ORIGINAL ARTICLE

Prevalence and Determinants of Hypertension among Adolescents: A Cross Sectional Study in South Kerala

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ABSTRACT

Background and Objective: Hypertension is one of the major risk factors for Non-Communicable disease related morbidity and premature mortality worldwide. Rising levels of Non-Communicable diseases necessitate adoption of early detection of premorbid conditions and risk factors and preventive strategies in vulnerable population. The current study was aimed at assessing the prevalence and associated factors of hypertension among adolescents in Southern Kerala. **Methods:** For this cross-sectional study, 1852 class eleven students from fifteen selected schools in the capital district, recruited using multistage cluster sampling procedure were examined by trained medical personnel. Blood pressure, anthropometry, and lifestyle parameters were assessed. Hypertension was determined based on the latest American Academy of Pediatrics recommendations. Adjusted Odds Ratios were calculated using binary logistic regression. **Results:** Grade 1 Hypertension was found in 24.68% (CI: 22.7%-26.6%) and Grade 2 in 8.31% (CI: 7%-9.5%). The odds of Hypertension were higher in boys (adjusted Odds Ratio- aOR 1.62, CI:1.3-2.0), overweight students (aOR 3.45, CI: 2.71-4.39), students with lower fruit intake (aOR 1.44, CI 1.06-1.95), lower daily physical activity (aOR 1.42, CI 1.08-1.86), and those who were currently using smokeless tobacco products (aOR 3.71, CI: 1.1-12.5). **Conclusion:** High levels of hypertension among the students warrant concern and adoption of early screening measures in the school-level itself, with appropriate interventions including behavioral-change communication, and follow-ups.

KEY WORDS: Adolescents, Determinants, Hypertension, Kerala, Prevalence.

Introduction

The prevalence of hypertension and other lifestyle diseases in children and adolescents has become a growing concern in the past decade.[1,2] Aside from the fact that pediatric and adolescent age hypertension has a significantly high tendency to track into adulthood, there is also the proven increased risk for early onset complications of the disease, like stroke, and other cardiovascular diseases.[3,4] It has also been established that many of the unhealthy lifestyle practices, leading to NCDs have their roots in adolescence.[5,6] Since the contributing lifestyle factors are mostly shaped during formative years and adolescence, it is imperative for the identification of the same and adopting appropriate preventive measures.

In India, states like Kerala, with a higher human development index than most other parts of the country, are facing a higher burden of non-communicable diseases like diabetes, hypertension etc.[7] The existing preventive strategies in the state mostly focuses on adult screening, and management

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programs in the public health system, and the young population, who are a significant early detection and intervention point in the prevention of NCD morbidity are not focused upon. With increasing industrialization, technological advancements and globalization, adolescents are exposed to multiple risk factors including unhealthy dietary habits, academic stress, lack of physical activity, unhealthy habits such as smoking and alcoholism, apart from hereditary and environmental risk factors. The focus of NCD prevention programs need to include our adolescents as well, with the aim of early detection and intervention for risk factors.

The present study was conducted as part of the project for assessing the non-communicable disease risk factors in adolescent age higher secondary school children in Thiruvananthapuram district, in Kerala and was aimed at assessing the prevalence of hypertension and its associated factors among the students who are transitioning into adulthood. Higher secondary classes were selected because most of them belonged to middle to late adolescence, the age of initiation of various risk factors such as tobacco use, unhealthy diet patterns etc. and an apt age for intervention before they reach adulthood.

Materials and Methods

This Cross-sectional study was conducted among class eleven students in Government and Government-aided Higher Secondary Schools in Thiruvananthapuram district. Higher secondary school students (class eleven) between the ages of 15-18 years in the selected Government/ Government-aided schools, were recruited for the study after obtaining their parents' consent and assent of the students. Children who were severely sick or absent on the day of data collection were excluded from the study.

Participants were selected based on a multistage cluster sampling process from five randomly selected schools each from all three educational sub-divisions in the district. From the available science, commerce and humanities divisions of Class eleven in each school, one division in each available academic stream was randomly selected and students belonging to selected class were enlisted for the study. From the list available from the educational department, five higher secondary schools were selected from each sub educational district. Thus 15 schools were selected from mixed schools, girl's only schools, boy's only schools, special schools, and schools in marginalized areas in each sub-district. One class division each was randomly selected from the available class eleven Science, Commerce, and Humanities academic streams in the schools. A minimum sample size of 1700 was calculated based on the least prevalence of non-communicable disease risk factors (physical activity, overweight, hypertension, tobacco use) among adolescents which would accommodate for all the other risk factors, and using an expected prevalence of 7.98 percent of hypertension which was obtained from a school based pilot study conducted by the researchers in Thiruvananthapuram district itself.[8] A precision of two percent and design effect of two, and a non-response rate of 20% was also taken into account for the sample size calculation. The sample size was calculated using Open Epi version 3.03. A total of 1852 students were included in the study.

Study Tools

The lifestyle assessment of the students with regard to non-Communicable Diseases was done using a pre-tested, self-administered questionnaire in the local language, which recorded the socio-demographic details along with diet, physical activity patterns, and habits. Physical examination findings of Height, Blood Pressure, and additional findings also were recorded.

