

Prevalence of Prehypertension and Its Correlation with Body Mass Index in Undergraduate Students of Physiotherapy

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ABSTRACT

Background: Non-communicable diseases are increasing source of public health concern worldwide. Hypertension is one of the most common diseases affecting humans. Prehypertension (120-139/80-89 mmHg) is showing an alarming increase in young adults. Several factors influence the development of Prehypertension including environmental, socio-economic, lifestyle factors, demographic characteristics and genetic predisposition. Body Mass Index (excessive body fat deposition or adipose tissue accumulation) is directly related to high Systolic and Diastolic blood pressure.

Objective: To assess the magnitude of Prehypertension and to determine its correlation with Body Mass Index in university students.

Method: A cross-sectional study was conducted on 200 undergraduate students within the age group of 18-22 years was done. A semi structured pre-tested questionnaire was used to elicit the details on socio-demographic variables, dietary habits, smoking, alcohol consumption, physical activity and family history of Hypertension. Anthropometric measurements and blood pressure were recorded according to standard protocols.

Result: Out of the total sample population, 52.5% students fall under the criteria of Prehypertension among which males had higher prevalence (32.38%). Vegetarian diet (OR:0.477, 95% CI:0.235-0.969), history of smoking (OR:0.130, 95% CI:0.043-0.394) and family history of Hypertension (OR:0.456, 95% CI:0.231-0.900) were significant correlates of Prehypertension. Significant positive correlation was seen between BMI and Mean SBP ($r=0.258$, $p=0.0001$) and also between BMI and Mean DBP ($r=0.225$, $p=0.001$).

Conclusion: Prehypertension is prevalent in 52.5% of students. The risk factors found to be significantly associated were history of smoking, family history of Hypertension. Body Mass Index and Prehypertension were found to be positively correlated to each other.

Keywords: Prehypertension, Body Mass Index, Correlation, Risk factors.

INTRODUCTION

The National High Blood Pressure Education Program Coordinating Committee of the National Heart, Lung and Blood Institute in United States released the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood

Pressure (the JNC 7 report) on May 14th, 2003.^[1]

High blood pressure is a known predictor of cardiovascular disease, cerebrovascular accidents, and death with regionally variable and increasing magnitude.^[2] Cardiovascular disease is the prime contributor to NCD-related morbidity and mortality among adults. In which a few are non-modifiable,

while others are lifestyle-related and thus modifiable.^[3] The current American College of Cardiology (ACC) / American Heart Association (AHA) guidelines have also identified the importance of initiating early lifestyle interventions for raised blood pressure.^[4]

Prehypertension is one of the most common conditions affecting human beings worldwide with a recent finding showing an alarming increase in Prehypertension among young adults.^[2,5] The aim of the JNC-7 was to increase awareness of near-normal levels of blood pressure so that such “Prehypertensives” would initiate health-promoting lifestyle modifications to delay the development of frank Hypertension.^[6] It is associated with increased risk of major cardiovascular events and renal failure and it is amenable to control if it is detected early.^[2,4]

According to the study of M.Fareed et al. Prehypertension is associated with a 1.7-fold increase in Coronary artery disease and a 3.5-fold increase in Myocardial infarction.^[7] Evidence from the classical Framingham Heart study showed that prehypertensive individuals are two times more likely to develop a high blood pressure than those with normal blood pressure and that around 37% of adults having high normal blood pressure can lead to the progression of Prehypertension to Hypertension in four years.^[4,5]

In addition, it was found that Hypertension is ‘getting younger’, which means that more younger people are being diagnosed with Hypertension. The prevalence of Prehypertension itself was found to be higher than Hypertension among young adults.^[8] Several factors have been reported to influence the development of Prehypertension including environmental, socio-economic, behavioral, lifestyle factors, demographic characteristics and genetic predisposition.^[4,5] Primary prevention with a focus on reducing avoidable risk factors is the most cost effective approach to control this emerging scenario.^[9]

