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Prevalence of Obesity and Hypertension among Rural School Adolescents: A School Based Pilot Study in Kerala, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Aim: The prevalence of hypertension and obesity is increasing worldwide. Recent data on sustained hypertension and obesity among school-going children and adolescents from the state of Kerala, India are limited. The aim of the present study was to estimate the prevalence of obesity and hypertension among apparently healthy school going adolescents.
Methodology: A cross-sectional survey was conducted among 252 school going adolescents aged 11-16 years (173 boys and 79 girls) selected from two private aided rural schools of Thrissur, District, Kerala, India. Measurements like height, weight, and blood pressure were done using standard guidelines. Guidelines of Indian Academy of Pediatrics and standard guidelines of blood pressure measurement using gender height specific blood pressure percentile charts were used to identify the overweight/obese and pre-hypertensive/ hypertensive adolescents respectively. Analysis was done using SPSS version 27.0. Gender wise differences were checked using chi-square and t-test.
Results: Among 252 adolescents, 83 (20.7%) were either overweight or obese and pre-hypertensive or hypertensive. The overall prevalence of obesity and overweight was found to be 9.5% and 15.1% respectively. The overall prevalence of hypertension and prehypertension was

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found to be 15 (6.0%) and 24 (9.5%) respectively. Systolic blood pressure and diastolic blood pressure was found to be statistically lower (P<0.001) among those with normal BMI, than those with overweight or obesity. The mean systolic and diastolic BP was slightly more among boys than girls and it was not statistically significant.
Conclusion: The high prevalence of hypertension, obesity and the strong association between obesity and high blood pressure seen among school-going adolescents necessitates immediate attention. Strategies should be designed and implemented for prevention, early identification, and treatment of pediatric obesity and hypertension in forestalling the morbidity/mortality from non communicable diseases and its complications.

Keywords: Non communicable diseases; overweight; obesity; prehypertension; hypertension; adolescents; school children; India.

1. INTRODUCTION

Noncommunicable diseases (NCDs) are collectively responsible for 41 million deaths each year, equivalent to 71% of global all cause mortality and of these 77% are happening in low- and middle-income countries [1]. In India NCDs contribute to 62% of total deaths; of particular concern are the preventable premature deaths, which account for a staggering 48% of the overall mortality [2].

Children, adults and the elderly are all vulnerable to the risk factors contributing to NCDs. These risk factors are often interrelated including excessive alcohol use, smoking, overweight and obesity, and elevated blood pressure (BP), and abnormal lipid levels and each of which has been shown to be associated with both NCDs and other negative health outcomes [3,4]. A higher than normal body mass index (BMI), is associated with increased morbidity and mortality from coronary heart disease, osteoarthritis, type 2 diabetes mellitus, hypertension, and certain types of cancer [5]. Hypertension is a major risk factor for cardiovascular disease and globally accounts for 54% of all strokes and 47% of all cases of ischemic heart disease [6]. The epidemic of obesity when combined with high blood pressure is paralleled by an alarming increase in the incidence of many non communicable diseases including chronic kidney disease, stroke, diabetes and coronary heart disease.

Many of the outcomes associated with obesity and high blood pressure that were previously thought of as diseases of adults are now affecting children as well. Outcomes related to childhood obesity include hypertension, type 2 diabetes mellitus, dyslipidemia, left ventricular hypertrophy, nonalcoholic steatohepatitis, obstructive sleep apnea, and orthopedic problems (such as slipped capital-femoral epiphysis), as well as social and psychological problems [7]. Elevated BP in childhood or adolescence is associated with several intermediate markers and hard outcomes of cardiovascular disease in adulthood [8].

Thus, the objective of this study was to estimate the prevalence of overweight, obesity, and hypertension and to associate overweight, and obesity with prehypertension and hypertension among school going adolescents living in the study area.

2. MATERIALS AND METHODS

2.1 Design, Setting and Population

This quantitative, cross sectional survey was carried out among adolescents studying in selected rural high schools of Thrissur subdistrict, Kerala, India. Details of high schools in the study area and student strength were taken from district education office. Study was conducted in two randomly selected private aided rural high schools from June 2015 to March 2016. Data were collected by the investigator and trained medical personnels. There were five private high schools, twelve private un-aided schools and thirteen government schools which constituted the sampling frame in the selected area. All the healthy adolescents from the selected standard were included based on inclusion and exclusion criteria. All the children/adolescents aged 11–16 years, both genders and willing to participate were selected to participate in the study. Those who were a known case of any chronic illness including endocrine problems, heart diseases or hypertension and/or acute illness, physical or mental disabilities (prediagnosed) at the time of the study were excluded.

