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Original Article

The tryst between obesity and blood pressure among school children in Northern Emirate – A cross-sectional study

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Abstract

Childhood hypertension is a rising concern and a known predictor of adult cardiovascular issues. This study aimed to assess the prevalence of hypertension and its association with BMI among school children aged 10–14 years in Ras Al Khaimah. A cross-sectional observational study was conducted in schools in Ras Al Khaimah over four months using convenience sampling. Children aged 10–14 years, with parental consent, were included. Data on BMI and BP were collected using standardized instruments. SPSS software was used to analyze the data. The study analyzed 296 children (137 males, 159 females) with a mean age of 11.95±1.28 years. Normal BMI was observed in 76%, while 13.5% were obese. Hypertension was present in 23.3% of children, with a significant association between high BMI and hypertension (Chi-square=12.17, $p<0.05$). Mean BP correlated strongly with SBP ($r=0.84$) and DBP ($r=0.93$) and moderately with BMI ($r=0.41$), all statistically significant ($p<0.05$). The study revealed a significant link between high BMI and hypertension in children, with 23.3% exhibiting elevated blood pressure. These findings support early screening and school-based interventions to prevent long-term health risks.

Keywords: childhood obesity, hypertension, lifestyle, body mass index, school-going children

Introduction

Hypertension in the pediatric population is a growing global concern [1, 2]. Beyond being a significant contributor to morbidity and mortality, it places a substantial burden on healthcare systems, families, and society as a whole. Although evidence indicates a rising prevalence of hypertension among youth, its long-term consequences remain poorly understood and are often overlooked [2]. Childhood hypertension is frequently asymptomatic, leading to missed diagnoses by healthcare professionals. It is a well-established predictor of adult hypertension and organ damage, yet it remains an underestimated issue, particularly in developing countries, where an increasing number of otherwise healthy children are being diagnosed [3]. Normal blood

pressure values in children and adolescents are determined by age, gender, and height. Several factors contribute to the rising incidence of pediatric hypertension, including lifestyle changes such as reduced physical activity, high-calorie and high-sodium diets, low potassium intake, consumption of caffeinated and alcoholic beverages, smoking, mental stress, and sleep deprivation.

A study done in the UAE among children demonstrated that a higher BMI percentile is associated with higher blood pressure [3]. The global tendency towards obesity among children is evident in several studies, as reported by a systematic review [4]. Further, there is a trend for increasing myocardial infarction among the young population, which could be attributed to lifestyle habits and undetected risk factors [5]. Along the same line, several complications of concurrent hypertension and obesity have been reported among children, such as retinal abnormality and poor sleep [6, 7]. Obesity in childhood would determine dysglycemia and carotid intima thickness in adulthood [8]. Obesity has also been shown to be associated with short sleep duration and dental caries [9, 10]. Regular screening of the students is required to prevent obesity-related complications in later life.

Hence, we designed this study to determine the prevalence of hypertension in children aged 10–14 years and to study the association between BMI and blood pressure among school-going children. The study also aimed to assess the other contributing factors responsible for high blood pressure. In our study, 69 (23.3%) children out of 296 were recorded as having high blood pressure above the 95th percentile. Higher BMI was found in 40 (13.5%) children among the 300. The possible causes for higher BP and higher BMI among our subjects are lifestyle-related factors such as sedentary status and diet.

Material and methods

The cross-sectional observational study was conducted at schools in Ras Al Khaimah over months. Convenience Sampling was used to select the schools for participation in the study. All children between 10 and 14 years old, whose parents gave consent, were recruited. After ethical committee approval, different schools in Ras Al Khaimah were approached to conduct the study in their schools after administrative approvals (RAKMHSU-REC-21-2017-UG-M-SC).

All children eligible for the study were explained the purpose of the study with an informed consent form and an information sheet to take home. The investigators collected parents' phone numbers and emails, talked to them about the study, and took consent through Google forms or physical forms sent through students. Demographic data, required anthropometric measurements, and systemic examinations were recorded in the proforma after informed consent from the parents. Two blood pressure measurements on two days at two different timings were recorded for each child included in the study from January 2018 to April 2018.

Assuming the total population of school children (10–14 years) as 2000 and an expected population proportion of 30% with a margin of error of 5% and confidence level of 95%, the sample is calculated as 278. However, a sample size of 300 is estimated, and dropouts are expected during the study. Children who were already diagnosed with chronic diseases more than 2 weeks prior were excluded. Also, the children who were absent during any day of taking blood pressure were excluded from the analysis (Figure 1).

Anthropometry and blood pressure measurement

The required data were collected using an electronic weighing machine, stadiometer, and sphygmomanometer with appropriate-sized cuffs, blood pressure, and BMI charts. Using SPSS software, the BMI percentiles of school-going children between 10 and 14 years were correlated with their blood pressure (BP). Appropriate statistical tests, such as the student t-test and correlation coefficient, were used for data analysis.

