Risk factors associated with high blood pressure in adolescents

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ABSTRACT

High levels of arterial blood pressure in childhood and adolescence have been often associated with other cardiovascular risk factors – apart from arterial hypertension in the adult stage of life. The present study aimed at identifying risk factors associated with high blood pressure in adolescents. The subjects were 674 adolescents from public and private schools in the city of João Pessoa, Paraíba. These subjects were of both sexes (i.e., 303 boys and 371 girls) and their ages spanned from 14 to 17 years old. By means of a questionnaire, information about the following aspects was gathered: a) socio-demographic status; b) physical activity levels; c) eating habits; d) body mass index; e) consumption of alcohol and smoking. Moreover, measurements of arterial pressure (AP) showed that the prevalence of high AP was 7.4%, being higher in boys (10.2%) when compared with girls (5.1%, $p < 0.01$). The results of the multivaried analysis indicated that overweight adolescents displayed from five to six times more chance of having high AP than adolescents with light/normal weight (boys: *OR* = 5.5; CI 95% = 1.11-27.53, and girls: *OR* = 4.8; CI 95% = 1.51-15.45). The other variables did not seem to be associated with high AP. In this study, among the various risk factors analyzed, body overweight acted out as the only potential risk factor increasing arterial blood pressure in adolescents, irrespective of their sex and age.

Keywords: Arterial hypertension. Adolescence. Risk factor.

INTRODUCTION

High blood pressure represents one of the main public health risks problems in developed as well as in development countries. The behavior of the high blood pressure (BP), in the initial phases of life, has shown a strict relationship with hypertension in adulthood[1-2]. Moreover, it has raised the interest of researchers in investigating the prevalence of high BP in childhood and adolescence, as well as its associated risk factors.

International[3-7] and national[8-13] research has shown prevalence of high BP in children and adolescents of 1-12% and 2-10%, respectively. High pressoric values have been associated with excessive body weight[4,8,10] and cardiovascular diseases[11-13]; however, little has been investigated on the contribution of other risk behaviors (unsuitable diet[4,8], excessive alcohol intake[4,8], smoking[7,14] and sedentarism[7-8]) for pressoric increase in adolescents. In addition, few studies[4,8] have simultaneously analyzed three or more risk factors for high BP.

Considering high BP as a multifactorial problem which affetcs many different populational groups, it becomes crucial to identify risk factors associated with high pressoric levels in young adults, with the purpose to early intervene on them and minimize cardiovascular problems in adolescence and consequently, in adulthood.

The aim of this study was to identify risk factors (surplus weight, insufficient levels of physical activity, unsuitable eating habits, smoking and alcohol intake) associated with high BP in adolescents of both genders.

METHODS

The present study was characterized as an epidemiological research of transversal cutting. It was developed between March and October, 2005, with adolescents of public and private schools of João Pessoa, PB. The intervention protocols in the study were approved by the Ethics Research Committee, of the Paraíba Federal University and followed norms of the 196/96 Resolution from the National Health Board on research involving humans.

The sample was divided in three stages: district (five districts); characteristic of the school (public and private) and the degrees of the high school (sophomore to senior years). Fifteen schools were systematically selected (10 public – 2 per district) and 5 private – 1 per district) out of the 65 high schools from the county.

In order to have the sample size determined, hypertension prevalence of 7%[15], reliability interval of 1.96 (BI 95%), estimated error of 2% and increase of 10% as possible index of loss have been considered. The minimum sample total was of 674 adolescents; however, 784 participated in the study. Exclusion criteria were: adolescents with regular bf anti-hypertensive medication use, pregnant adolescents, (n = 3; 0.4%), incomplete or doubtful information completion of the questionnaire (n = 84; 10.7%) and refusal to participate in the study (n = 23; 2,9%).

A questionnaire[16] which collected data on some aspects was used, namely: a) socio-demographic aspects (age, gender and economic status); b) physical activity level; c) eating habits; d) referred measurements of body weight and height; e) smoking and alcohol intake. Initially, the students were told about the aim and procedures of the research, followed by the questionnaire. It was applied in a room by two researchers previously trained. After having answered the questionnaire, the students would be taken in groups by the researchers to a reserved room and were submitted to measurements of blood pressure, performed by two experienced professionals. The total time spent per group was of approximately 50 to 60 minutes, where 15 to 20 minutes were spent with the questionnaire completion and 35 to 40 minutes for blood pressure measurements.

