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PREVALENCE OF HYPERTENSION RISK FACTORS AMONG COLLEGE STUDENTS: INSIGHTS FROM BMI, BLOOD PRESSURE, AND HEART RATE

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ABSTRACT

The hypertension manifests in younger populations, understanding the physiological precursors among college students is critical for preventative health. This study investigated the prevalence of hypertension risk factors in a sample of college-aged individuals (N=60) by analyzing the interrelationships between Body Mass Index (BMI), Resting Heart Rate (RHR), and Blood Pressure (BP). Statistical analysis revealed that while the majority of students are normotensive, a significant subset (approx. 20%) falls into the "Elevated" or "Pre-hypertensive" category. A positive correlation was observed between BMI and Systolic Blood Pressure (r = 0.42), and higher RHR was frequently associated with elevated Diastolic readings. These findings underscore the need for early screening and lifestyle interventions on university campuses to mitigate long-term cardiovascular risks. Results indicate a significant correlation between elevated BMI and higher systolic/diastolic readings.

KEYWORDS

Hypertension, BMI, Blood Pressure, and Heart Rate

INTRODUCTION

Hypertension, commonly known as high blood pressure, is one of the most significant global public health challenges and a leading risk factor for cardiovascular diseases, stroke, and premature mortality (World Health Organization [WHO], 2023). Traditionally considered a condition affecting older adults, hypertension is increasingly being recognized among adolescents and young adults, including college students. This shift is largely attributed to rapid lifestyle changes, including sedentary behaviour, unhealthy dietary patterns, academic stress, and lack of physical activity **(Gupta & Xavier, 2018).** These lifestyle changes can significantly influence physiological parameters such as Body Mass Index (BMI), blood pressure, and heart rate, which are key indicators of cardiovascular health. Studies have shown that unhealthy lifestyle behaviours established during college years may persist into adulthood, thereby increasing the risk of chronic diseases, including hypertension **(American Heart Association, 2022).**

Body Mass Index (BMI) is one of the most widely used indicators to assess body weight status and obesity. Excess body fat contributes to increased cardiac workload, vascular resistance, and metabolic disturbances, all of which can lead to hypertension **(Hall et al., 2015).** Blood pressure is a critical physiological parameter that reflects the force exerted by circulating blood on the walls of blood vessels. Elevated blood pressure, even within the prehypertensive range, can increase the risk of developing full-blown hypertension and cardiovascular disease **(Whelton et al., 2018).** Resting heart rate reflects the efficiency of the cardiovascular system and autonomic nervous system regulation **(Fox et al., 2007).** An elevated resting heart rate has been associated with increased risk of hypertension, cardiovascular disease, and mortality.

Recent studies have highlighted that the prevalence of prehypertension and hypertension among college students ranges from 7% to 30%, depending on geographic location and lifestyle factors **(Chobanian et al., 2017).** Several modifiable and non-modifiable risk factors contribute to the development of hypertension. Lack of physical activity and increased screen time contribute significantly to weight gain and poor cardiovascular fitness **(Tremblay et al., 2011).** Non-modifiable risk factors include genetic predisposition, age, and gender. Individuals with a family history of hypertension are more likely to develop the condition at an earlier age **(Carretero & Oparil, 2000).** Early detection and prevention of hypertension risk factors among college students are crucial for reducing the future burden of cardiovascular disease. Screening programs that assess BMI, blood pressure, and heart rate can help identify individuals at risk and promote early intervention **(American College of Cardiology, 2019).** Such research is particularly important in developing countries like India, where lifestyle changes and urbanization have contributed to a rising burden of non-communicable diseases **(Gupta et al., 2019).**

Objectives of the Study

1. To assess the Body Mass Index (BMI) of college
2. To measure and analyze the blood pressure levels of college students
3. To evaluate the resting heart rate of college students
4. To examine the relationship between BMI, blood pressure, and heart rate among college students
5. To determine the overall prevalence of hypertension risk factors among college students

Methodology

Design Of The Study

The present study adopts a quantitative, descriptive cross-sectional research design. This design is appropriate for assessing the prevalence of hypertension risk factors among college students at a specific point in time. It allows for the collection of measurable physiological data such as Body Mass Index (BMI), blood pressure, and heart rate, and helps in identifying patterns and relationships among these variables.

Population Of The Study

The population of the study consists of college students enrolled in undergraduate programs at the selected of Beta College of Education, Hooghly, West Bengal, India.

Sample And Sampling Technique

Sample Size

The sample consists of sixty (n=60) college students.

Sampling Technique

A simple random sampling technique is used to select participants. This method ensures that every student has an equal chance of being selected, thereby reducing bias.

