The Prevalence of Elevated Blood Pressure in Adolescents in Nassau, The Bahamas

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ABSTRACT

Objective: *To determine the prevalence of elevated blood pressure (EBP) in Bahamian adolescents.*
Methods: *A cross-sectional survey employing a self-administered questionnaire, and concurrently obtaining anthropometric measurements, was conducted involving selected grades 9, 10 and 11 students of all targeted public high schools in The Bahamas. Statistical analyses correlated blood pressure with body mass index (BMI), age and gender.*
Results: *The mean age of the 785 participants was 14.6 (± 1.153) years, and 87.6% were Bahamian. The prevalence of elevated systolic blood pressure (SBP) was 4.7% and 6.6% for elevated diastolic blood pressure (DBP). Elevated blood pressure prevalence was 8.9%. Elevated blood pressure was more common among grade 9 students (12–14-year olds), who had the largest proportion of EBP (55.7%). Both SBP and DBP increased with age in the males. Overall, students' prevalence of overweight/obesity was 32.2% (14.4% overweight, 17.8% obese). Body mass index, number of days per week eating fast food and perception of body weight were predictive of EBP. Body mass index, age and perception of body weight were found to be predictive of SBP ($\beta_{BMI} = 0.25$, $p < 0.001$; $\beta_{Age} = 0.14$, $p < 0.001$; $\beta_{Weight} = 0.08$, $p < 0.037$) and DBP ($\beta_{DBP} = 0.192$, $p < 0.001$). Overweight/obese students were 2.7 times more likely to have EBP. Elevated blood pressure was markedly associated with BMI, family history of hypertension and parents' overweight/obese status.*
Conclusion: *The estimated prevalence of EBP in adolescent school children in New Providence, Bahamas, was comparable with neighbouring nations.*

Keywords: Adolescence, blood pressure, high school, prevalence, students

Prevalencia de la Hipertensión en Adolescentes en Nassau, Bahamas

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RESUMEN

Objetivo: *Determinar la prevalencia de la presión arterial elevada (PAE) en los adolescentes de las Bahamas.*
Métodos: *Se realizó una encuesta transversal empleando un cuestionario autoadministrado, obteniendo a la par medidas antropométricas, entre estudiantes de los grados 9, 10 y 11 seleccionados de todas las escuela secundarias públicas de las Bahamas. El análisis estadístico estableció una correlación entre la presión arterial y el índice de masa corporal (IMC), la edad, y el género.*
Resultados: *La edad promedio de los 785 participantes fue 14.6 (± 1.153) años, y un 87.6% eran bahameños. La prevalencia de la hipertensión sistólica (PAS) fue 4.7%, y 6.6% para la hipertensión diastólica (PAD). La prevalencia de la presión arterial fue 8.9%. La presión arterial elevada fue más común entre los estudiantes del grado 9 (12 a 14-años de edad), los cuales presentaban la mayor proporción de PAE (55.7%). Tanto la PAS como la PAD aumentaban en relación con la edad en los varones. En general, la prevalencia del sobrepeso/obesidad entre los estudiantes fue 32.2% (14.4% sobrepeso, 17.8% obesos). El índice de masa corporal, el número de días por semana consumiendo comidas rápidas, y la percepción del peso corporal, fueron elementos predictivos de la PAE. Se halló que el índice de masa corporal, la edad, y la percepción del peso corporal eran factores predictivos de la PAS ($\beta_{IMC} = 0.25$, $p < 0.001$; $\beta_{edad} = 0.14$, $p < 0.001$; $\beta_{peso} = 0.08$, $p < 0.037$) y PAD ($\beta_{PAD} = 0.192$, $p < 0.001$. Los estudian-*

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tes con sobrepeso u obesos presentaban 2.7 veces más probabilidades de tener PAE. La presión arterial elevada estuvo marcadamente asociada con el IMC, los antecedentes familiares de hipertensión, y el estatus de sobrepeso u obesidad de los progenitores.
Conclusión: *La prevalencia estimada de PAE en adolescentes escolares en Nueva Providencia, Bahamas, era similar a la de las naciones vecinas.*