In order to have the economic status defined, the directions proposed by the Brazilian Association of Market Research Institutes were used[17]. This proposal classifies individuals under classes A, B, C, D and E from the reached scores. The Body Mass Index (BMI) was obtained based on the self-reported measurements of body weight and height, and it was classified in under weight/normal weight and surplus body weight (overweight/obesity)[18].

In order to have the physical activity level determined (PAL), a retrospective instrument of self-record of daily activites was used[19]. The physical activities were distributed in nine categories, accord-

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ing to the estimation of caloric expenditure: 1. physical activity in lying position; 2. activities in sitting position; 3. activities in standing position; 4. activities of light dislocations (< 4 km/hour); 5. light manual work; 6. active leisure activities and recreational sports; 7. moderate rhythm manual work; 8. active leisure activities and moderate intensity sports; 9. intense manual work and practice of competitive sports.

The instrument was filled out by the adolescents themselves, in three days of the same week (one weekend day and two weekdays), which would register in 36 periods of 30 minutes each (from 6 to 24 hours) the kind of activity performed, from the nine categories, being the pondered mean of the three days used for calculation. The PAL was obtained through the estimation of the energetic demand by kilogram of body mass, of the activities performed during the day (kcal/kg/day)[20] and the adolescents were classified in active: ≥ 40 kcal/kg/day; moderatly active: between 36.9 and 39.9 kcal/kg/day and insufficiently active: < 36.9 kcal/kg/day[21].

The data on the eating habits were based on the scores attributed to the frequency of fruit and vegetables intake (did not eat = 0; 1-2 days/week = 1; 3-4 days/week = 2; 5-6 days/week = 3; 7 days/week = 4), sweets and fried food (did not eat = 4; 1-2 days/week = 3; 3-4 days/week = 2; 5-6 days/week = 1; 7 days/week = 0). Based on reached scores, the quartiles were calculated and three classification categories were created: suitable eating habit (percentile > 75), unsuitable (between 50-75) and very unsuitable (percentile < 50). Data concerning smoking and alcohol intake were collected with the report and the weekly frequency of consumption. The adolescents who smoked and/or drank liquor at least once a week, were considered smokers and drinkers, regardless the amount.

In order to have the blood pressure measured, aneroid sphygmomanometers (Missouri Industry and Commerce Ltda) periodically calibrated were used, with cuffs of two dimensions (18 x 9 cm and 22 x 14 cm) and pediatric stethoscope. The BP was measured on the right arm with the subject relaxed in the sitting position and two measurements with minimum interval of two minutes were taken. The mean value of the measurements was considered. High BP was considered the values in the percentile ≥ 95 adjusted to the height percentile, age, and gender[3].

In the statistical analysis, the high BP prevalence was calculated, considering the socio-demographic variables. The ki-square test was used to compare the prevalence of risk factors in adolescents with normal and high BP. Concerning the regression analysis, the bi-varied logistic regression was used in order to observe the isolated association of risk factors in the increase of blood pressure as well as the multivaried regression for estimation of the Odds Ratio = OR of prevalence of high BP, adjusted to independent variables (BMI, physical activity, eating habits, smoking and alcohol intake) and control (age and economic status), stratified by gender. All analyses were performed in the *SPSS* program, version 10.

RESULTS

Out of the total of 674 adolescents (303 males and 371 females), age ranging between 14 and 17 years (16.5 ± 0.9 year), 57.4% went to public schools, 48.5% were from highest economic class (A, B), 32.3% (n = 200) were from the intermediate class (C) and 19.2% (n = 119) were from the lowest economic classes (D, E).

The prevalence of high BP in adolescents was 7.4%, being higher in males (10.2%) than females (5.1%, p < 0.01). In table 1, it was observed that out of the 7.4% of adolescents with high BP, 84% went to public schools and 16% to private schools (p < 0.01). Moreover, differences between ages have not been found. Concerning economic status, the prevalence was higher in the lowest classes (C = 34.1%; D, E = 36.4%) when compared with the highest ones (A, B = 29.5%, p < 0.01).

Table 2 compared the normal and high BP in each risk factor. The overweighed adolescents demonstrated prevalence three times higher of high BP when compared with the low weight/normal weight ones (18% *vs* 6%, p < 0.01), once in the remaining factors the prevalence of high BP did not significantly differ between groups. In males, only the body surplus fat was related with high BP (p < 0.02); while in females, there was relationship also with smoking, a prevalence of 22.2% between smokers and less than 5% for non-smokers (p < 0.02).