Results

The study included 296 children (137 males and 159 females) with a mean age of 11.95±1.28 years. The average height and weight were 1.51±0.11 m and 45.93± 13.48 kg, respectively, with a mean BMI of 19.95± 4.16 kg/m^2. The mean systolic blood pressure (SBP) was 111.6±11.96 mmHg, diastolic blood pressure (DBP) was 66.10±9.08 mmHg, and mean blood pressure (BP) was 81.26±9.02 mmHg (Table 1).

Regarding BMI, 76% of children had normal weight, 10.5% were in the pre-obesity range, and 13.5% were classified as obese. Blood pressure distribution showed that 65.5% had normal BP, 11.1% had prehypertension, and 23.3% had hypertension (Table 2). A significant association was found between BMI and hypertension (Chi-square=12.17, $p<0.05$), with 18 out of 40 children with high BMI having hypertension (Table 3). Mean BP

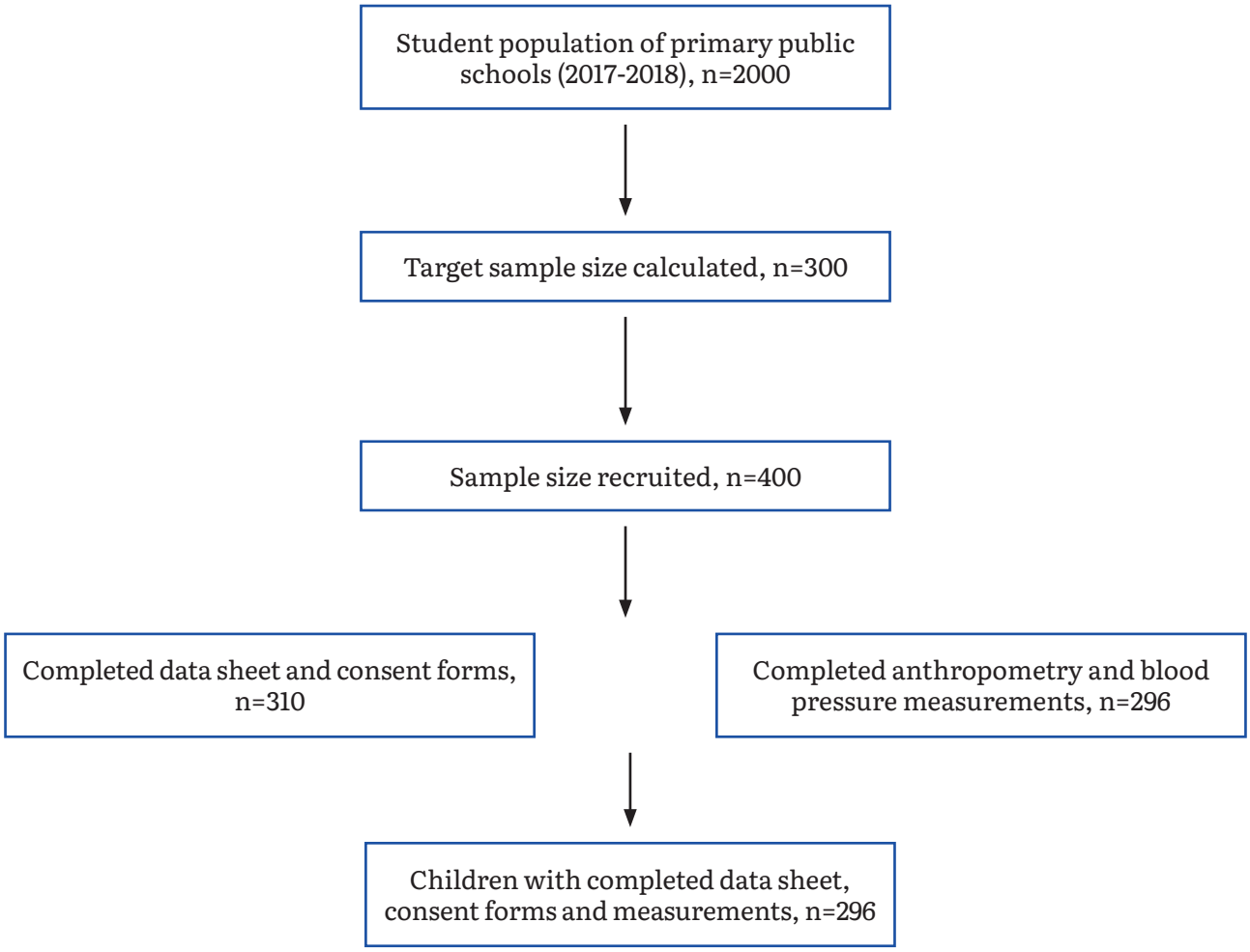

Figure 1: The schematic of the recruitment of children for the study.