Palabras claves: Adolescencia, presión arterial, escuela secundaria, prevalencia, estudiantes

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INTRODUCTION

Hypertension is a risk factor for cardiovascular disease (CVD), contributing to the increasing economic burden of chronic non-communicable diseases (CNCDs). In 2002, the estimated cost for hypertension in The Bahamas was $35 281 854 or 0.65% of the gross domestic product (1). Furthermore, hypertension is strongly linked to the increasing prevalence of overweight and obesity. The Bahamas, like many of its sister nations in epidemiological transition, shows an alarmingly high rate of obesity (2). The National Chronic Non-Communicable Disease Survey (2005) estimated that 23% of 11–20-year olds were overweight (3). Williams found that 15.6% of 10–19-year olds were at risk of being overweight and 22.6% were obese (4). The prevalence of overweight and obesity is mirrored in the adult and adolescent populations. The Caribbean region is no different from other countries in that youths have adopted unhealthy lifestyles (2).

Agyemang *et al*, in Suriname, showed that body mass index (BMI) was positively associated with blood pressure (BP) in adolescents (5). In Tobago, Nichols *et al* looked at 12–16-year olds between 1999 and 2000 and found that elevated blood pressure (EBP) was associated with overweight and a family history of hypertension (6). In The Bahamas, a 1989 survey estimated 17% of the population 15–64 years old was borderline hypertensive and 13% was hypertensive (7). However, little is known about the prevalence of EBP in this adolescent population or its relationship to the increasing rates of overweight and obesity. In this study, the researchers aimed to determine the prevalence of EBP and associated risk factors in adolescents in New Providence, Bahamas, and if the correlation of increased overweight or obesity and EBP in this adolescent population is similar to data seen globally.

SUBJECTS AND METHODS

A cross-sectional study was conducted on adolescents selected from grades 9, 10 and 11 in all public high schools in New Providence, Bahamas, for the 2011–2012 school year. There are presently eight junior high and eight senior high schools located in New Providence with students' age ranging from 12–18 years. The population of public high school students in New Providence was approximately 15 051. Within the selected grades, the classes in each school were described as cluster units. Cluster random sampling was done to select the subset of classrooms within which all students were then canvassed for recruitment into the study. A design effect of 1.45 was incorporated to adjust for the use of cluster sampling of classrooms for the sample size calculation. Nine hundred and six student adolescents were enrolled to complete the study questionnaires, derived mainly from the Global School-Based School Health Survey, the Healthy Youth Survey and the State and Local Youth Risk Behaviour Survey (8–10), and which were administered one to two months prior to the anthropometric measurements. The measurements were done by the research team who were trained during the completion of the questionnaires, allowing participants to become accustomed to the research team and decreasing anxiety surrounding blood pressure measurement.

Blood pressure was measured according to the American Heart Association Guidelines 2005. Elevated blood pressure (hypertension and prehypertension) is categorized in adolescents as hypertension if systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) $\geq 95^{th}$ percentile (for gender, age and height) and prehypertension is BP between the 90^{th} and 95^{th} percentile (11). Participants rested for five minutes in a seated position with the arm rested on a table at the level of the heart. Tight clothing was removed from the arm and a mercury sphygmomanometer with appropriate sized cuff (for mid-arm circumference) was placed on the arm. The cuff size was determined by measuring the arm midpoint between the shoulder and elbow and the bladder width was approximately 40% of the arm circumference. A full range of cuff sizes was available at all times. The cuff was inflated while palpating the radial artery and continued until 20–30 mmHg above the disappearance of the radial pulse. The stethoscope's diaphragm was placed over the brachial artery in the ante-cubital fossa and the cuff was deflated at 2–3 mmHg per second. The first (Korotkoff) sound was used as the SBP and the disappearance of the fifth (Korotkoff) sound was used as the DBP. The BP was taken three times, five minutes apart and the mean of the last two readings used as the participant's BP measurement. All BP readings were recorded as heard and not rounded off and participants' pulse rate was ascertained approximately one minute prior to BP measurement; all BP measurements were taken at the same time (in the mornings) daily to ensure consistency with results. History of hypertension/use of hypotensives was denied by all.