Blood pressure is associated with Body Mass Index (BMI), there is a reduction in blood pressure with significant weight loss which suggests that BMI is not merely a marker of factors associated with high blood pressure but is positively associated.^[10] According to WHO, BMI, formerly called the Quetelet’s Index, is a measure for indicating nutritional status in adults. It is defined as a person’s weight in kilograms divided by the square of the person’s height in metres (kg/m^2).^[11] A positive linear relationship between Obesity and Blood Pressure is well documented in Asian-Pacific Perspective.^[12] In the classical Framingham Heart study, weight gain was a major risk factor for the development of Hypertension and accounted for upto 75% of the risk. The prevalence of elevated blood pressure increased with increasing BMI percentile.^[13]

Many studies have showed that excessive body fat deposition or excessive adipose tissue accumulation is directly related to emulate from the length of time people are exposed to these modifiable risk factors.^[14] Amidst growing urbanization, socio-developmental and lifestyle changes have administered to physical inactivity, emphasize on technology and consumption of junk food and other modified dietary patterns characterized by increased consumption of diets rich in fat, sugar and calories which has led the young adults to suffer from obesity and Prehypertension.^[15] Nowadays the young population, especially the college going students are not much into the physical activity which leads to a sedentary lifestyle, which is one of the major causes of Prehypertension, also various other factors like family history of Hypertension, addiction of smoking and alcohol, extra salt in meals contribute to it. There is a great need of detecting Prehypertension in young adults and to estimate the impact of it. Therefore, for a greater understanding, this study was aimed to estimate the prevalence of Prehypertension and to identify its correlation with Body Mass Index.

MATERIALS & METHODS

Methodology

Source of data: Undergraduate students of Physiotherapy of Dr. A.P.J. Abdul Kalam College of Physiotherapy.

Study setting: Dr. A.P.J. Abdul Kalam College of Physiotherapy.

Method of collection of data: Data was collected by primary investigator.

Study design: Descriptive study.

Study type: Cross-sectional study.

Sample size: 200 students.

Target population: Undergraduates of Physiotherapy within the age group of 18-22 years.

Sampling method: Convenient sampling.

Study duration: 6 months.

Inclusion criteria

1. Undergraduate students of Physiotherapy.
2. Students within the age group of 18-22 years.
3. Both males and females.
4. Who are willing to give informed consent.

Exclusion criteria

1. Postgraduate students of Physiotherapy.
2. Known hypertensive who is on anti-hypertensive drugs.
3. Students with other co-morbidities.

Materials to be used

1. Consent form.
2. Data Collection Sheet.

Equipments to be used

1. Standard weighing scale.
2. Wall mounted stadiometer.
3. Mercury sphygmomanometer (Diamond).
4. Stethoscope (Microtone).

Outcome measures

1. Questionnaire.

A semi structured pre-tested questionnaire by Sanjay Kini, Veena G. Kamath, et al, (April 29, 2016) was used. The

questionnaire is comprised of details on socio-demographic variables, dietary habits, smoking, tobacco use, alcohol consumption, physical activity, family history of hypertension and anthropometric measurements.

Procedure

This study was designed to assess the prevalence of Prehypertension and find the correlation between Prehypertension and Body Mass Index. The participants were screened according to the inclusion and exclusion criteria. The informed consent was taken from the participants regarding the procedure prior to the study. The participants were explained about the procedure and were ensured that no harm will be caused to them. Then participants were asked to fill the Questionnaire. The weight of participant was measured in kilograms using standard weighing scale without shoes. The height of participant was measured using wall mounted stadiometer in standing posture without shoes, with bony prominences such as heels, buttocks, shoulders and occiput touching the wall. The height was measured in centimeters and then it was converted into meters square, as to calculate BMI in kilograms divided by meters square, as per the SI unit recommendations. The participants were classified as per the ASIAN criteria of BMI. Blood pressure measurements were taken in sitting position. The participant was asked to sit comfortably on a chair with back supported, feet on the floor, legs uncrossed, upper arm bared, arms well supported at the level of the heart. A mercury column sphygmomanometer was used for blood pressure measurement with an appropriate size of cuff bladder encircling at least 80% of arm circumference over left side to ensure accurate reading. The first and last audible Korotkoff sounds were recorded as Systolic and Diastolic pressures respectively by auscultatory method along with a stethoscope. Two readings were taken at least 10 minutes apart and the average reading was calculated arithmetically and

was taken as the final reading. The participants were classified as per the JNC 7 criteria. Precautionary measures like avoiding any conversation during the measurements were taken to prevent any false increase in blood pressure.