2.2 Data Collection Instruments

A pre-tested structured questionnaire was used to collect the required information i.e., age, gender, standard, height, weight and blood pressure. Standardized anthropometrical measurements of the students were done in school uniform without shoes. Weight of all adolescents were taken to the nearest 0.1 kg using a calibrated and standardized portable electronic weighing scale. Weight was measured in light clothing, with shoes and coats removed. The scale was placed on a hard, even surface. They were asked to look straight and stand still on the centre of the scales without support and with the weight distributed evenly on both feet. Height was measured without shoes to the nearest 0.1 cm using calibrated stadiometer. We ensured child standing upright, barefoot on the ground with heels, buttocks, upper back and back of head making firm contact with the wall. The chin is tucked in slightly and the head is held erect. Zero error was set after every 10 measurements. Blood pressure was measured using an electronic sphygmomanometer (OMRON machine, Omron Corporation Tokyo, Japan) to the nearest 1 mmHg in a sitting posture with the hands resting on the examining table with the cubital fossa supported at the level of the heart. Care was taken to use the appropriate cuff size so that cuff bladder covers 80–100% of arm circumference. The BP measurement was done on the right arm for consistency. A second reading was taken after 5 minutes interval. Precautions were taken to eliminate confounding factors like anxiety, fear, laugh etc., which may affect the BP reading. All the measurements were done twice and the average of the two measurements was taken as final observation.

2.3 Data Analysis

BMI was calculated and categorized as normal weight, overweight and obese by calculating BMI z scores as per the standard guidelines published by Indian Academy of Pediatrics (IAP) [9]. Gender and height specific BP percentile were used to recognize respective systolic as well as diastolic BP percentiles [10]. They were considered hypertensive if the systolic or diastolic blood pressure or both were equal to or more than the 95^{th} percentile for height for age and gender. Those with SBP and/or DBP between 90th to 95th percentile were recognized as pre-hypertensive and remaining were normotensive [11].

Data was coded and entered on excel spread sheet. All the entries were double checked for any possible key-board error. Cross validation and consistency checks were also done. SPSS version 27.0 was used for data analysis. A P value less than 0.05 was considered as statistically significant. Categorical variables were expressed in frequency and percentages, while quantitative variable were expressed as mean ± standard deviation. Association among BMI Z score and blood pressure percentiles were done for gender as well as age specific groups. Chi square and t test were applied to check the association among study variables.

3. RESULTS

There were 252 adolescents among which 173 (68.7%) were boys and 79 (31.3%) were girls. Average age of participants was 12.29±0.5 yrs. There were no statistically significant difference in the mean height among boys and girls.

In the presents study, 190 (75.4%) adolescents had normal BMI, while 9.5% and 15.1% of the participants were found to obese and overweight. The mean BMI among adolescents was found to be 17.44 ± 3.15. The mean BMI was found to be statistically higher among girls (18.33 ± 3.37), than that of boys (17.03± 2.97) at .01 level (P=.002). For normal BMI Z score among adolescents, mean weight was 38.50±10.94 while it was 43.09±15.30 among obese adolescents.

The overall prevalence of hypertension and prehypertension was found to be 15 (6.0%) and 24 (9.5%) respectively. The mean SBP for boys and girls was found to be 106.78 ± 11.01 and 106.23 ± 9.60 respectively, while for both gender combined was found as (106.61 ± 10.57). The mean DBP for boys (62.55 ± 7.64) was slightly more than girls (61.85 ± 6.79) and recorded as 62.33 ± 7.38 for overall study participants. The mean weight was found to be significantly (P < .001) lower among normotensives (38.07 ± 8.15) when compared to those with prehypertension (42.60 ± 10.45) and hypertension (46.13 ± 13.66). The height was found to be comparable at .05 level among normotensives, prephpertensives and hypertensives.

Among all 169 (79.3%) adolescents had normal weight and normal blood pressure while remaining 83 (20.7%) were either overweight or obese and pre-hypertensive or hypertensive. Among 213 (84.52%) normotensive, 169 (79.3%)

had normal BMI Z score, while remaining 44 (20.7%) were either overweight or obese. Among 190 (75.4%) normal weight adolescents 62(24.6%) were either pre hypertensive or hypertensive (Table 1).

From Table 2, it is clear that systolic blood pressure was found to be statistically lower (P < .001) among those with normal BMI, when compared to those with overweight (108.34 ± 11.06) and obesity (116.92 ± 15.46). Similarly DBP was significantly lower among (P< .001) among those with normal BMI (61.16 ± 6.90) when compared to those with overweight (64.92 ± 6.93) and obesity (67.79 ± 8.43).

4. DISCUSSION

Obesity seems to be growing in children and adolescents regardless of age, gender, and regional differences [12,13]. Studies conducted in different parts of India have reported varying prevalence of overweight and obesity among children and adolescents. A higher prevalence of overweight/obesity similar to the present study findings were reported by Jagadesan S et al (private school- 26.4%, government schools- 4.6%) [14], and Tharkar S et al (12.1% among the children and 15.5 % among the adolescents) [15]. But a comparatively lower prevalence were reported by Viswambharan KJ [16], (7.7% were overweight or obese, 1.9% were obese and 5.8% were overweight, 8.2% among boys and 7.3% among girls) Cherian AT [17], Obesity 3.0% for boys and 5.3% for girls) and Abraham RJ [18] (overweight 7.4% and obesity 2.5%).