Table 1: Study characteristics of the population (n=296).

Parameter		Frequency/Mean±SD
Gender	Males	137
	Females	159
Levels/grades in the school	5th	47 (15.9%)
	6th	70 (23.6%)
	7th	50 (16.9%)
	8th	66 (22.3%)
	9th	63 (21.3%)
Age (years)		11.95±1.280
Height (m)		1.51±0.11
Weight (kg)		45.93±13.48
Body mass index (kg/m²)		19.95±4.16
Mean SBP (mmHg)		111.6±11.96
Mean DBP (mmHg)		66.10±9.08
Mean BP (mmHg)		81.26±9.02
Television watching in hrs		1.63±1.14

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Table 2: Frequency table of blood pressure and body mass index.

Parameter	Categories	Number of children	Percentages
Blood pressure	Normal	194	65.5
	Prehypertension	33	11.1
	Hypertension	69	23.3
Body mass index for age	Normal ≤90th percentile	225	76.0%
	Pre-obesity (>90th but <95th percentile)	31	10.5%
	Obesity (≥95th percentile)	40	13.5%

showed a strong correlation with SBP (r=0.84) and DBP (r=0.93) and a moderate correlation with BMI (r=0.41), all statistically significant (p<0.05) (Figure 2).

Discussion

In our study, 69 (23.3%) children out of 296 were recorded as having high blood pressure above the 95th percentile. Higher BMI was found in 40 (13.5%) children among the 300. The possible causes for higher BP and higher BMI among our subjects are lifestyle-related factors such as sedentary status and diet. Screening children early is essential and has epidemiological significance, contributing to general public health [11]. Hypertension is unnoticed even in adults, and it becomes even more important to detect in childhood. Our findings contribute to the arena of health research and policymakers to strategize preventive measures.

Our study concurs with the global phenomenon of increasing blood pressure among children and adolescents. The worldwide pooled occurrence of high blood pressure in individuals ≤19 years old was found to be 9.7% with prehypertension and 4.0% with hypertension, based on the guideline definitions from the 2004 Fourth Report [2]. The definition of hypertension varies minimally between guidelines; however, it may pose a difference in diagnosing hypertension [12–16]. The consensus among different guidelines for the definition of high blood pressure in childhood is also essential to be taken for pediatric health. The AAP guideline may tend to underestimate the prevalence of high blood pressure, whereas it overestimates the prevalence of hypertension when compared with the fourth report [17]. We followed the generalized definition of prehypertension (≥90th to <95th percentile) and hypertension (≥95th percentile) as given by the fourth report of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents [12].

The correlation between hypertension and obesity also means that obesity can act as a screening tool to identify children for blood pressure screening [18]. Our study highlights the significance of BMI as a determinant of high blood pressure among schoolchildren. The findings concur with several other studies done in school-age populations [19].

Further, dietary intake during childhood needs to be monitored. Children are more prone to fast food and ultra-processed foods. Particularly, sodium intake during childhood determines the morbidity pattern and dietary habits that carry on into adulthood [20].

Higher body weight also poses increased cardiometabolic risk, including higher glucose and triglyceride levels [21]. In addition, higher body weight, irrespective of normal metabolic status, is associated with

Table 3: Cross table of frequency of children with normal mean blood pressure and high blood pressure as compared to BMI.

	Normal BP	Hypertension	Total
Normal BMI	205	51	256
High BMI	22	18	40
Total	227	69	296

Note: Hypertension is BP≥95 percentile compared to normative charts; High BMI is BMI ≥95 percentile; Chi-square value 12.17; The p-value<0.05.