Statistical Analysis

Statistical analysis was done by using Descriptive and Inferential statistics using Chi square test, Pearson's Correlation Coefficient and Multivariate Regression Analysis and software used in the analysis were SPSS 27.0 version and GraphPad Prism 7.0 version and $p < 0.05$ is considered as level of significance.

RESULT

Prevalence of Prehypertension:

Table 1: Distribution of Prehypertensive and Normotensive patients according to their Gender:

Gender	Prehypertensive	Normotensive	χ^2 -value
Male	34(32.38%)	18(18.95%)	4.67 P=0.031, S
Female	71(67.62%)	77(81.05%)	
Total	105(100%)	95(100%)	

History of Smoking had more prevalence of Prehypertension and was a significant factor (Table 2). Family History of Hypertension

200 students were approached and all of them participated in the study (response rate: 100%). Overall, 105 (52.5%) students had Prehypertension and the remaining 95 (47.5%) students were found to be Normotensive.

Chi-Square Test for Prevalence of Prehypertension by various Socio-demographic and Lifestyle factors:

The mean age of Prehypertensive students was 20.62 years (SD=1.06) and that of Normotensive students was 20.82 years (SD=1.01). Prehypertension was more prevalent at the age of 19 years (15.24%) and 20 years (36.19%). It was more significantly prevalent in Males (Table 1).

also had prevalence of Prehypertension and was a significant factor (Table 3)

Table 2: Distribution of Prehypertensive and Normotensive patients according to History of Smoking:

H/O Smoking	Prehypertensive	Normotensive	χ^2 -value
Yes	32(30.48%)	9(9.47%)	13.49 P=0.0001,S
No	73(69.52%)	86(90.53%)	
Total	105(100%)	95(100%)	

Table 3: Distribution of Prehypertensive and Normotensive patients according to F/H/O Hypertension:

F/H/O Hypertension	Prehypertensive	Normotensive	χ^2 -value
Yes	68(64.76%)	46(48.42%)	5.43 P=0.020,S
No	37(35.24%)	49(51.58%)	
Total	105(100%)	95(100%)	

Multivariate Regression Analysis for the Correlates of Prehypertension:

It was seen that Vegetarian Diet, History of Smoking and Family History of Hypertension had significant association with Prehypertension. Other factors like

Age, Gender, Marital status, Religion, Type of Family, Socio-economic status, Cooking oil, Extra salt in meals, Alcohol use, Physical Activity, BMI and Waist-Hip Ratio did not show any association with Prehypertension (Table 4).

Table 4: Multivariate Regression Analysis:

Prehypertension		B	Std. Error	Wald	df	p-value	Odd's Ratio	95% Confidence Interval for Exp(B)		
								Lower Bound	Upper Bound	
MULTIVARIATE REGRESSION	Intercept	-0.084	1.489							
	Age	19 yrs	-0.989	0.662	2.232	1	0.135,NS	0.372	0.102	1.361
		20 yrs	0.120	0.417	0.083	1	0.773,NS	1.128	0.498	2.555
		21 yrs	0.168	0.500	0.113	1	0.737,NS	1.183	0.444	3.154
		22 yrs								
	Gender	Male	0.166	0.572	0.085	1	0.771,NS	1.181	0.385	3.626
		Female								
	Marital Status	Married	21.223	0.000	.	1	.	1648077796.51	1648077796.515	1648077796.515
		Unmarried								
	Religion	Hindu	0.744	1.384	0.289	1	0.591,NS	2.103	0.140	31.693
		Muslim	0.130	1.552	0.007	1	0.933,NS	1.139	0.054	23.830
		Christian								
	Type of family	Nuclear	0.494	0.353	1.957	1	0.162,NS	1.638	0.820	3.272
		Joint								
	Socio-economic Status	Low	0.626	0.349	3.226	1	0.072,NS	1.871	0.944	3.706
		Middle								
	Diet	Veg	-0.740	0.361	4.196	1	0.041,S	0.477	0.235	0.969
		Non Veg								
	Cooking Oil	Coconut Oil	0.057	0.543	0.011	1	0.916,NS	1.059	0.365	3.071
		Pure Ghee	-0.188	0.367	0.262	1	0.609,NS	0.829	0.404	1.702
		Refined Oil								
	Extra salt in meals	Yes	-0.501	0.405	1.527	1	0.217,NS	0.606	0.274	1.341
		No								
	Smoking	Yes	-2.041	0.566	13.010	1	0.0001,S	0.130	0.043	0.394
		No								
	Alcohol use	Yes	0.429	0.456	0.887	1	0.346,NS	1.536	0.629	3.751
		No								
	Physical Activity	Light	-0.180	0.573	0.099	1	0.753,NS	0.835	0.272	2.567
Moderate		-0.256	0.586	0.190	1	0.663,NS	0.774	0.245	2.444	
Heavy										
F/H/O HT	Yes	-0.785	0.347	5.124	1	0.024,S	0.456	0.231	0.900	
	No									
BMI(kg/m2)	Underweight	0.524	0.657	0.634	1	0.426,NS	1.688	0.465	6.122	
	Normal	0.260	0.384	0.459	1	0.498,NS	1.297	0.611	2.751	
	Overweight									
Waist-Hip Ratio	Low Risk	-0.641	0.492	1.696	1	0.193,NS	0.527	0.201	1.382	
	Moderate Risk	0.177	0.430	0.169	1	0.681,NS	1.193	0.514	2.772	
	High Risk									

