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The interplay between hypertension and BMI in Coptic teenagers

Abstract

Background: Elevated Body Mass Index (BMI) is a significant risk factor for developing hypertension (HTN). Other factors, including family history, smoking, and energy drinks consumption, can potentially increase the risk for HTN. Limited data are available on the risk factors for HTN in Coptic adolescent population. Hence, this study sought to investigate the association between these risk factors and HTN in Coptic adolescents.

Methods: A screening survey was conducted on 140 high school students who attended church services. After signing a consent form, each participant was interviewed and asked to answer the survey questions. The blood pressure was measured twice after 15 minutes of rest using Omron device. Both weight and height were measured, and BMI was calculated using CDC BMI calculator. Descriptive statistics, univariate, and multivariable logistic regression analyses were used to explore the relationship between the HTN and other potential variables.

Results: The cohort included 70 females (50%) and 70 males (50%) aged 16-21. The overall prevalence of HTN was 45.7% (73% in males and 18.6% in females). Participants were categorized by BMI into normal (n=78), overweight (n=44), and obese (n=18) groups. Compared to the normal weight group, the odds ratio (OR) for HTN in the overweight and obesity groups was 7.2 (95% C.I. 3.1 – 16.6, p<0.001) and 1.9 (95% C.I. 0.67 – 5.5, p=0.27), respectively. Among the total cohort, hypertensive individuals exhibited significantly higher BMI compared to normotensive individuals (26.3 [23.5, 28.3] vs. 22.5 [20.6, 25.7], p=0.001). However, there was no association between HTN and other covariates (p>0.05). In multivariable logistic regression, the association between HTN and elevated BMI remained significant (adjusted OR 3.8, 95% C.I. 1.6 – 9.3; p=0.002).

Conclusion: our findings are consistent with accumulative evidence about the positive relationship between BMI and HTN, which is a part of the metabolic syndrome. Moreover, this is the first study to investigate the risk factor profile for HTN in Coptic adolescents. Larger scale epidemiologic studies are needed to assess the prevalence of HTN in this population and the best approach to manage the modifiable risk factors.

Keywords: hypertension, BMI

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Introduction

Hypertension (HTN) is a global epidemic that is a significant risk factor for various cardiovascular diseases. Defined as having three elevated systolic or diastolic blood pressure readings based on the subject's sex, age, and height, HTN affects many people of all backgrounds and ages.[1] By WHO definitions, a BMI of 18.5–24.9 kg/m^2 represents normal range weight, a BMI of 25–29.9 kg/m^2 represents overweight, and a BMI of ≥30 kg/m^2 represents obesity.[2] Obesity is a major health concern that is associated with adverse cardiovascular outcomes and HTN.[3] Obesity-related HTN is characterized by a predominance of systolic HTN, tachycardia, and blood pressure variability.[4] Several mechanisms can contribute to the development of obesity-induced HTN including increased sympathetic activity and catecholamines, alterations in kidney function, salt and water retention, and activation of the renin-angiotensin-aldosterone (RAAS) system.[5] Both obesity and HTN have adverse renal outcomes. On one hand, chronic HTN can lead to kidney tissue scarring and development of chronic kidney disease (CKD). On the other hand, obesity impairs natriuresis and renal neurohumoral mechanisms and induce structural changes that can lead to nephron dysfunction.[6] Childhood obesity rates in the US have been increasing over the years, reaching 1 in every 5 children.[7] Furthermore, the number of adolescents observed with clinical HTN in the US is 3-5%, with 10-14% in the prehypertension stage.[8] Although the rates in the US may be alarming, in Africa, the rates are much higher with 9.9% of adolescents having elevated blood pressure.[9] However, limited data are available about the prevalence of HTN among Coptic adolescents who live in the US. Hence, this study aimed to explore the prevalence of HTN among Coptic teenagers, specifically the relationship between HTN and elevated BMI. Ultimately, this analysis can provide insight into the interconnection between BMI and HTN among a specific group of people that has not been well studied.