Blood Pressure (BP) was measured in the right arm by using standard measurement practices. BP was measured after the student rests for at least 5 minutes in a sitting position, by a medical officer using standardized, professionally precalibrated mercury sphygmomanometer using auscultatory method, using an appropriately-sized cuff selected based on expert recommendations. Two separate readings were taken for each student at a 10-minute interval and the average of the two systolic BPs was calculated as the Systolic BP, and the average of the two Diastolic BPs were taken as the Diastolic BP. The American Academy of Pediatrics (AAP) standard guideline for measurement of blood pressure was used for the BP measurement.[9]

Body weight was measured to a nearest of 0.01 kg using a precalibrated digital weighing scale. Height was recorded in centimeters using a portable stadiometer. Weight and height were converted to metric measurements in order to determine the Body Mass Index (BMI) and classified based on the Indian Academy of Pediatrics (IAP), Standardized BMI chart for Indian children, and the Extended International

Obesity Task Force (IOTF) measurement.[10]

A ten-item Perceived Stress Scale, developed by Cohen et al, was used to measure the stress levels.[11] The lifestyle assessment questionnaire assessed the consumption of fruits, vegetables, different categories of undesirable foods, eating habits, physical activity patterns, and screen use of the students.

Statistical Analyses

The average systolic and diastolic blood pressures were calculated. Factors associated with hypertension were assessed using chi-square analyses, and multivariate logistic regression in Statistical Package for the Social Sciences (SPSS) version 25.

Ethical considerations

The study was conducted after obtaining clearance from the Institutional Ethics Committee. (Clearance no-03/CDC/2018 dated 19/5/2018). Assent of the students and written informed consent of parents were obtained prior to recruiting the students for the study.

Results

The study was conducted among 1852 higher secondary students. About 65.8% were girls and half of them were from science stream. About 52.9% belonged to APL (Above poverty line category, while 47.1% belonged to BPL (Below Poverty line) category. Around 76% were from rural areas while 24 % from urban areas.

We found that 457(24.68%; CI: 22.7%-26.6%) and 153(8.31%; CI: 7%-9.5%) of the students had average blood pressure more than the latest AHA/AAP guidelines for Grade 1 (systolic BP 130 -139 mm Hg; diastolic BP 80-89 mm Hg) and Grade II (systolic BP 140 mm Hg or more, or diastolic BP 90 mm Hg or more) hypertension respectively.

Bivariate analyses revealed that levels of hypertension (both Grade I and Grade II combined) were significantly higher in boys (p 0.001), overweight students (p 0.001) those of a higher socio-economic status (p 0.002), children with lower levels of fruit intake (p 0.002), lower daily physical activity (p 0.048) higher screen time (p 0.037), and those who were engaged in drug (p 0.02) and smokeless tobacco abuse (p 0.005). We did not find any significant association between blood pressure levels and the place of residence (rural/urban) of the students, junk food consumption, or perceived stress levels [Table 1].

Multivariate logistic Regression revealed higher odds of Hypertension in boys (adjusted Odds Ratio-aOR 1.62, Confidence Interval: 1.3-2.0), overweight students (aOR 3.45, CI: 2.71-4.39), students with lower fruit intake (aOR 1.44, CI 1.06-1.95), lower daily physical activity (aOR 1.42, CI 1.08-1.86), and those who were currently using smokeless tobacco products (aOR 3.71, CI: 1.1-12.5) [Table 2].

Discussion

The study was conducted in the background of the rising NCD burden and risk factors in the state and aimed at assessing the situation among adolescents about to enter adulthood. The present study was conceived from the findings related to hypertension from a study conducted by the researchers in a single school in the district.[8] In the present study, almost a quarter of the students had blood pressure levels higher than the AAP guidelines for Grade 1 Hypertension, and around 8.3%, which translates to around one in twelve students had blood pressure values in the Grade II Hypertension levels. We also found higher levels of hypertension among boys, overweight students, those with low fruit consumption and physical activity levels and in students with smokeless tobacco abuse.

The studies on hypertension among children and adolescents in India were mostly urban or rural school-based studies and involved pre-adolescent and early adolescent age groups. Studies among middle to late adolescents or those in early stages of youth, as well as those in district-wide samples have been very rare. The prevalence of hypertension or elevated blood pressure from these studies vary from around 5% in Delhi to around 21% in both Chennai and Ahmadabad.[12–18] A meta-analysis of twenty-five studies in India found a pooled prevalence of 7.6% of Hypertension in adolescents (10-19 year age group).[19] The present study findings are more in line with the studies in Chennai and Ahmadabad. The higher values found by the study could be due to the higher age-group of the study subjects and the classification guidelines used for interpretation.[9]

The present study found higher prevalence of hypertension among males. Studies in Delhi, had found higher levels of diastolic hypertension in adolescent boys compared to girls, and higher levels of systolic hypertension in girls.[14,15,17] Junk food consumption, use of tobacco products and alcohol