TABLE 1
Socio-demographic characteristics of the adolescents with high BP

Variables	General			Male			Female		
	n	%	p[z]	n	%	p[z]	n	%	p[z]
Age (years)									
14	3	6.0	0.83	2	6.5	0.60	1	5.3	0.69
15	14	28.0		8	25.8		6	31.6	
16	19	38.0		14	45.2		5	26.3	
17	14	28.0		7	22.6		7	38.8	
School characteristic									
Public	42	84.0	0.01	25	80.6	0.01	17	89.5	0.02
Private	8	16.0		6	19.4		2	10.5	
Economic class									
A, B	13	29.5	0.01	9	32.1	0.03	4	25	0.37
C	15	34.1		8	28.6		7	43.8	
D, E	16	36.4		11	39.3		5	31.3	

[z] – Ki-square test (p < 0.05).

TABLE 2
Prevalence of normal and high blood pressure for the conditions presented in each analyzed variable

Variables	General			Male			Female		
	BP normal	BP high	p[z]	BP normal	BP high	p[z]	BP normal	BP high	p[z]
BMI									
Low weight/normal weight	94.0	6.0	0.01	91.6	8.4	0.02	95.9	4.1	0.04
Surplus fat	81.8	18.2		78.8	21.2		86.4	13.6	
Physical activities									
Little active	92.4	7.6	0.94	87.7	12.3	0.41	95.1	4.9	0.88
Moderately active	93.2	6.8		92.2	7.8		94.1	5.9	
Active	93.0	7.0		92.5	7.5		93.8	6.3	
Eating habits									
Very unsuitable	91.4	8.6	0.48	88	12	0.16	94.5	5.5	0.13
Unsuitable	93.9	6.1		89.2	10.8		98.8	1.2	
Suitable	93.8	6.2		96.6	3.4		92.2	7.8	
Smoking									
Yes	83.3	16.7	0.08	86.7	13.3	0.68	77.8	22.2	0.02
No	92.9	7.1		89.9	10.1		95.4	4.8	
Alcohol intake									
Yes	94.8	5.2	0.27	93.3	6.7	0.25	96.9	3.1	0.40
No	92.2	7.8		89.1	10.9		94.4	5.6	

[z] – Ki-square test (p < 0.05).

In the binary regression, the relationship of the risk factors isolated in high BP was analyzed. Besides that, in males the odds ratio for high BP was almost three times higher (OR = 2.95) in the ones who presented body surplus fat, when compared with the ones with low weight/normal weight ones. In females, the prevalence of high BP was 5.7 times higher among smokers when compared with non-smokers. The other variables did not present association with high BP in both genders (table 3).

In the multivariate regression, all risk factors were included in the model adjusted to economic class and age of adolescents. The outcomes show that males and females with surplus fat presented odds ratio 5 to 6 times higher to have high BP when compared with those with lowweight/normal weight (males: *OR* = 5.5; BI 95% = 1.11-27.53 and females: *OR* = 4.8; BI 95% = 1.51-15.45).

TABLE 3
Binary and multivaried logistic regression for estimation of association (*Odds ratio – OR*) between risk factors and pressoric increase in adolescents from João Pessoa, PB

Variables	Male		Female	
	OR[a] (BI 95%)	*OR*[f] (BI 95%)	*OR*[a] (BI 95%)	*OR*[f] (BI 95%)
BMI				
Low weight/normal weight	1	1	1	1
Surplus fat	2.95 (1.15-7.56)	4.8 (1.51-15.45)	3.7 (0.98-13.99)	5.5 (1.11-27.53)
Physical activity				
Little active	1	1	1	1
Moderately active	0.60 (0.22-1.63)	0.96 (0.31-2.94)	1.23 (0.40-3.70)	1.23 (0.31-4.8)
Active	0.58 (0.22-1.49)	0.76 (0.26-2.22)	1.31 (0.40-4.32)	1.29 (0.29-5.63)
Eating habits				
Very unsuitable	0.89 (0.38-2.07)	0.76 (0.26-1.99)	0.21 (0.03-1.68)	0.00 (0.00-6.3)
Unsuitable	0.26 (0.06-1.14)	0.12 (0.01-0.96)	1.44 (0.55-3.77)	0.79 (0.23-2.69)
Suitable	1	1	1	1
Smoking				
Yes	1.37 (0.29-6.39)	1.16 (0.11-11.9)	5.71 (1.10-29.6)	22.8 (0.95-551)
No	1	1	1	1
Alcohol intake				
Yes	0.58 (0.23-1.49)	0.83 (0.25-2.73)	0.53 (0.12-2.37)	0.14 (0.01-2.47)
No	1	1	1	1

OR[a] = Odds ratio of chance non-adjusted for high BP; OR[f] = *Odss ratio* adjusted to age, economic class ans remaining variables; BI 95% = reliability interval of 95%.

