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The Predictors of Hypertension in Children: Palestinian Perspective

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Abstract

Children with high blood pressure are much more likely than children with lower blood pressure to experience hypertension in adulthood. The purpose of this study was to determine the prevalence of hypertension and predictors of hypertension in Palestinian children.

Method: Cross-sectional study was performed on five hundred and nine (10–13) year old students from governmental schools in Jenin and Tubas. Anthropometric measures consist of body mass index, hip circumference (HC), waist circumference (WC), the ratio of waist to hip (WHR), and the ratio of waist to height (WHtR) were measured. Blood pressure was assessed including systolic (SBP) and diastolic (DBP) utilizing a (Dynamap) vital signs monitor.

Results: Approximately 38.7% of participants (38.8% females and 38.63% males) were considered pre-hypertensive and 7.3% of the participants (7.4% females and 7.1% males) were hypertensive. Also, there was a weak to moderate relationship between mean blood pressure (systolic and diastolic) and the anthropometric measurements. Additionally, most predictors with significant effects on early childhood hypertension were body mass index (OR 1.16, 95% CI 1.09–1.23).

Conclusions: Hypertension and prehypertension are present in Palestinian children. Waist hip ratio is the greatest predictor of BP, followed by body mass index. Hence, weight-reduction strategies to at-risk children are crucial to minimizing the prevalence of Palestinian childhood hypertension.

Keywords

hypertension, child, Palestine, obesity, body mass index

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Introduction

Hypertension during childhood and adolescence is often more frequent than commonly thought. In fact, blood pressure (BP) in childhood is linked with BP in adulthood (Chen & Wang, 2008); thus, children with increased BP are more prone to experience adult hypertension than children with normal or lower BP. Nevertheless, the utility of routine child BP screening continues argued based on only screening of the moderate BP relationship between childhood and adulthood (Chen & Wang, 2008; Kelly et al., 2015; Toschke et al., 2010; Lurbe et al., 2016).

Increased childhood hypertension prevalence is joined with higher cardiovascular risk causes in adolescents and adults. (Lurbe et al., 2016) Childhood hypertension can result in increasing tissue damage like heart failure, stroke, pulmonary edema, eye damage, and kidney failure (Alkahtani, 2015; Kim et al., 2013).

Hypertension has also been related to adolescent obesity (Sun et al., 2007). Hypertension risk assessment is important for the implementation of effective prevention and control measures. To address the adulthood hypertension, it may be determined using some predictors in various age groups (Berenson et al., 1998). As the predicting influences of hypertension of adult across adolescent ages are uncertain and have not been evidently identified, therefore, the purpose of the study was to determine the prevalence of hypertension and predictors of blood pressure (BP) in Palestinian children.

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Methods

Study Design and Participants

A cross-sectional study was undertaken in the period from 10 March to 10 May 2019 among children between the ages of 10 and 13 years old recruited from Jenin and Tubas Governmental schools for both males and females. Convenience sample consisted of five hundred nine (10-13) year old students. Students who have taken insulin, glucocorticoids, anticonvulsants, or have previous experience of medical or surgical heart problems were excluded. Approval was obtained from the Research Ethics Committee of the Arab American University (Opinion 097/2019). In addition, the permission was given from the Ministry of Education.

Parents of participants completed informed consent to join in the study. A second meeting was arranged after the initial meeting to gather data. Measurements were performed in the morning after 8 hours of fasting with no intake of beverages or food, as well as 24 hours with no participation in exercise, restricted to conditions of rest. Parents and their children were given instructions the day before the measurements were obtained.

Measurements

Included were the anthropometric variables like height, HC, WC, WHR, and WHtR. For measuring height a Harpenden stadio-meter (Harpenden 602 VR, Holtain, Wales, UK®) was utilized. Each student was notified to stay in an erect position with his/her back, knees, and heels in constantly touching the vertical height rod of the stadio meter's and head oriented in the Frankfurt plane. To determine his/her height, the horizontal head piece was then put over the head of the participant. Height was checked twice to the nearest 0.5 cm, without shoes. The waist circumference was assessed two times with an automatic Seca roll-up metal tape (1 mm precision) using the horizontal plane halfway between the upper border of the iliac crest and the lowest rib at the end of expiration. The hip circumference as seen from the right side was measured two times at the maximum extension of the buttocks; and averages of the two measurements obtained. The BMI was calculated as body weight in kilograms divided by square height in meters, and the international standards specified overweight and obesity, corresponding to values higher than the 85th and 95th percentiles, respectively, for BMI and for age and sex (Cole et al., 2000). According to the International Society for the Advancement of Kinanthropometry, the anthropometric measurements reported by a protocol guideline maintaining inter-observer reliability and were assessed by the same anthropometrist (Marfell-Jones et al., 2012).