Pearson’s Correlation Coefficient of Body Mass Index (BMI) with mean Systolic Blood Pressure (SBP) and mean Diastolic Blood Pressure (DBP):

Significant positive correlation was seen between BMI and Mean Systolic Blood Pressure and also between BMI and Mean Diastolic Blood Pressure (Table 5).

Table 5: Correlation between BMI and Prehypertension Pearson’s Correlation Coefficient:

	Mean	Std. Deviation	N	Correlation 'r'	p-value
BMI	24.76	4.44	200	-	-
SBP	122.99	6.22	200	0.258	0.0001,S
DBP	81.71	6.60	200	0.225	0.001,S

DISCUSSION

The present study was designed to estimate the prevalence of Prehypertension and correlate it with Body Mass Index (BMI) in undergraduate students of Physiotherapy of Dr. A.P.J. Abdul Kalam College of Physiotherapy. This sample population was chosen because young adults of this age group are more prone to develop Prehypertension due to various factors like

sedentary lifestyle, environmental factors, influence of peer group, personal habits like smoking, alcohol consumption due to social factors. Blood pressure is the force exerted by circulating blood against the walls of the arteries. Systolic blood pressure is the number that represents the pressure in the blood vessels when the heart contracts or beats. Diastolic blood pressure is the

number that represents the pressure in the blood vessels when the heart rests between beats. Hypertension is when the blood pressure is too high. The term Prehypertension is of recent origin, provided by JNC 7. In the past, Prehypertension was called as transient hypertension, borderline hypertension and high-normal blood pressure.^[2] Prehypertension is associated with increased coronary atherosclerosis and increased arterial intima-media thickness.^[9] The numerous risk factors for CVDs other than Hypertension are usually categorized as modifiable (like smoking, obesity, alcohol and sedentary lifestyle) and non-modifiable (like increasing age, male sex, family history).

Prehypertension, being a symptomless disease, is largely neglected and overlooked by family physicians. The prevalence of Prehypertension in the present study population of 200 students was 52.5% (n=105). The results are consistent with a study done by Ejiroghene M. Umuerrri et al in Nigeria where the prevalence of Prehypertension was 42.5% in the age group of more than 18 years.^[3] According to JNC 7 the major lifestyle modifications recommended for management of Prehypertension are weight reduction, the Dietary Approaches to Stop Hypertension (DASH) eating plan, which is rich in potassium and calcium and reduction in total and saturated fat, reduction of sodium intake, regular aerobic physical exercise and moderation of alcohol intake.^[9]

Obesity is on surge due to rapid changes in lifestyle and dietary habits. In addition, over the last few years physical activity has decreased, screen-time has increased. Obesity is considered as a gateway to many life threatening diseases like CVDs, metabolic syndromes, diabetes, different gastrointestinal and respiratory diseases and certain types of cancers and Hypertension.^[14]