Table 1: Hypertension and associated factors among the study participants

Characteristic	Category	Normal Blood Pressure	Hypertension (Grade I or II)	Total	P value
Gender	Male	394	240 (37.9%)	634	0.001
	Female	846	370 (30.4%)	1216	
Socio-economic status	BPL	603	265 (30.53%)	868	0.002
	APL	629	345 (35.42%)	974	
Residence location	Rural	942	463 (32.95%)	1405	0.908
	Urban	295	147 (33.26%)	442	
Consumption of deep fried snacks	Less than three days a week	552	300 (35.21%)	852	0.058
	Three or more days a week	676	303 (30.95%)	979	
Consumption of sugar-sweetened beverages	Less than three days a week	1092	523 (32.38%)	1615	0.068
	Three or more days a week	136	86 (38.74%)	222	
Fruit consumption	Less than a day per week	138	89 (39.21%)	227	0.002
	At least one day per week	1092	518 (32.17%)	1610	
Recreational Screen time	Within 2 hours/ day	835	381 (31.33%)	1216	0.037
	More than 2 hours/ day	380	216 (36.24%)	596	
Daily Physical Activity	Less than half an hour a day	189	115 (37.83%)	304	0.048
	Half an hour or more a day	1044	491 (31.99%)	1535	
Drug abuse	Never user	1212	589 (32.70%)	1801	0.02
	Current/Past user	17	18 (51.43%)	35	
Smokeless tobacco	Never/Past user	1227	598 (32.77%)	1825	0.005
	Current user	4	5 (55.56%)	9	
Perceived Stress levels	Low-Moderate	1150	559 (32.71%)	1709	0.148
	High	74	45 (37.81%)	119	
Body Mass Index	Not overweight	1064	400 (27.32%)	1464	0.001
	Overweight	170	210 (55.26%)	380	

Table 2: Logistic Regression Analysis of Factors Associated with Hypertension Risk

Characteristic	Adjusted Odds Ratio (aOR)	aOR 95% Confidence Limits		p value
		Lower limit	Upper Limit	
Male	1.619	1.301	2.016	0.001
Fruit consumption less than once a week	1.436	1.057	1.951	0.021
Less than half an hour of daily physical activity	1.419	1.08	1.864	0.012
Overweight	3.445	2.705	4.388	0.001
Current use of smokeless tobacco	3.709	1.101	12.496	0.034

have been found to increase the odds of hypertension in parts of north India like Uttar Pradesh, Bihar etc.[18,20] while some urban studies did not find any such associations. These differences may be due to the changes in the tools used and the socio-demographic characteristics of the regional population.

The levels of hypertension that emerges from the study are alarming, as it has been shown that NCD risk factors in children and adolescents like elevated blood pressure and obesity tend to track into adulthood as well and will add to the NCD burden of the state in the near future as these students enter adulthood.[3,21,22]. The Comprehensive National Nutrition Survey (2016-2018) reported even higher rates, with 35.1% of children aged 10 to 12 years and 25.1% of those 13 years or older exhibiting elevated blood pressure.[23] Overweight and obesity were associated with a higher risk of high BP in both younger and older children and high BP coexisted with other cardiovascular disease risk factors.[23] The survey also found that adolescents with high fasting blood glucose, high hemoglobin A_{1c}, high triglyceride, and high low-density lipoprotein cholesterol levels had a higher risk of high BP.[23]

Elevated BP in childhood has also been found to be associated with early markers of cardiovascular abnormalities such as left ventricular hypertrophy and atherosclerosis.[4,24] The results point out the requirement for routine blood pressure screening of school students and implementation of necessary interventions at school levels itself, for promoting health and well-being, as well as prolonging the quality of life of the future citizens, which will also have an impact on the economy.[25] The higher odds of hypertension among overweight students and those with low physical activity stresses the adoption of an integrated approach with screening for other NCD risk factors and promotion of desirable diet and physical activity habits. We also recommend further studies in other adolescent age groups for obtaining a better picture of the situation, so as to implement age appropriate preventive strategies.

The present study used pre-tested questionnaires in the regional language for data collection, along with standardizing measures. The study was preceded by a pilot study in the same district, based on which sampling was done, and schools in different categories from all three educational sub-districts in the district were included in the study, which adds to the generalizability of the results in the region.

Limitations of the study

This cross-sectional study, based on self-reported data from students, may be subject to recall bias. Conducted exclusively in Kerala, its findings may not be generalizable to other regions in India, where health indicators and socioeconomic conditions vary. Additionally, the design limits causal inferences.

Conclusion

High levels of hypertension among higher secondary school students in the district indicate that the state is looking at a significant proportion adults and young adults requiring medical care for hypertension and related complications in the near future. This warrants reinforcement of the existing NCD preventive programs in the state with the adoption of blood pressure monitoring of adolescent students for early detection of hypertension and timely interventions, in order to reduce the morbidity due to NCDs. For this, we recommend that the school health programs in the state be expanded with yearly screenings of blood pressure and other NCD risk factors and mechanisms for intervention and follow up be set up. Measures also need to be taken to improve the physical activity habits of the students, and to discourage the abuse of tobacco products among school children, along with measures to increase healthy foods like fruits in the diet.

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Conflict of Interest

None.

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