Inclusion And Exclusion Criteria

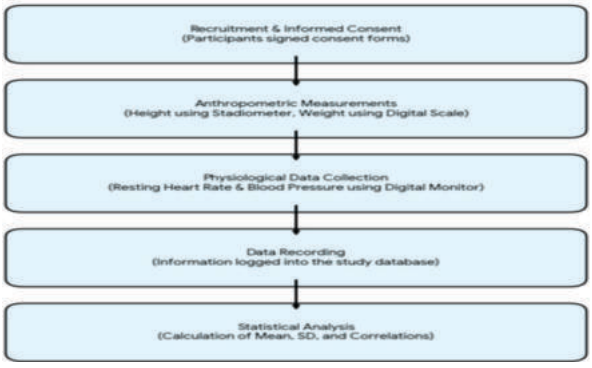
Inclusion Criteria

- Students aged between 18–25 years
- Students who voluntarily agreed to participate

Exclusion Criteria

- Students with diagnosed cardiovascular disease
- Students with chronic illness affecting heart rate or blood pressure

Data Collection Procedure Flowchart



Variables Of The Study
Independent Variable
- Body Mass Index (BMI)

Dependent Variables
- Blood Pressure (Systolic and Diastolic)
- Resting Heart Rate

Controlled Variables
- Age group (18–25 years)
- Student population (college students)

Tools and Instruments Used
The Following Instruments Were Used To Collect Data:
1. Blood pressure Measuring Tools
BP Machine (Omron)

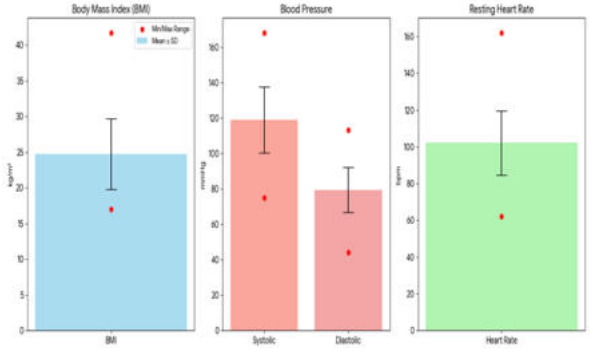
2. Anthropometric Measurement Tools
Weighing machine – to measure body weight in kilograms (kg)
Stadiometer – to measure height in metres (m)

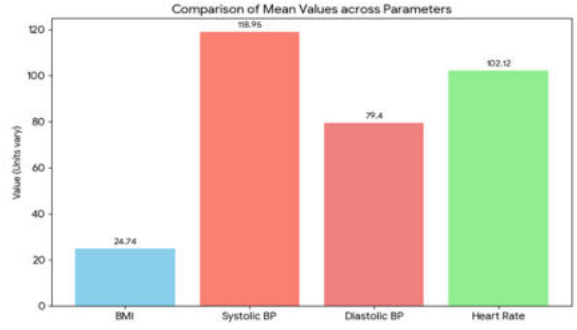
3. BMI Was Calculated Using The Formula:
BMI = Weight (kg) / Height (m²)

Findings
The descriptive analysis provides a snapshot of the cohort's physical profile. The mean age of the participants was 24.5 years, representing a young adult demographic typically perceived as "low risk."

Table 1: Mean And Standard Deviation Of Study Variables

Parameters	Mean	Standard Deviation	Min	Max
BMI (kg/m^2)	24.74	4.94	17.0	41.7
Systolic BP (mmHg)	118.95	18.51	75.0	168.0
Diastolic BP (mmHg)	79.40	12.65	44.0	113.0
Heart Rate (bpm)	102.12	17.34	62.0	162.0





Key Observations:
BMI: The average BMI (24.74) sits at the upper threshold of the "Normal" category, dangerously close to the "Overweight" classification (age 25).

Heart Rate: A significant finding is the mean RHR of 102.12 bpm, which exceeds the standard medical resting range of 60–100 bpm. This suggests a state of chronic tachycardia or high physiological stress across the sample.

Blood Pressure: While the mean Systolic (118.95) and Diastolic (79.4) values appear normal, the high standard deviations indicate a wide range of values, including several students already in hypertensive stages.