Students were asked to come in their physical education uniform, remove shoes and jackets, stand straight, feet together and centred on the scale. Weight (to the nearest 0.1 kg) was taken and height (to the nearest 0.01 m) measured on a pro-

perly calibrated SECA 769 electronic balance scale. Body mass index changes during the transitional period of adolescence; it is determined by taking the age and gender of the participants into account and dividing weight (kg) by height (m^2) [classification as defined by World Health Organization] where overweight is $\geq 85^{th} < 95^{th}$ and obese $\geq 95^{th}$ percentiles. Permission was granted by the Ethics Committees of the Public Hospitals Authority/The University of the West Indies and Ministry of Education, and full confidentiality maintained. Consent was obtained from both participant and parent.

Statistical analyses were performed using SPSS for Windows, release 17.0. Descriptive statistics provided summary point and dispersion estimates. Inferential statistics assessed statistical significance of correlational analysis; logistic and linear regression looked for associations between BP, BMI and other indices.

RESULTS

Nine hundred and six students completed the questionnaire, of which 785 (86.6%) completed all measurements. Study demographics are presented in Table 1.

Table 1: Demographics of the participants (n = 785)

Characteristic	% Distribution	Gender		
	Total	Males	Females	*p*-value
Mean age (SD) (years)	14.57 (± 1.15)	14.76 (± 0.06)	14.40 (± 0.05)	< 0.001
Gender				< 0.735
Male	53.5			
Female	46.6			
Ethnicity/nationality (%)				
Bahamian	87.6	87.4	87.9	
Haitian	9.3	9.9	8.8	
Jamaican	2.5	2.5	2.6	
American	0.3	0.0	0.5	
Others	0.3	0.3	0.2	
Blood pressure classification (%)				0.928
Normotensive	91.1	91.0	91.2	
Prehypertensive	5.6	5.5	5.7	
Hypertensive	3.3	3.6	3.1	
Mean blood pressure (mmHg)				
SBP	102.81 (± 13.43)	104.24 (± 0.71)	101.56 (± 0.65)	0.005
DBP	65.34 (± 8.89)	64.80 (± 0.48)	65.82 (± 0.42)	0.111
Mean percentile (± 1 SD)				
SBP	27.77 (± 37.26)	25.53 (± 1.39)	29.73 (± 2.17)	0.115
DBP	49.28 (± 25.73)	49.38 (± 1.39)	49.19 (± 25.73)	0.920
Median percentile (IQR: Q1, Q3)				
SBP	15.80 (4.0, 43.00)	14.30 (3.80, 41.90)	16.90 (4.90, 45.40)	0.195
DBP	45.40 (29.35, 68.40)	46.20 (30.46, 67.10)	43.55 (27.80, 89.50)	0.862
Blood pressure percentile categories (%)				
SBP – Normotensive	96.6	97.3	96.0	0.292
Prehypertensive	1.5	1.6	1.4	
Hypertensive	1.9	1.1	2.6	
DBP – Normotensive	93.4	93.4	93.3	0.168
Prehypertensive	4.7	3.8	5.5	
Hypertensive	1.9	2.7	1.2	
BMI classification (%)				
Underweight	4.8	6.0	3.8	0.177
Normal weight	62.9	64.9	61.2	
Overweight	14.4	12.3	16.2	
Obese	17.9	16.7	18.8	
Overweight/obese parent(s) (%)	29.5	26.6	29.4	0.022
Positive family history of HTN (%)	49.0	44.4	53.1	0.007

SBP: systolic blood pressure; DBP: diastolic blood pressure; BMI: body mass index; HTN: hypertension

The estimated prevalence of EBP in this study is 8.9%. Participants' mean SBP was 102.81 mmHg (± 13.43) and their mean DBP was 65.34 mmHg (± 8.89) with both showing a significant increase with age (Table 2). Moreover, of those with EBP, the mean SBP and DBP as well as the age, gender and gender-adjusted percentiles for the same were all found to be significant at $p < 0.001$. Elevated blood pressure was more common among the grade 9 students (12–14 years), with a proportion of 9.5%, or 55.7% of those with EBP (Table 2).

