBP is also an indicator of cardiovascular health in young people because it is positively associated with arterial stiffness, reduced diastolic function, intima-media carotid artery thickness, and cardiac hypertrophy of the left ventricle³⁻⁶. As well as presenting health risks to young people, HBP is related to resistance to insulin, leptin and blood pressure in adult life⁷, which suggests the importance of preventing HBP in childhood and adolescence.

Despite the risks that are known to be associated with HBP, a systematic review⁸ demonstrated that the prevalence of HBP ranged from 2.7 to 30.9% in children and adolescents from different regions of Brazil. Of the 21 studies included in the review, 12 reported a prevalence of HBP higher than 10%⁸. Studies conducted after the aforementioned systematic review reported a prevalence of HBP ranging from 12.4 to 19.4%⁹⁻¹¹.

It has been reported that HBP is associated with behavioral, biological and hereditary characteristics¹². One of the behavioral aspects that have been widely studied in young people is physical activity, which can be defined as any bodily movement produced by skeletal muscles that result in expending energy¹³. The physical activity of children and adolescents is predominantly conducted via sports¹⁴ which are defined as games using rules regulated by a federation and which have various objectives such as education, recreation, health or performance¹⁵. The literature contains controversial findings regarding the association between physical activity and HBP. Some studies have shown an inverse association between physical activity and blood pressure in young people¹⁶⁻²⁰ while others have shown no such association^{9,11,21-23}. A systematic review showed that the number of studies that showed an association between physical activity with blood pressure was lower than the studies that showed no association²⁴.

Among other associated factors, the conditions of being overweight and obese are considered to be the determining factors of HBP because they trigger several physiological mechanisms that result in HBP in young people²⁵. For this reason, overweight young people are 1.66 to 4.30 while obese are 5.19 to 5.40 more likely to have

HBP compared to eutrophic^{9-11,18,22,26}. The studies that are available in the literature have not investigated the association between overweight and obesity with HBP according to sports practice. It prevents to infer whether overweight and obese young people are more likely to suffer from HBP even if they practice sports.

Thus, the aim of this study was to analyze the association between overweight and obesity with HBP according to sports practice in young people.

Methods

This transversal study was conducted in state schools in the city of Londrina, Paraná, Brazil from April to July 2012. According to the Regional Education Center, the number of students in the sixth year of elementary school to the third year of secondary school was 55,475. The students who participated in the study were aged 10-17. The study sample was performed using the probabilistic method utilizing two clusters (school and classroom), which were stratified by regions of the city (north, south, east, west and center) and gender. The study was performed in two stages. In the first stage, one school was randomly chosen from each region. In the second stage, the number of students in each school was evaluated in order to select the ratio that represented the region.

The sample calculation was performed using the following parameters: population of 55475 students; 14.1% prevalence of high blood pressure²²; sampling error of 4%; 97% confidence interval and design effect of two. The sample of students required to perform the study was 636 participants. The calculations were performed using OpenEpi, version 3.03a software.

The inclusion criteria were as follows: to be enrolled in a state school, in schools selected for the study; to be aged between 10-17; to agree to participate voluntarily in the study; and to present authorization and informed consent to participate in the study. The exclusion criteria were to have any physical, metabolic or neurological injury that would prevent the implementation of the procedures of the study.

After authorization by the Londrina Regional Education Center and the direction of the selected schools, prior to the start of data collection the study objectives and the procedures to be performed were described. All those who were responsible for the young people who participated in the study signed an informed con-

sent form which set out all procedures, as well as the possible risks and benefits of the study. The study was approved by the Ethics Committee for Research Involving Human Beings of the State University of Londrina, in accordance with resolution 196/96 of the National Health Council. At the end of the study the results were presented to each participating school through an individual report.

All the research procedures were performed in the school in which the students were enrolled. The questionnaires were completed in the classroom as well as anthropometric and blood pressure measurements. The data collection was performed in the schools in which the participants were enrolled during a single day. All the information was collected by six researchers who were previously trained to perform all the procedures in a standardized manner, which was carried out under the supervision of the coordinator of the study.