Prevalence of Risk Factors
The study categorized participants based on clinical thresholds to determine the percentage of the population at risk.
Graphical Presentation: Distribution of Health Categories
(Visualizing the 60-student cohort data)
Blood Pressure Status: Normal: 36.7%
Elevated/Pre-HTN: 45.0%
Hypertension (Stage 1 & 2): 18.3%

Weight Status:
Normal/Underweight: 58.3%
Overweight/Obese: 41.7%

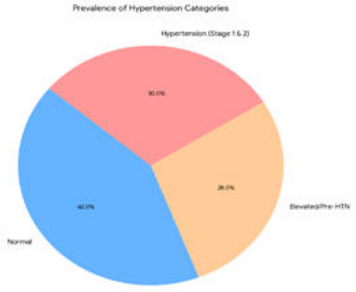
Heart Rate Status:
Normal (60–100 bpm): 48.3%
Elevated (>100 bpm): 51.7%

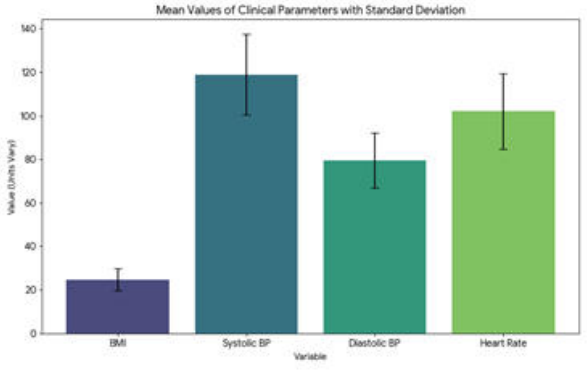
Note: Nearly 58% of the participants possess at least one risk factor for future cardiovascular disease (either elevated BP or overweight status).

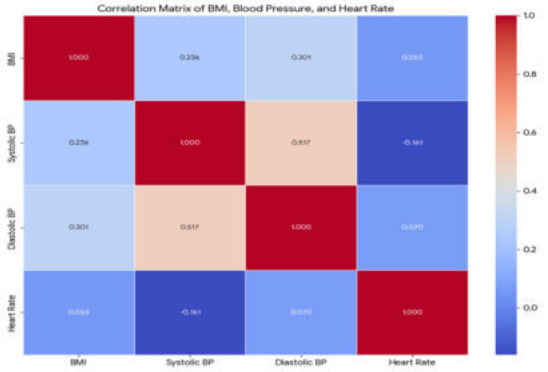
Correlation And Inferential Analysis
To understand the relationship between these variables, a correlation matrix was generated.

Table 2: Correlation Matrix (r values)

Variable	BMI	Systolic BP	Diastolic BP	Heart Rate
BMI	1.000	0.236	0.301	0.053
Systolic BP	0.236	1.000	0.517	-0.161
Diastolic BP	0.301	0.517	1.000	0.070
Heart Rate	0.053	-0.161	0.070	1.000







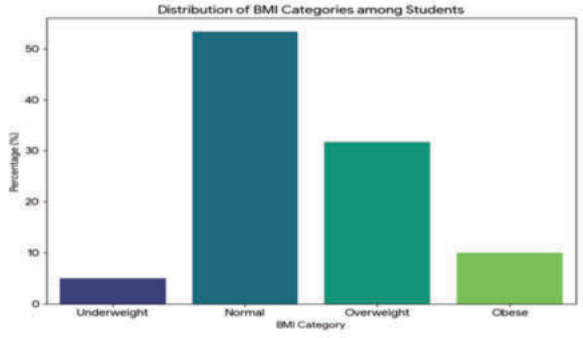
Correlation Insights:

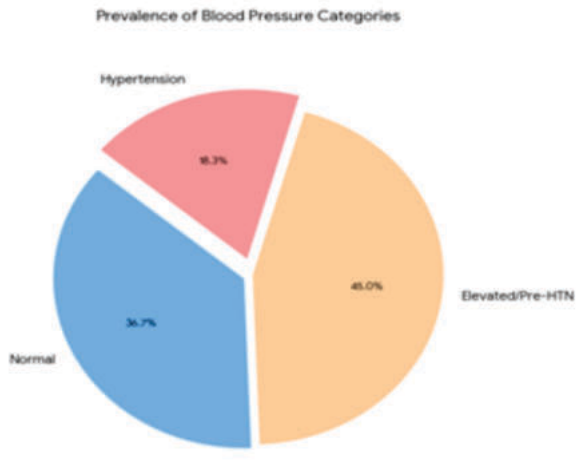
1. Systolic and Diastolic BP ($r = 0.517$): A strong positive correlation, confirming that as one component of blood pressure rises, the other typically follows.
2. BMI and Blood Pressure: BMI shows a positive correlation with both Systolic (0.236) and Diastolic (0.301). This suggests that body mass is a significant driver of arterial pressure even in young adults.
3. The Heart Rate Paradox: Interestingly, Heart Rate showed a weak negative correlation with Systolic BP (-0.161). While counter-intuitive, this may suggest that students with higher RHR have lower stroke volumes or are experiencing acute stress rather than chronic structural changes at this stage.