Methods

This was a prospective study that included high school students who attended church services from a total of 7 churches, 5 in Nashville, TN, and 2 in Atlanta, GA. Participants were selected without any specific exclusion criteria. A screening survey was conducted on 140 high school students. Each participant was of Coptic ethnicity, between the ages of 16-21, and currently living in the United States. After signing a consent form, each participant was interviewed and asked to answer the survey questions. The surveys were anonymous as each

participant filled them out alone. The survey included questions about the participant's age, sex, family history, as well as their history with other possible risk factors as shown in Table 1. The blood pressure was then measured twice after 15 minutes of rest using an Omron device (3 Series®, Model BP7150, OMRON Healthcare, Inc, Japan).

Table 1 Baseline characteristics of the included individuals

Variables	HTN (n=64)	Normal (n=76)	P Value
Age (median, 25th & 75th percentiles)	18 (17, 19.75)	18 (16, 20)	0.88
Male (N)	51 (79.7%)	19 (25%)	<0.001
Family history of HTN (N)	18 (28.1%)	28 (36.8%)	0.27
Smoking (N)	5 (7.8%)	2 (2.6%)	0.25
Alcohol (N)	11 (17.2%)	5 (6.6%)	0.06
Recreational drugs (N)	4 (6.3%)	2 (2.6%)	0.4
Energy drinks	33 (51.6%)	36 (47.4%)	0.62
Systolic (median, 25th & 75th percentiles)	138 (134, 147)	114 (108, 120.75)	<0.001
Diastolic (median, 25th & 75th percentiles)	82 (76, 89.75)	75.5 (70, 80)	<0.001
BMI (median, 25th & 75th percentiles)	26.28 (23.5, 28.26)	22.46 (20.6, 25.68)	<0.001

HTN, hypertension; BMI, Body Mass Index

Blood pressure less than 130/80 mmHg is considered normal. Both weight and height were measured, and BMI was calculated using a CDC BMI calculator

(https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/english_bmi_calculator/bmi_calculator.html). BMI groups were categorized according to the WHO guidelines as follows: underweight: BMI<18.5, healthy weight: BMI 18.5-24.9, overweight: BMI 25-29.9, and obese: BMI ≥30. Descriptive statistics, univariate, and multivariable logistic regression analyses were used to explore the relationship between the HTN and other potential variables.

Results

A total of 140 individuals, aged 16-21 years old, were included in this study. Baseline characteristics are summarized in Table 1. The cohort included 70 females (50%). The overall prevalence of HTN was 45.7% (73% in males and 18.6% in females). Participants were categorized by BMI into normal (n=78), overweight (n=44), and obese (n=18) groups. Compared to the normal weight group, the odds ratio (OR) for HTN in the overweight and obese groups were 7.2 (95% C.I. 3.1 - 16.6, p<0.001 and 1.9 (95% C.I. 0.67 - 5.5, p=0.27), respectively. As expected, compared to the normotensive group, HTN group had significantly elevated systolic (138 [134, 147] vs. 114 [108, 120.75], p=0.001) and diastolic (82 [76, 89.75] vs. 75.5 [70, 80], p=0.001) BP readings. Among the total cohort, hypertensive individuals exhibited significantly higher BMI compared to normotensive individuals (26.3 [23.5, 28.3] vs. 22.5 [20.6, 25.7], p=0.001). However, there was no association between HTN and other covariates (p>0.05). In univariate logistic regression analysis, elevated BMI was associated with the development of HTN (OR 4.9, 95% C.I. 2.4 – 10.2; p=0.001), whereas no statistically significant association was found between HTN and other variables including age, family history of HTN, smoking, alcohol consumption, recreational drug use, and energy drinks (Table 2). In multivariable logistic regression, the association between elevated BMI and the development of HTN remained significant (adjusted OR 3.8, 95% C.I. 1.6 - 9.3; p=0.002) (Table 3). Notably, in both univariate and multivariate logistic regression analyses, male gender was associated with an increased risk of HTN.