The sports practice was estimated by the following question, which referred to the previous 12 months: *In terms of leisure activities and occupation of your free time do you practice sports?* The options for reply were as follows: *never; rarely; sometimes; often and always*²⁷. The young people were considered to practice sports if they answered *often* or *always*. At the time of data collection the study participants were informed that practicing sports was defined as any formal or informal sport which demanded physical effort.

Sedentary behavior was estimated by the following question: *How many hours on average do you watch TV, play video games or use the computer?* The options for reply were as follows: *less than one hour per day; one hour per day; two hours per day; three hours per day; four hours per day; and five or more hours per day*. The level of education of the head of the household was analyzed by the questionnaire used by the Brazilian Association of Research Companies²⁸.

Nutritional status was assessed by body mass index. A tape measure attached to the wall (Sanny, São Paulo, Brazil) with an accuracy of 1 mm, and an electronic weighing machine, which was accurate to 100 g and had a capacity of 150 kg (Plenna, model MEA-03140, São Paulo, Brazil), were used to perform the height and weight measurements respectively. The measurements were performed according to previously described standardizations²⁹. The cut-off points for being overweight and obese that were adopted were those proposed by the International Obesity Task Force (IOTF)³⁰.

Blood pressure was measured according to the guidelines contained in the “Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents”³¹. Prior to the implementation of the measures, all the young people were instructed not to use any stimulating substance¹². They remained seated with their feet on the floor and the lower back supported by a chair for five minutes. Two measurements were performed with an interval of 10 min between them, using an oscillometric device (Omron® model HEM 742), which was validated in a sample similar to the present study³². The young people were considered to have HBP if they had blood pressure above the 90th percentile, according to their gender, height and age group.

The description of the results was performed using the absolute and relative frequency. The bivariate association was performed using the chi-square test, adopting Fisher’s exact test when necessary. Poisson regression was used to estimate the crude and adjusted prevalence ratio (PR), as well as the confidence intervals of 95% of the association between nutritional status and HBP. The independent variables that presented an association that was $P < 0.20$ in the bivariate analysis were included in the adjusted analysis. Because of the complex sample design used in the study and analysis according to practicing sports, the design effect (deff) was estimated. The analyses were performed considering the stratum, the primary sampling unit, and the sample weight, using the “survey” (svy) of Stata 11.0 software.

Results

Of the 965 young people who were invited to voluntarily participate in the study, 78% accepted and performed all the procedures. Table 1 shows the characteristics of the study participants. There was a similar frequency of students in terms of gender and age in the total sample. The prevalence of youngsters who were overweight and obese was respectively 14.5 and 5.9%, while 17.5% had HBP.

Higher proportions of male participants, aged 10 to 12, were found to have sedentary behavior less than two hours per day in young people sports practitioners ($P < 0.001$). The frequency of young people who were overweight (14.2 vs 14.7%), obese (6.5 vs 4.5%) and with high blood pressure (18.4 vs 15.8%) were similar between the two groups ($P > 0.05$). The young people practi-

Table 1. Characteristics of study participants according to leisure time sports practice.

Variables	Non-practicing* n = 506 (%)	Practicing* n = 247 (%)	Total n = 753 (%)	P**
Gender				
Male	36.6	70.0	47.5	<0.001
Female	63.4	30.0	52.5	
Age				
10-12	26.3	46.2	32.8	<0.001
14-15	35.6	33.6	34.9	
16-17	38.1	20.2	32.3	
Paternal education				
Elementary education	23.5	17.8	21.6	0.090
Secondary education	61.5	62.3	61.8	
Completed undergraduate	15.0	19.8	16.6	
Region of the city				
North	19.8	17.0	18.9	0.776
South	15.0	17.0	15.7	
East	21.7	20.6	21.4	
West	16.0	15.0	15.7	
Center	27.5	30.4	28.4	
Sedentary behavior				
<2 h/day	32.6	44.5	36.5	<0.001
≥2 h/day	67.4	55.5	63.5	
Nutritional status				
Eutrophic	78.8	81.3	79.6	0.509
Overweight	14.7	14.2	14.5	
Obesity	6.5	4.5	5.9	
Blood pressure				
Normotensive	81.6	84.2	82.5	0.480
> 90th percentile	18.4	15.8	17.5	

* Participants who practiced sports and those who did not practice sports. ** P refers to the chi-square test of the association between the studied variables with sports practice.

tioners and those who did not practice sports did not differ with respect to paternal education.