There was no difference in EBP by gender, odds ratio (OR) = 0.97 (95% CI: 0.59, 1.59). Students with a positive family history for hypertension had a higher median DBP than those who reported a negative family history of hypertension. In addition, 52.3% of the prehypertensives and 46.2% of the hypertensives reported a positive family history of hypertension (Cramer's V = 0.097, $p < 0.005$). The prevalence of overweight/obesity was 32.2% (14.4% overweight, 17.8% obese). Just fewer than 30% of the overweight and obese students had EBP (Table 3).

Linear regression revealed that BMI alone was predictive of DBP ($\beta_{DBP} = 0.192$, $p < 0.001$); However, BMI, age and perception of one's weight were found to be predictive of SBP ($\beta_{BMI} = 0.25$, $p < 0.001$; $\beta_{Age} = 0.14$, $p < 0.001$; $\beta_{Weight} = 0.08$, $p < 0.037$) and DBP ($\beta_{DBP} = 0.192$, $p < 0.001$). Concerning EBP, BMI was a predictor (OR 1.070, CI: 1.035, 1.109, $p < 0.001$; Pearson correlation 0.218). Both number of days per week one eats fast food and perception of weight were also predictive of EBP [OR 0.706 (0.504, 0.987), OR 2.163 (1.162, 4.027), respectively] (Table 4). An additional finding was a 2.7 times risk of EBP in the overweight and obese participants.

Table 2: Elevated blood pressure and mean SBP and DBP according to age groups and gender

Variable	EBP % (n)	Pre-HTN % (n)	HTN % (n)	% EBP with Pre-HTN	% EBP with HTN	Mean SBP mmHg (95% CI) n = 785	Mean DBP mmHg (95% CI) n = 785
Age (years)							
12–14	9.5 (39)	5.6 (23)	3.9 (16)	59.0 (23)	41.1 (16)	101.60 (100.19, 103.01)	64.31 (63.46, 65.16)
15–16	8.7 (29)	5.7 (19)	0 (10)	65.5 (19)	34.5 (10)	104.02 (102.70, 105.33)	66.32 (65.36, 67.27)
17–19	5.1 (2)	5.1 (2)	0 (0)	100 (2)	0 (0)	105.33 (101.96, 108.69)	68.03 (65.18, 70.86)
Total	8.9 (70)	5.6 (44)	3.3 (26)	62.9 (44)	37.1 (26)	102.81	65.34
Cramer's V, *p*-value	0.03, 0.66	0.034, 0.70		0.14, 0.16		*p* 0.025	*p* 0.001
Gender							
Male		5.5 (20)	3.6 (13)	60.6 (20)	64.9 (24)		
Female		5.7 (24)	3.1 (13)	39.4 (13)	35.1 (13)		
Cramer's V, *p*-value		0.014, 0.928		0.044, 0.713			

EBP: elevated blood pressure; HTN: hypertension; SBP: systolic blood pressure; DBP: diastolic blood pressure

Table 3: Comparison of body mass index (BMI) categories within blood pressure ranges

	Blood pressure within BMI categories (percentages)			
Blood pressure category	**Underweight (n)**	**Normal weight (n)**	**Overweight (n)**	**Obese (n)**
Normotensive	94.7 (36)	93.9 (464)	96.5 (109)	75.5 (106)
Prehypertensive	5.3 (2)	3.2 (16)	3.5 (4)	15.7 (22)
Hypertensive	0.0 (0)	1.8 (14)	0.0 (0)	8.6 (12)

Cramer's V = 0.183, $p < 0.001$; Spearman's correlation: $r_{Sp} = 0.178$, $p < 0.001$

Table 4: Logistic regression models for prehypertension/hypertension *versus* normal and hypertension *versus* prehypertension