In contrast to the present study findings, Tony L et al reported a comparatively higher prevalence of pre-hypertension and hypertension 21.4% and 21.3% respectively among adolescent school children in Kerala. The prevalence of systolic and diastolic pre-hypertension was found to be 21.4% and 5.3% respectively [19]. Amma D et al reported an overall prevalence of prehypertension and hypertension to be 24.5% (males-30.5%, females-20.3%) and 0.6% (males-0.98%, females-0.34%) respectively among school going adolescents in a rural area of Kerala, India [20] while Mohan B et al in his study among children from rural areas reported a lower prevalence of 2.56% [21]. In a study done by Singh AK et al. the prevalence of systolic hypertension (SBP >140) was 7.84% and diastolic hypertension was (DBP >90) 2.15% [22]. Comparatively higher mean blood pressure among boys compared to girls reported in the present study was supported by Amma D et al. [20] and Sugarman JR [23].

Previous studies had demonstrated that obesity when combined with hypertension can significantly increase future morbidity and mortality from non communicable diseases especially cardiovascular diseases [24,25]. Excess weight in childhood and adolescence is reported to be the most common cause of hypertension [26]. A recent study conducted by Sreedharan J et al. reported a 14% increased risk for getting pre-hypertension or hypertension for a unit increase in BMI among youth [27]. Mohan B et al reported that hypertension among adolescents is positively associated with overweight and obesity (high BMI) [21]. The present study also supported the observation made by other authors with regard to overweight or obesity. Prehypertension and hypertension was significantly higher among those with overweight or obesity at .001 level. Increased BMI may be associated with a combination of factors including over activity of the sympathetic nervous system (SNS), insulin resistance, and abnormalities in vascular structure and function may contribute to obesity-related hypertension in children as in adults [28].

The present study has few important limitations. A major limitation of the study is relatively lower sample size and lack of participants across the state of Kerala. The cross-sectional nature of study with a non-prospective design is another draw back to establish the causality between high BMI and increased BP among study population. Thus, the prevalence rates obtained in this study may not be a true indication of actual prevalence rates. Hence, the study need to be replicated to larger to a larger cohort to increase the generalizability.

Table 1. Prevalence of obesity and hypertension among study participants

Blood Pressure	Body Mass Index			χ^2 value	P value
	Normal weight f (%)	Over weight f (%)	Obese f (%)		
Normal	169 (79.3)	28 (13.1)	16 (7.5)	22.959	< .001
Pre HTN	15 (62.5)	7 (29.2)	2 (8.3)		
HTN	6 (40.0)	3 (20.0)	6 (40.0)		
Total	190 (75.4)	38 (15.1)	24 (9.5)		

Table 2. Gender wise prevalence of obesity, hypertension and mean descriptive variables

Variables	Gender Wise difference evaluation				Mean Score			
	Boys f (%)	Girls f (%)	χ^2 Value	P Value	SBP	DBP	Weight	Height
Blood Pressure								
Normal	147 (85.0)	66 (83.5)	8.138	0.017	103.92 ± 7.80	60.72 ± 5.87	38.07 ± 8.15	148.50 ± 8.48
Pre HTN	12 (6.9)	12 (15.2)			118.88 ± 7.72	67.50 ± 6.73	42.60 ± 10.45	151.67 ± 7.51
HTN	14 (8.1)	1 (1.3)			125.20 ± 15.69	62.33 ± 7.38	46.13 ± 13.66	151.87 ± 11.141
Body Mass Index								
Normal	135 (78.0)	55 (69.6)	2.229	0.328	104.96 ± 8.87	61.16 ± 6.90	35.31 ± 5.74	148.32 ± 8.45
Over Weight	24 (13.9)	14 (17.7)			108.34 ± 11.06	64.92 ± 6.93	46.79 ± 6.28	150.84 ± 9.30
Obese	14 (8.1)	10 (12.7)			116.92 ± 15.46	67.79 ± 8.43	55.71 ± 7.16	151.54 ± 8.24

5. CONCLUSION

Although morbidity and mortality from NCDs mainly occur in adulthood, exposure to risk factors begins in early life. The high prevalence rates of obesity and hypertension and association between obesity and high blood pressure found among rural adolescents are alarming. Prevention and early detection of these risk factors should be given an emphasize at both population and individual levels to curb the epidemic of non-communicable diseases and its consequences in adulthood.

CONSENT AND ETHICAL APPROVAL

Ethical approval was obtained from the institutional ethics committee of JMMC&RI, Kerala and the study was conducted after obtaining written permission from Directorate of Public Instructions, school authorities, and Parent - teacher associations of the selected schools. Informed and written consent from parents and adolescent assent was distributed and obtained prior to the filling of the questionnaire.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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