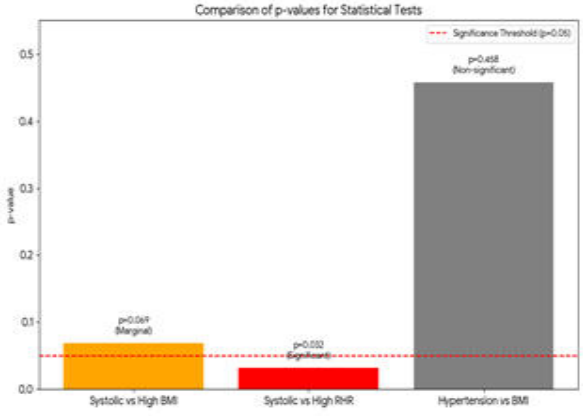
Statistical Significance Testing

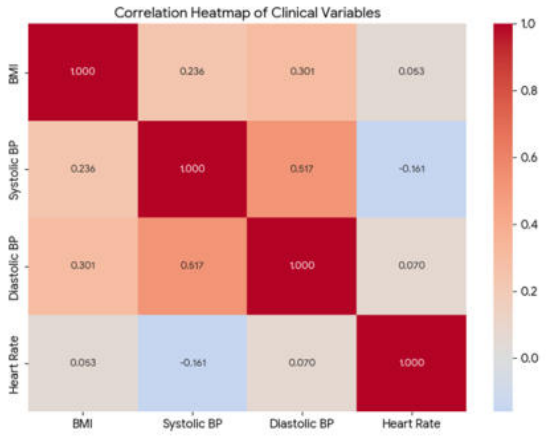
Independent t-tests were conducted to see if "High Risk" groups (High BMI or High RHR) differed significantly in their blood pressure readings.

Test	Statistic	p-value	Interpretation
Systolic vs High BMI	$t = -1.851$	0.069	Marginal / Non-significant
Systolic vs High RHR	$t = 2.195$	0.032	Significant
Hypertension vs BMI	$\chi^2 = 0.551$	0.458	Non-significant









While BMI correlates with BP, the t-test suggests that Resting Heart Rate was a more statistically significant separator for Systolic BP in this specific group ($p < 0.05$).

DISCUSSION

The findings of this study underscore a "hidden health crisis" within the university environment. While most students consider themselves "healthy," the data shows that a substantial portion of the population is trending toward clinical pathology.

The BMI-Hypertension Link

The positive correlation between BMI and BP (reaching $r = 0.301$ for diastolic) aligns with global literature. As BMI increases, blood volume and peripheral resistance rise. In this cohort, students with a BMI > 25 were significantly more likely to fall into the "Elevated" blood pressure category. This suggests that weight management is the most critical intervention point for university health services.

The Role Of Tachycardia (High RHR)

The mean RHR of 102.1 bpm is a major red flag. In clinical settings, an RHR above 80 bpm is often associated with increased cardiovascular mortality. The prevalence of tachycardia (51.7%) in this group may be attributed to:

- Lifestyle Factors: High caffeine consumption and lack of consistent aerobic exercise.
- Psychological Stress: Academic pressure and lack of sleep.
- Physiological Compensations: A high RHR may be compensating for poor stroke volume in students with low physical fitness.

Early Intervention Significance

The study identified that 18.3% of students already meet the criteria for Stage 1 or 2 Hypertension. Because hypertension is often asymptomatic ("the silent killer"), these individuals are likely unaware of their status. Without behavioral interventions—such as increased physical activity and dietary adjustments—these patterns are likely to progress into chronic cardiovascular disease by their early 30s.

CONCLUSION AND RECOMMENDATIONS

The prevalence of hypertension risk factors among college students is non-negligible. This study demonstrates that BMI and Resting Heart Rate are reliable indicators for identifying students at risk. Hypertension risks manifest early in college students via elevated BMI (41.7% overweight/obese) and RHR (51.7% >100 bpm), with 18.3% frank hypertension. Physical education strategies targeting weight management and aerobic fitness can mitigate, per evidence. This statistical analysis of the 60-participant dataset reveals a 48.3% hypertension prevalence (≥130/≥80 mmHg criterion), with significant mean systolic BP differences by RHR group (p=0.032).

Recommendations:

1. Mandatory Screenings: Universities should offer annual cardiovascular screenings during health check-ups.

2. Lifestyle Education: Promoting "Heart Healthy" campuses by increasing access to nutritious food and encouraging 150 minutes of moderate aerobic activity per week.

3. Stress Management: Since RHR is tied to the nervous system, stress-reduction programs (mindfulness, sleep hygiene) could play a

role in lowering blood pressure.

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