Blood Pressure

Dynamap Vital Signs Monitor (Model BP 8800, Critikon, Inc., Tampa, FL.) was applied to measure systolic blood pressure (SBP) and diastolic blood pressure (DBP) by adopting instructions from the European Heart Society (after 10 min of rest, student in supine position, on the right arm at the level of the heart, in a semi-flexed posture).

Childhood hypertension was specified as $\geq$95th percentile value of SBP or DBP. In childhood, blood pressure $\geq$90th percentile but <95th percentile is referred to as prehypertension (Flynn et al., 2017).

Statistical Analysis

All the data were analyzed using version 23 of SPSS. The study participants' baseline characteristics were described using mean, standard deviation, and percentage. Inferential statistical analysis (An independent t-test, and Pearson r) and logistic regression were also used.

Results

A total of 509 children aged 10 and 13 years studying in Grade 5, 6, 7, and 8 consented to the study. Approximately 52.5% were males and 47.5% were females with 1:1.105 female and male sex ratio.

The average age of participants was 11.5 ± 1.1 years. There were no differences between males and females regarding weight, height, and body mass index. However, Females had significantly had less waist circumference and more hip circumference than the males (Table 1).

Using Pearson's correlation coefficients the relationship between SBP/DBP and various anthropometric measurements were established. In females the relationship between mean SBP and BMI ($r = 0.316$), WC

Table 1. Children's Demographic information and the Anthropometric Measurements (n=509).

Variable	Males M(SD)	Females M(SD)	Total M(SD)
Age	11.4 ± 1.1	11.5 ± 1.1	11.5 ± 1.1
Height	151.7 ± 11.4	152.7 ± 9.5	152.2 ± 10.5
Weight	43.1 ± 13.4	43.7 ± 12.3	43.4 ± 12.9
Waist circumference	73.5 ± 11.4	70.7 ± 8.9	72.2 ± 10.3*
Hip circumference	77.50 ± 14.3	83.83 ± 10.0	80.5 ± 12.8*
BMI	18.5 ± 4.0	18.5 ± 3.84	18.5 ± 3.9
WHR	1.0 ± 0.2	0.9 ± 0.1	0.91 ± 0.2*
WHtR	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1*

Note. BMI = body mass index; WC = waist circumference; HC = hip circumference; WHR = waist-to-hip ratio; WHtR = waist-to-height ratio.
*$p < 0.05$.

(r = 0.259), and HC (r = 0.251) were moderate and statistically significant. However, there was weak and statistically significant relationship between mean SBP and WHtR (r = 0.172). Mean DBP also correlated significantly but weak with BMI (r = 0.239), WC (r = 0.129) and HC (r = 0.225). In males the relationship between mean SBP and BMI (r = 0.252), WC (r = 0.205), HC (r = 0.124), and WHtR (r = 0.180) was weak yet statistically significant. Mean DBP was also significant but with a weak relationship to BMI (r = 0.144), WC (r = 0.168), WHR (r = 0.155), and WHtR (r = 0.155), as shown in (Table 2).

More than half of the sample (54.0%) are listed as normotensive. Table 3 indicates that 54.3% of the children were males and 53.7% were females with normal pressure while 38.6% males and 38.8% females of children were pre-HTN participants. Unfortunately, 7.3% of the participants (7.1% males and 7.4% females) were hypertensive

In Table 4 appears the differences in anthropometric measurements between normotensive and pre-hypertensive participants. Hypertensive and pre-hypertensive participants were somewhat older than normotensive participants. There was no a significant difference in WHR (P = 0.267) between hypertensive/pre-hypertensive and normative participants. Significantly higher were hypertensive and pre-HT participants, HC (83.0 ± 13.8 vs 78.4 ± 11.6), BMI (19.7 ± 4.4 vs 17.5 ± 3.1) WC (75.0 ± 10.3 vs 69.8 ± 9.7) and WHtR (0.5 ± 0.06 vs 0.5 ± 0.07).

Table 2. Partial Correlation Coefficients Between Anthropometric Indicators and Blood Pressure (n=509).

	SBP		DBP	
	Males	Females	Males	Females
Variable	r	r	r	r
BMI	0.252**	0.316**	0.144*	0.239**
WC	0.205**	0.259**	0.168**	0.129*
HC	0.124*	0.251**	0.009	0.225**
WHR	0.044	0.051	0.155*	0.114
WHtR	0.180**	0.172**	0.155*	0.506

Note. HC = hip circumference; WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; WHR= Waist Hip Ratio; WHtR= Waist Height Ratio.
*$p < 0.05$. **$p < 0.01$.

Table 3. Prevalence of HT and pre-HT (n=509).