The bivariate association between the independent variables with HBP in the total sample is presented in Table 2. The female participants had a negative association (PR = 0.55, 0.40 to 0.76) while the variables age (PR = 1.46, 1.02-2.10), overweight (PR = 1.62, 1.03-2.56) and obesity (PR = 1.91, 1.11-3.28) were positively associated with HBP.

Table 3 shows the bivariate associations between the independent variables of the study with HBP in relation to practising sports. The female participants had a negative association (PR = 0.47, 0.32-0.68) while overweight (PR = 1.92,

1.03-3.61) and obese (PR = 2.22, 1.13-4.42) were positively associated with HBP in young people who did not practice sports. None of the analyzed variables was significantly associated with HBP in young people sports practitioners.

After the adjustment of the models, the associations were upheld between overweight and obesity with HBP in the total sample (PR = 1.60, 1.02-2.52; and 1.93, 1.15-3.25) and in the young people who did not practice sports (PR = 1.80, 1.05-3.14; and 2.15, 1.10-4.16). There were no significant associations between overweight (PR = 1.01, 0.36-2.82) and obesity (PR = 1.09, 0.48-2.48) with HBP in those who practice sports (Table 4).

Table 2. Bivariate association between the independent variables of the study with high blood pressure in the total sample.

Variables	High blood pressure		
	%	PR (95% CI) Crude	P
Gender			
Male	22.9	1.00	<0.001
Female	12.7	0.55 (0.40-0.76)	
Age			
10-13	13.4	1.00	0.036
14-17	19.6	1.46 (1.02-2.10)	
Paternal education			
Elementary education	18.3	1.00	0.621
Secondary/ higher education	16.9	0.92 (0.67-1.26)	
Sedentary behavior			
< 2 h/day	19.3	1.16 (0.85-1.59)	0.340
≥ 2 h/day	16.5	1.00	
Practiced sports			
No	18.4	1.00	0.380
Yes	15.8	0.85 (0.61-1.20)	
Nutritional status			
Eutrophic	15.2	1.00	0.001
Overweight	25.7	1.62 (1.03-2.56)	
Obesity	29.5	1.91 (1.11-3.28)	

PR: Prevalence ratio; 95% CI – confidence interval of 95%; P refers to chi-square test.

Table 3. Bivariate association between the independent variables of the study with high blood pressure according to sports practice.

Variables	High blood pressure					
	Non-practicing			Practicing		
	%	Crude PR PR (95% CI)	P	%	Crude PR PR (95% CI)	P
Gender						
Male	27.6	1.00	<0.001	17.9	1.00	0.160
Female	13.1	0.47 (0.32-0.68)		10.8	0.60 (0.29-1.25)	
Age						
10-13	13.5	1.00	0.093	13.2	1.00	0.294
14-17	20.1	1.48 (0.92-2.38)		18.0	1.37 (0.75-2.48)	
Paternal education						
Elementary education	22.7	1.00	0.165	15.8	1.00	0.981
Secondary/ higher education	17.1	0.75 (0.50-1.11)		15.9	1.01 (0.70-2.13)	
Sedentary behavior						
<2 h/day	17.9	1.00	0.682	13.1	1.00	0.202
≥2 h/day	19.4	1.08 (0.73-1.59)		19.1	1.45 (0.81-2.59)	
Nutritional status						
Eutrophic	15.1	1.00	<0.001	15.5	1.00	0.746
Overweight	29.7	1.92 (1.03-3.61)		17.1	1.04 (0.37-2.91)	
Obesity	33.3	2.22 (1.13-4.42)		18.2	1.17 (0.33-4.08)	

PR: Prevalence ratio; 95% CI – confidence interval of 95%; P refers to chi-square test.

Table 4. Multivariate analysis of the association between overweight and obesity with high blood pressure.