	Beta	Standard error	*p*	OR (95% CI)
Model I: (hypertension/prehypertension *vs* normal)				
Body mass index	0.069	0.018	< 0.001	1.071 (1.035, 1.109)
Constant	-3.983	0.456	< 0.001	
Model II: (hypertension *vs* prehypertension/normal)				
Perception of weight†	0.772	0.317	0.015	2.163 (1.162, 4.027)
No. days/week eating fast foods	-0.349	0.171	0.042	0.706 (0.504, 0.987)
Constant	-5.098	1.186	< 0.001	

†1 = very underweight, 2 = slightly underweight, 3 = about the right weight, 4 = slightly overweight, 5 = very overweight

DISCUSSION

The purpose of this study was to determine the estimated prevalence of EBP in adolescents in New Providence, Bahamas. The majority of participants were Bahamian. Elevated blood pressure was associated with BMI, family history of hypertension and parents' overweight/obese status. The estimated prevalence of EBP in adolescent school children in New Providence, Bahamas, was found to be 8.9%, or nearly one in ten students was found to have EBP. Patterns seen in both male and female hypertensives were observed in proximate studies, such as in Tobago and Suriname (5, 6). Furthermore, this study estimated that one out of three students was overweight/obese. This was higher in comparison to a Turkish study that showed a strong relationship between BMI and hypertension despite its prevalence of obesity being markedly less than that found in The Bahamas (12). Adolescent rates of overweight/obesity in The Bahamas are definitely unacceptable as they mirror the high prevalence of overweight/obesity and a relatively high prevalence of EBP that exist in the adult population. This estimated prevalence of EBP was also consistent with other studies regionally [EBP of 14%], and globally ranging from 2.9%–24% (5, 6, 12–18). The means for SBP and DBP in this study were lower than those found in Suriname and Tobago (5, 6). There was little to no preponderance to gender (OR: 0.97); this mirrored findings in a Seychelles study (18).

The estimated prevalence of prehypertension and hypertension (5.6%, 3.3%) was similar to other studies ranging from 2.3–31.4% and 2.1–15%, respectively (16, 19–21). The trend of an increased proportion of prehypertension in the younger age groups and overall was observed in these studies (19, 20, 22). Moreover, the lower prevalence of hypertension in older students may be due to the variability of BP in adolescents. Furthermore, the finding of a higher proportion of hypertension among younger students could be attributable to pubertal changes in body composition and hormonal factors seen during the adolescent growth spurt in this age range. However, this does not minimize the need for concern regarding the trends noticed.

Extrapolating from findings by Falkner *et al* (21), where approximately 7% of the prehypertensives progressed to hypertension, it could be estimated that another 148 prehypertensives would transition to hypertension, adding to the existing 6% of Bahamian high school students with hypertension (*ie* 1032 of 17 208), over an average of three years. This only compounds the economic burden on healthcare. The linear increase in BP with age and similarly for BMI (both predictors of SBP) can be correlated to the increase in prevalence seen among adults. The resilience of BP in this age group was shown where it was affected mildly by increases in BMI for DBP. This is in agreement with other studies internationally (5, 6, 12–18, 21). Another finding consistent with regional studies was the relationship between BP and family history of hypertension (5, 6). Direct comparisons between the estimated prevalence of EBP in this study and other studies were limited, due to varying procedures used in measuring BP and the measurement taken on a single visit. Future studies should have blood pressures measured on three separate occasions for a more precise prevalence of hypertension in adolescents.

In conclusion, this study shows a significant prevalence of EBP in Bahamian adolescents. The significant findings of the association between overweight/obesity and elevated BP, along with the tracking of the aforementioned into adulthood, is an indication that unless interventions are made, the impact on the cost of burden of care for hypertension, obesity and cardiovascular disease can be crippling to a country in transition such as The Bahamas. School-based health programmes and health promotion endeavours which prioritize therapeutic lifestyle changes should be the cornerstone of primary prevention in the adolescent population (14). We advise yearly screening among Bahamian adolescents aimed at reducing the already highly suspected increase of cardiovascular disease risk profile.

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