Table 2 Univariate logistic regression analysis for association to development of HTN

Variables	Odds ratio	95% CI	P Value
Elevated BMI	4.9	2.4 - 10.2	<0.001
Age	1.01	0.84 - 1.2	0.9
Male gender	11.7	5.3 - 26.2	<0.001
Family history of HTN	0.67	0.33 - 1.4	0.3
Smoking	3.13	0.6 - 16.7	0.2
Alcohol consumption	2.9	0.97 - 8.9	0.06
Recreational drugs	2.47	0.44 - 13.9	0.3
Energy drinks	1.18	0.6 - 2.3	0.6

HTN, hypertension; BMI, Body Mass Index

Table 3 Multivariable logistic regression analysis for association to development of HTN

Variables	Odds ratio	95% CI	P Value
Elevated BMI	3.8	1.6 - 9.3	0.002
Age	0.97	0.75 - 1.2	0.8
Male gender	8.3	3.5 - 19.6	<0.001
Family history of HTN	0.68	0.27 - 1.7	0.4
Smoking	1.6	0.12 - 22.8	0.7
Alcohol consumption	2.46	0.59 - 10.2	0.22
Recreational drugs	0.71	0.05 - 9.7	0.8
Energy drinks	1.24	0.52 - 3	0.63

HTN, hypertension; BMI, Body Mass Index

Discussion

Our study contributes to the growing body of evidence highlighting the relationship between elevated BMI and HTN, which is a part of the metabolic syndrome, in the adolescent population.[10,11] Moreover, this is the first study to investigate the risk factor profile for HTN in Coptic adolescents. The prevalence of HTN in our cohort is notably higher than the rates typically observed in the general adolescent population.[8] This significant discrepancy may be partially explained by the high proportion of individuals with elevated BMI in our cohort, as our

results indicate a strong association between elevated BMI and HTN. This finding is consistent with prior studies, such as the Egyptian study on school adolescents, which also demonstrated a significant increase in odds of having elevated blood pressure among obese adolescents compared to those with normal weight.[11] Our findings align with the current understanding of obesity-related HTN, particularly the mechanistic pathways involving increased sympathetic nervous system activity, alterations in renal function, and activation of the renin-angiotensin-aldosterone system. Moreover, obesity can induce a state of leptin resistance and hyperinsulinemia with insulin resistance resulting in a proinflammatory process, endothelial dysfunction, and impaired salt and water excretion; all can lead to the development of hypertension.[3,12] The lack of significant associations between HTN and other covariates, such as age, family history of HTN, and lifestyle factors such as smoking, energy drinks, and alcohol consumption, is somewhat unexpected. However, the specific demographic and cultural characteristics of our Coptic adolescent population may account for these differences. For example, cultural factors could influence self-reporting behaviors or modulate the impact of certain risk factors, such as diet and physical activity, on HTN development. Moreover, the relatively small sample size could have impacted the significant association of HTN to these co-variables.

Our findings have important clinical implications. The high prevalence of HTN in this cohort suggests a need for targeted interventions to address modifiable risk factors such as BMI. Early identification and management of elevated BMI in adolescents could potentially reduce the burden of HTN and its associated long-term complications. Health education programs tailored to the cultural context may be particularly effective in promoting healthy lifestyle choices among adolescents.

This study has some limitations that should be considered. First, the questionnaire was self-reported by the participants which could introduce a possibility of reporting bias. Particularly, the questions about smoking, alcohol drinking, and recreational drug use may have had the most inaccurate answers due to the nature of these questions. Additionally, the cross-sectional design of our study limits the ability to infer causality between elevated BMI and HTN. Longitudinal studies would be necessary to establish a temporal relationship between these variables. Another limitation is the relatively small sample size and the specific focus on Coptic adolescents, which may limit the generalizability of these findings to other populations. Furthermore, we did not account for dietary intake and physical activity which could influence both BMI and blood pressure.

In conclusion, our study highlights a strong association between elevated BMI and HTN in Coptic adolescents, consistent with the broader literature on obesity-related HTN. The findings underscore the importance of addressing obesity as a key risk factor for HTN in this population. Further research, including larger and longitudinal studies, is needed to better understand the interplay between BMI, HTN, and other potential risk factors and to develop effective prevention and management strategies.

Informed consent

Written informed consent was obtained from all participants in this study.

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Disclosure of interest

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