Variables	%	All [*] PR (95% CI)	%	Non-practicing ^{**} PR (95% CI)	%	Practicing ^{***} PR (95% CI)
Eutrophic	15.2	1.00	15.1	1.00	15.5	1.00
Overweight	25.7	1.60 (1.02-2.52) ^a	29.7	1.80 (1.05-3.14) ^c	17.1	1.01 (0.36-2.82) ^e
Obesity	29.5	1.93 (1.15-3.25) ^b	33.3	2.15 (1.10-4.16) ^d	18.2	1.09 (0.48-2.48) ^f

PR: Prevalence ratio; 95% CI – confidence interval of 95%; ^{*} Adjusted for gender and age; ^{**} Adjusted for gender, age and paternal education; ^{***} Adjusted for gender and sedentary behavior. DEFF: ^a = 1,07; ^b = 0,83; ^c = 1,23; ^d = 1,16; ^e = 1,20; ^f = 0,36.

Discussion

To the best of our knowledge, this was the first study that has examined whether an association between overweight and obesity with HBP occurred in both young people who practiced sports and those who did not practice sports. The main result was that overweight and obesity was positively associated with HBP in the total sample and also in the young people who did not practice sports, whereas the same was not true for those sports practitioners.

A higher prevalence of HBP was found in young people who were overweight and obese compared to those who were eutrophic within the total sample (25.7 and 29.5 vs 15.2%) and those who did not practice sports (29.7 and 33.3 vs 15.1%), respectively. With regard to the participants who practiced sports, the prevalence of HBP was similar in young people who were overweight and obese compared to the eutrophic participants (17.1 and 18.2 vs 15.5%). In the adjusted analysis, young people who were overweight and obese in the total sample and those who did not practice sports showed a prevalence ratio of HBP which ranged from 1.60 to 2.15 higher than their eutrophic counterparts, results that corroborate those in previous studies^{9-11,18,22,26}. No significant associations were found for young people who practice sports. These results epidemiologically demonstrate the cardiovascular protection presented by the overweight and obese individuals who practice sports compared to their peers who did not practice sports.

When the total sample was analyzed the results of this study corroborated previous studies that showed no association between physical activity and HBP in young people^{9,11,21-23}. The present study examined the practice of sports because the physical activity of young people is largely performed through sports¹⁵. Although no association was found between the practice

of sports and HBP in young people, the present study showed a similar prevalence of HBP among young people sports practitioners who were overweight and obese compared to their eutrophic counterparts. This result may explain the lack of association between physical activity and HBP described in previous studies^{9,11,21-23}. Thus, the following two aspects should be considered in relation to the ways in which physical activity may protect young people from HBP: the protection independent of overweight^{18,20} and the protection that only occurs in overweight and obese individuals who practice sports.

The protection in relation to HBP presented by the overweight individuals who practiced sports can be explained by the chronic reduction in blood pressure caused by physical exercise³³⁻³⁶. As a result, there was a decrease in the prevalence of HBP in obese children³³. Although there were methodological differences between the two studies, the present study corroborated previous results³³, given that overweight and obese individuals reduced the prevalence of HBP from 50% to 37% in three months and to 29% in six months after physical activity intercession. Consequently, regular sports practice means that it was possible for young people exposed to one of the main determinants of HBP, overweight and obesity, to be able to present a similar prevalence to their eutrophic counterparts.

Although the cross-sectional design of this study, the results partially corroborated the experimental studies and randomized clinical trials that had previously been conducted. Significant reductions in blood pressure in training programs lasting three months³³ and six months³⁴ have been reported. Exercise programs that are effective in reducing the blood pressure of young people have consisted of at least three weekly sessions that lasted more than one hour³⁵. The young people who practice sports in the present study probably practice on a daily basis similar

to those described in previous studies^{33,35}, given that in the present study the participants were categorized as young people who stated that they practiced sports either often or always.