Both the renin-angiotensin-aldosterone system (RAAS) and the sympathetic nervous system (SNS) activation have synergistic effects on renal sodium retention

and impaired renal pressure natriuresis and may subsequently induce Hypertension. Pro-inflammatory cytokines and oxidative stress contribute to vascular endothelial dysfunction, impaired local vasodilatory response and increased peripheral resistance. Obesity-related metabolic disorders such as insulin resistance, dyslipidemia, chronic inflammation and lipotoxicity facilitate progression of chronic kidney disease (CKD). CKD is a well-known risk factor for Hypertension and therefore, a potential amplifier of the effect of obesity on blood pressure.^[13]

Prehypertension has been considered as a significant risk factor for developing adulthood diseases and it is associated with micro and macro vascular complications like increased incidence of cerebrovascular accidents (CVAs) or stroke, CVDs like myocardial infarction or heart attack and angina or coronary heart disease (CHD), congestive heart failure (CCF) and renal insufficiency or renal failure, liver diseases, psychological disorders and cancers.^[14] The correlation between BMI and Prehypertension is robust. In the present study, it was seen that BMI had significant correlation with mean Systolic and mean Diastolic blood pressure. Similar results were seen in a study by Daniel Gyamfi et al in Ghana, where BMI was positively correlated with mean Systolic ($p=0.0001$) and mean Diastolic ($p=0.0001$) blood pressure. Consequently, the prevalence of Prehypertension increases with increasing BMI.^[16]

In the present study, prevalence of Prehypertension according to age was not significant, but was more significant in males. Similar to the present study, most of the studies have reported a higher prevalence of Prehypertension among males than females. In this study, BMI and waist-hip ratio (WHR) were not significantly associated with Prehypertension. Archana Bhaila et al conducted a study among medical students in Nepal, in which they reported significantly higher prevalence among males and obese students with p

value <0.0001 , association with BMI was contradicting to present study. They also reported no significance with age ($p=0.231$) and WHR ($p=0.219$).^[15]

The present study also evaluated the association of other risk factors with Prehypertension. It was found that history of smoking, family history of Hypertension contributes significantly towards the magnitude of Prehypertension. But the association with marital status, religion, type of family, socio-economic status, dietary habit, cooking oil, extra salt in meals, alcohol use, physical activity was not significant. There are limited studies that have evaluated these factors.

In the present study on multivariate regression analysis vegetarian diet, history of smoking, family history of Hypertension was found to be significant correlates of Prehypertension. Sanjay Kini et al, in their study found that on multivariate logistic regression analysis age group of 25–30 years, white collared and skilled occupation, students, refined cooking oil, extra salt in meals, salty food items, overweight and obese as significant risk factors for Prehypertension.^[1]

This condition can be easily tackled by health promotional measures which obviate the need for pharmacological therapy. It is recommended to develop healthy lifestyle methods including exercise for maintaining a normal weight and preventing obesity as most of the studies have found that BMI is a very strong predictor of Prehypertension.

The decision to conduct this study was one of the strategies to combat Hypertension as early as possible. As for future health professionals or specifically doctors, maintaining good health status and early management of pre-disease state is crucial. Although Prehypertension is just a precursor, it could increase when the stressor becomes higher in clinical years. Early intervention may be required as the nation must have healthy doctors as role models for their patients and the community.

Future studies should also incorporate investigations of fasting plasma glucose, total cholesterol, low density lipoprotein and high-density lipoprotein levels for a better understanding of Prehypertension.

CONCLUSION

The prevalence of Prehypertension in undergraduates of Physiotherapy was 52.5%. Body Mass Index and Prehypertension were found to be positively correlated to each other. The risk factors found to be significantly associated with Prehypertension were history of smoking, family history of Hypertension. Since Prehypertension is an alarming pre-disease state nowadays, especially among younger age group, early detection and screening at the age of 18 years is a crucial as part of preventive intervention for Hypertension. Screening strategies for Prehypertension should be initiated at an early age. This necessitates the urgent need for emphasizing health promotional behavior to avoid the impact of Hypertension and other cardiovascular diseases. The importance of lifestyle modifications with respect to personal habits, dietary habits and physical exercise needs to be impressed upon young adults.

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