	Males	Females	Total
Normotensive	145 (54.3%)	130 (53.7%)	275 (54.0%)
Prehypertension	103 (38.6%)	94 (38.8%	197 (38.7%)
Hypertension	19 (7.1%)	18 (7.4%)	37 (7.3%)

Logistic regression with enter step showed that among independent variables, body mass index (OR 1.16, 95% CI 1.09-1.23) was the most relevant with major effects on early childhood hypertension. Among anthropometric measurements, the increase of BMI by 1 unit raises the risk of hypertension by 16% in the model (Table 5).

Discussion

This study was undertaken to identify anthropometric measurements correlations in Palestinian children with hypertension and pre-hypertension. This was Palestine's first epidemiological study, exploring correlations between overweight/obesity factors and hypertension.

The current study revealed a correlation between obesity and SBP markers in the range of 0.124 to 0.316 and for DBP in the range of 0.129 to 0.239 for both genders, which was in agreement with previous findings that higher for SBP than for DBP (Chen & Wang, 2008; Kelly et al., 2015; Toschke et al., 2010). It was, however, low when compared to the (Chen & Wang, 2008) meta-analysis which found correlation of 0.38 for SBP and 0.28 for DBP.

Overall, approximately 7.3% of children (10–13 years) suffered from hypertension in the study population. A study in Saudi Arabia showed that fewer than 10% of participants, consistent with the current study,

Table 4. Comparison of Anthropometric Data Between Normotensive and HT Subjects (n=509).

	Normotensive	Prehypertension/ hypertension	p-value
Age (yrs)	11.4 ± 1.1	11.5 ± 1.1	0.273
BMI (kg/m^2)	17.5 ± 3.1	19.7 ± 4.4	<0.01
WC (cm)	69.8 ± 9.7	75.0 ± 10.3	<0.01
HC (cm)	78.4 ± 11.6	83.0 ± 13.8	<0.01
WHR	0.9 ± 0.2	0.9 ± 0.7	0.267
WHtR	0.5 ± 0.06	0.5 ± 0.07	<0.01

Note. HC = hip circumference; WC = waist circumference; BMI = body mass index; WHR= Waist Hip Ratio; WHtR= Waist Height Ratio.

Table 5. Predictors for Hypertension (n = 509).

Independent variable	OR [95% CI]	*p* value
Age	0.978 [0.82, 1.164]	0.805
BMI	1.160 [1.09, 1.23]	0.001
Gender	0.941 [0.63, 1.40]	0.941
WHR	0.992 [0.61, 1.62]	0.973
WHtR	0.732 [0.43, 1.24]	0.246

Note. BMI = body mass index; WHR= Waist Hip Ratio; WHtR= Waist Height Ratio.

were adolescents with SBP and DBP at the ≥95th percentile (Mahfouz et al., 2012).

On the other hand, the prevalence of hypertension was reported in Australian children at 12.6% and the BMI was the most significant predictor of BP (Larkins et al., 2018).

In the current study, females had a slightly greater percentage of high BP than males. These results were unsupported by other studies that indicates that being male is an important risk factor for high BP development (Mahfouz et al., 2012).

Our findings reinforce earlier reports that adult risk factors for hypertensive BP may be recognized in children and adolescent (Huang et al., 2015; Kelly et al., 2015). The relationships were nevertheless small to moderate.

The current study revealed that BMI and WHR were predictors of hypertension among children. These results were supported a study in Saudi Arabia which indicated an increase in hypertension among children. Additionally, the study revealed that several factors increase hypertension such as physical inactivity (Koura et al., 2012) and obesity (Al-Hariri et al., 2014).

Children aged 10 to 13 years with hypertension were more likely to have hypertension later on than children of the same age range with normal BP (OR 1.16, 95% CI 1.09-1.23) after controlling different risk factors of hypertension involving overweight/obesity. Various studies (Din-Dzietham et al., 2007; Falkner et al., 2006; Huang et al., 2015) reported the correlation between overweight/obesity and hypertension in children. Our study found that increased BMI among children 10-13 years of age are more likely to have a hypertensive BP that shows a probable answer for adult hypertension prevention. In this context, various studies have found that children with higher BMI have transformed the standard BP deviation scores from initial standard to high BP values at follow-up (Miersch et al., 2013). Furthermore, changes in BMI during periods of growth have been found to predict BP levels during adolescence (Kollias et al., 2012); for example, Kelly et al. (2015) revealed that the resolution of increased BP during the transition from childhood to adulthood may be partly clarified by increases in related variables such as decreasing the BMI z-score between childhood and adulthood. Contrary with the literature (Neuhauser et al., 2015; Sarganas & Neuhauser, 2016; Wolf-Maier et al., 2003) the current study results did not indicated probability regarding gender for having hypertension as reported an OR = 0.941 (95% CI 0.63–1.40) for 10- to 13-year-old.

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