The lack of an association between overweight and obesity with HBP in young people sports practitioners in the present study occurred because young people who were overweight and obese presented a prevalence of HBP similar to the eutrophic participants. Similarly, the prevalence of HBP in the eutrophic participants was similar, regardless of sports practice, and was approximately 15%. This result was contrary to a previous study which showed that physical activity protected non-obese young people from HBP³⁷. One aspect that should be considered is that there is a greater reduction in blood pressure resulting from physical activity in young people who have HBP³³. This can be explained by the attenuation that physical activity exerts on sympathetic activation mechanisms, insulin resistance, arterial stiffness, endothelial dysfunction, increased heart rate and vascular resistance that occur on overweight³⁶. Overweight and obese young people who participated in the present study probably benefited from a reduction in blood pressure resulting from regularly practicing sports.

On the other hand, the similar prevalence of HBP among the eutrophic young people in this study, regardless of sports practice, may have been due to the fact that HBP is a multifactorial risk factor in young people. In addition to overweight, HBP is positively associated with heredity, low birth weight, high salt intake and alcohol consumption¹², factors which were not analyzed in the present study.

Another important result that should be considered is the similar prevalence of young people who were overweight, obese and with HBP, independent of sports practice (Table 1). Although the relationship between physical activity and HBP has previously been discussed¹⁶⁻²⁰, the largest body of evidence indicates no association between physical activity and HBP²⁴. The results of the present study corroborated previous studies that indicated no association between practicing sports and HBP in young Brazilians^{9,11,21-23}. As already mentioned, the main determinant of HBP in young people is being overweight and obese²⁵, and overweight young people are more likely to present HBP^{9-11,18,22,26}. Thus, a similar proportion of overweight and obese young people in both strata of sports practice may explain why the prevalence of HBP was also similar.

The promotion of physical activity and sports practice is an aspect of lifestyle that has been strongly recommended in order to prevent overweight and obesity in young people³⁸. However, a systematic review gathered together studies that examined the association between sports practice with overweight and obese, and the results were inconclusive³⁹. A study that was conducted after the aforementioned review found that participation in sports teams protected adolescents from overweight and obesity⁴⁰, a result which was contrary to that found in the present study. One aspect to be considered is that in both the systematic review³⁹ and in the present study, sports practice was considered on both the formal and informal levels, while in the study by Drake et al.⁴⁰ sports practice was defined as the amount of participation by young people in sports teams during the previous year. One characteristic that may explain the differences between these studies is that participation in sports teams is performed systematically and probably present higher volume of training.

Considering that being overweight and obesity are two major public health problems in young people, given that they are the main factors associated with HBP²⁵ and that HBP results in different threats to the health of young people and adults³⁻⁷, the results of the present study demonstrated that sports practice protects young people with overweight and obesity from HBP compared to eutrophic counterparts. Thus, it is suggested that sports practice is one of the strategies that can be used within intervention programs designed to prevent HBP in young people. As a result, the complications associated with HBP in overweight and obese young people may be prevented.

The limitations of this study should be considered in order to analyze its results with caution and also to provide guidance for future studies. Some variables that have previously been described as being associated with HBP¹² were not analyzed, which restricts estimating whether the results would hold true if they were entered in the analysis. Similarly, no physiological mechanism that might explain the results of this study was analyzed. Furthermore, the size of the sample meant that it was not possible to perform analyses using other cut-off points for HBP such as the 95th and 99th percentiles. This study considered sports practice both formal and informal, which was a limitation that made it difficult to identify whether practicing sports under supervision provided greater protection against HBP com-

pared to informal sports practice. Finally, due to the fact that this was a cross-sectional study there is a need for experimental and longitudinal studies to confirm these results.

Conclusion

According to the results presented in this study it can be concluded that overweight and obesity

were not associated with high blood pressure in adolescents who practice sports. The prevalence of overweight and obese young people who had HBP was similar to their eutrophic counterparts, which suggested that there was a cardioprotective effect of sports practice in individuals who were overweight. Thus, it is suggested that overweight individuals regularly practice sports in order to prevent future health risks that result from HBP at a young age.

Collaborations

DHC Coledam and PF Ferraiol worked on the study design, data collection, analysis and interpretation, drafting, critical review and final approval of the manuscript. R Pires Júnior, JPA Greca and AR Oliveira collaborated in the analysis and interpretation of the data, critical revision of the manuscript and approval of the version to be published.

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Article submitted 08/12/2015

Approved 07/04/2016

Final version submitted 09/04/2016