The remaining variables did not present significant statistic contributions in order to justify the increase of blood pressure (table 3).

DISCUSSION

The high BP prevalence in adolescents was of 7.4%. International records showed prevalences of 9-12%[4,6-7], except for Belgium (6.5%)[5]. In Brazil, studies performed with adolescents demonstrated 7-10% of prevalence of high BP[8,10,12]. Some authors have verified higher proportion of high BP in males[10,12], the same fact was observed in the present study. On the other hand, other studies have not found alterations between genders[6,9,11]. The difference in results may be associated with temporal differences in which the biological alterations occur (sexual maturation, body composition and testosterone production).

Concerning age, significant differences have not been observed in this study. In the literature, some authors have found differences[8], especially in the studies which chose to analyze age groups (children, adolescents) instead of age, indicating higher prevalence in older adolescents (15-17 years) compared with younger ones[4,7-8,10]. Concerning economic class, the prevalence of high BP was higher in adolescents from the lowest classes; in other studies it was not possible to observe this association[8-9,13]. However, some investigations have found higher prevalence in public schools students[13], according to what was observed in the present study. The kinds of instruments used to measure economic class and cuttings of economic status adopted may be considered disturbing factors in the comparison on the studies.

The occurrence of body surplus fat was significantly higher in adolescents who presented high BP, compared with those with normal BP. This result reinforces findings of many studies which reported great impact of the body surplus fat over blood pressure levels in children and adolescents[4,6,8,10-14].

Concerning physical activity, the physically active and inactive students did not present significant differences for prevalence of high BP. The same situation was observed in other studies[4,6-8], except for one[12] in which the authors verified higher chances of high BP (80% to 90%) among less active adolescents, compared with the more active ones. Despite using the same measurement instrument for physical activity, this study measured risk factors for cardiovascular diseases, and therefore high BP associated only with risk behaviors has not been adjusted to the BMI, which could have differentiated the result. The main causes of clashing results are derived from the difficulty in objectively and accurately measuring the PAL in this populational group. Moreover, since it is a transversal study in which the exposure (PAL) and the closing (BP) are collected in the same period of time, it does not allow observation of the effects of the physical activity since it does not present a temporal sequence.

In eating habits, the same behavior of physical activity was observed, which does not show association with high BP. Similar outcomes were observed in other investigations[4,8,13-14]. The difficulty in obtaining accurate data on eating habits in epidemiological studies is clear, once the used questionnaires are usually limited to raise data on the weekly intake frequency of some foods, not taking into consideration the food's cooking manner or the amount taken.

Exposition to smoking and/or alcohol intake did not demonstrate association with high BP. Many studies have not found associations between smoking and high BP either[4,9,11,14], nor between alcohol intake and high BP[4,11,14]. Although in adult population excessive alcohol intake and smoking demonstrate association with hypertension, cardiovascular morbidity and premature death[22], in children and adolescents this is not well established[4,14], what corroborates the results found in the present study. Such fact is probably because smoking is not popular or spreaded in this population and, in some cases, the omission or imprecision of information may alter the results.

Concerning limitations, self-referred measurements of height and weight were used for BMI calculation. Nonetheless, many studies have demonstrated high degree of correlation between referred and self-referred measurements both in adults (r = 0.85-0.97)[23-24] and in adolescents (r = 0.87-0.93)[25-26] and good concordance and validity of the referred BMI for prevalence studies.

Blood pressure measurement was performed in a single visit and cannot be used for arterial hypertension characterization. This measurement should be used as an indicator of blood hypertension risk for transversal comparisons in epidemiological studies performed with children and adolescents. Finally, the trustworthiness and accuracy of the provided information by questionnaire (physical activity, smoking, alcohol and eating habit) may present underestimated or overestimated values, since they reflect socially undesirable and desirable behaviors. However, it is a widely applied instrument in epidemiological studies due to its easy access, low cost and excellent validity.

CONCLUSION

In this study, among the several risk factors analyzed, body surplus fat behaved as the only risk factor with potential to increase blood pressure in adolescents, regardless gender or age. Although physical activity level, eating habits, smoking and alcohol intake have not been directly associated with high BP, the exposition to these behaviors may contribute for pressoric increase. Within this context, intervention strategies for weight control seem to represent one of the main actions directed to prevent and control high BP in adolescents.

These strategies must approach aspects of the social, cultural and economic reality of these adolescents investing in the adoption of an active life style and healthy diet with actions, interventions and continuous follow-up from education and information provided in the educational and family environment.

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