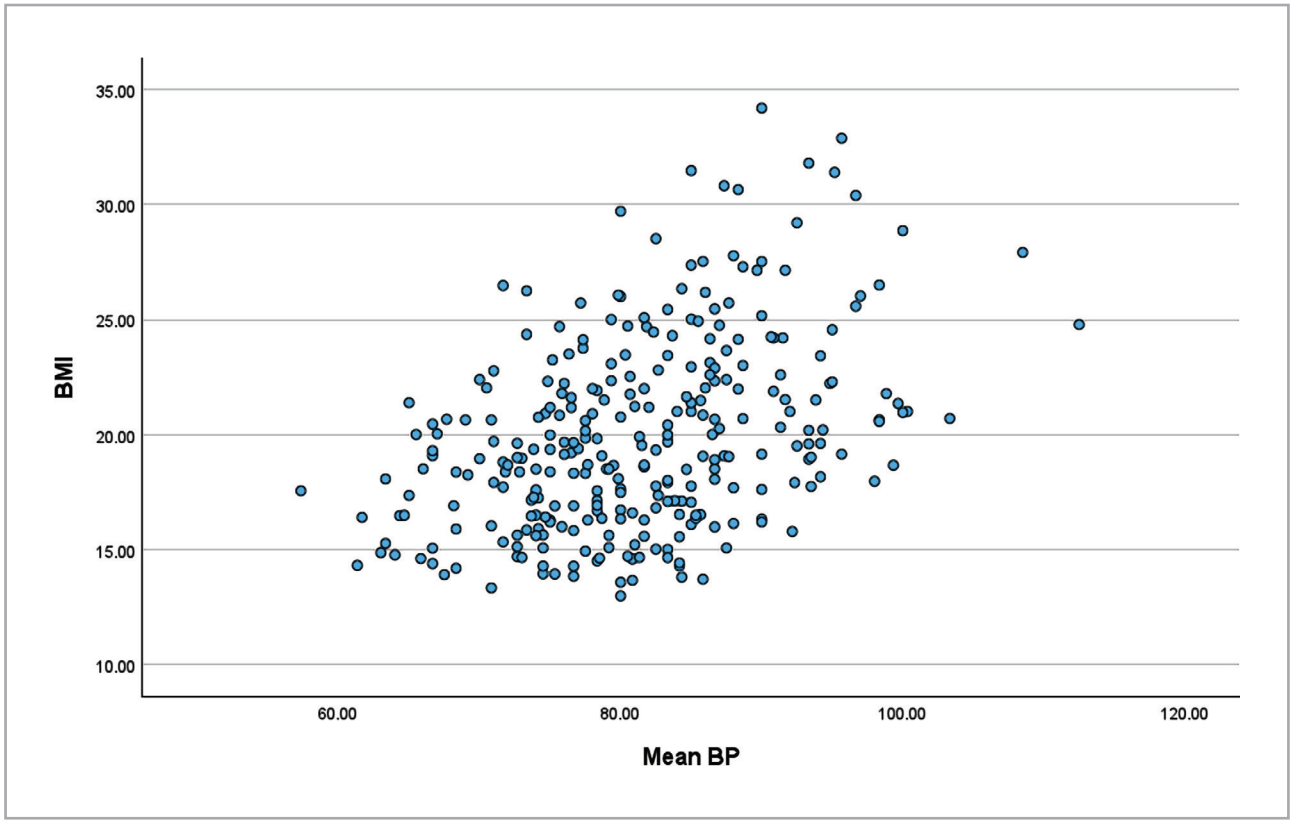

Figure 2: The correlation of mean BP with BMI in the study population.

myocardial infarction [22]. Our study should be implicated in light of the limitations of the methodology. The study was planned to measure two BP readings instead of three for a better school recruitment process, though most guidelines recommend three readings. Nevertheless, the data of our study also depicts a snapshot of blood pressure measurements. Further, blood pressure readings might be affected due to uncontrollable factors such as student anxiety and diurnal variations.

Our study's prime implication is designing preventive strategies for childhood hypertension and obesity. The excess weight gain during pregnancy poses a greater risk of obesity in offspring, even during midlife [23]. Maternal stress management could contribute to controlling obesity in children [24]. Further, the habits acquired during the early years of life have implications for lifespan [25]. Thus, preventive strategies should focus on "catching early" for better health implications throughout life [26]. Interventional strategies such as dietary habits, meditation, and physical activity during school hours should also be studied to assess avenues for controlling blood pressure among schoolchildren.

Future studies in the arena of childhood hypertension should consider a bigger sample size and be designed to assess a longitudinal pattern over months to get a clearer picture of the magnitude of the problem.

Conclusions

This study highlights a significant association between BMI and blood pressure among school-going children aged 10–14 years in Ras Al Khaimah. A considerable proportion (23.3%) of the participants were found to have hypertension, with a higher prevalence among those with elevated BMI. While 76% of the children had a normal BMI, 13.5% were classified as obese, and this group had a notably higher risk of developing hypertension. The statistical analysis confirmed a significant relationship between high BMI and hypertension (Chi-square=12.17, $p<0.05$), reinforcing excess weight's impact on children's blood pressure levels.

These findings emphasize the need for early identification and monitoring of children at risk of hypertension, particularly those with higher BMI percentiles. Preventive measures such as promoting a healthy diet, physical activity, and reducing sedentary behavior, including screen time, are crucial to mitigating obesity-related hypertension risk. School-based health interventions and awareness programs for parents and

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children can play a key role in controlling childhood obesity and preventing its long-term cardiovascular consequences.

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Conflict of interest

The authors declare no conflict of interest.

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