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Waist Circumference as a Superior Predictor of Hypertension among University Students: A Cross-sectional Study at the Faculty of Natural Sciences, University of Jos, Nigeria

Juliana Adar Nyam², Anil U. I. Sirisena^{1*} & Eti-mnbuk Akanbi²

¹Medical Physics Unit, Department of Radiology,
Jos University Teaching Hospital, Jos, Nigeria

²Department of Physics,
Faculty of Natural Sciences,
University of Jos, Jos. Nigeria

*Corresponding Author's E-mail: shallom2k3@yahoo.com

ABSTRACT

Hypertension is a critical global health issue, contributing to approximately 7.5 million deaths annually, accounting for 12.8% of all worldwide fatalities. This study focuses on the correlation between obesity-related anthropometric measurements and blood pressure among students in the Faculty of Natural Sciences at the University of Jos, aiming to uncover key predictors of hypertension in this population. A total of 170 students, comprising 83 males and 87 females aged between 16 and 49 years (mean \pm SD: 23.8 \pm 4.3 years), participated in the study. The research utilized Body Mass Index (BMI) to assess general obesity and Waist Circumference (WC) for abdominal obesity. Additionally, systolic (SBP) and diastolic blood pressures (DBP) were measured alongside heart rates. Using SPSS Version 21 for data analysis, the study explored the relationships between BMI, WC, and blood pressure readings. The findings revealed significant positive correlations: SBP with WC ($R = 0.315$, $p = 0.000$) and BMI ($R = 0.242$, $p = 0.001$), as well as DBP with WC ($R = 0.248$, $p = 0.001$) and Age ($R = 0.214$, $p = 0.005$). Notably, WC demonstrated a stronger correlation with SBP than BMI, suggesting that abdominal obesity is a more reliable indicator of hypertension risk. The prevalence of hypertension among the students was 11.18%, with 31.17% classified as pre-hypertensive. Alarmingly, 14.71% of participants exhibited abnormal heart rates, with cases of both bradycardia and tachycardia. Importantly, 10 of the 19 hypertensive students were unaware of their condition, highlighting a significant gap in health awareness. This study underscores the importance of WC as a superior predictor of hypertension over BMI, emphasizing the need for targeted interventions to address abdominal obesity in the prevention of cardiovascular diseases.

Keywords: Hypertension, Anthropometric indices, Body Mass Index, Waist Circumference, Systolic and Diastolic blood pressure.

INTRODUCTION

Research has consistently shown a significant relationship between academic achievement and the health status of students (Ickovics et al., 2014). Studies indicate that healthier students tend to perform better academically (Michael et al., 2015). Health issues such as hypertension, poor vision, malnutrition, obesity, unhealthy eating, and physical inactivity among others are strongly linked to poor academic performance (Chung & Massetti, 2021). Given the profound impact that health

problems can have on students' overall performance, it is crucial to examine the various health determinants and their effects on students. For instance, hypertension, a widespread public health issue, contributes to approximately 7.5 million deaths annually, representing 12.8% of all deaths worldwide. The prevalence of hypertension is expected to rise, potentially affecting 1.56 billion adults by 2025 (Singh et al., 2017). This underscores the need for comprehensive health interventions to support student achievement.

Raji et al. (2017) observed that the prevalence of hypertension among elderly Nigerians is high, with many individuals unaware of their condition. Among those who do receive treatment, only a small percentage achieve adequate blood pressure control. It is normal for blood pressure to rise during exercise or stress, but when it remains elevated even at rest and stays high for extended periods, it can cause damage to the arteries. Blood pressure that is consistently too low is termed hypotension, while consistently high blood pressure is known as hypertension. Normal blood pressure is referred to as normotension. Both hypertension and hypotension have various causes and may develop suddenly or persist over a long period.

Anthropometry involves the external measurement of human morphological traits and includes various metrics such as body mass, height, body mass index (BMI), body circumferences (arm, waist, hip, and calf), Waist-to-Hip Ratio (WHR), elbow amplitude, and knee-heel length (Sánchez-García et al., 2007). Numerous studies conducted in both developed and developing countries have explored the relationship between overweight/obesity and blood pressure (Nwaiwu and Ibe, 2014; Oduwole et al., 2012). For example, a 2021 study in Enugu titled "Obesity in Patients with Hypertension Attending a Medical Outpatient Clinic in a Tertiary Health Facility in Enugu, Southeast Nigeria" examined this relationship. Similarly, Olawoyin et al. (2017) analyzed the correlation between BMI and blood pressure among patients at the Murtala Specialist Hospital in Kano State, and Ibitoye et al. (2022) investigated the link between obesity and elevated blood pressure among school-aged adolescents in Ondo State. However, the relationship between elevated blood pressure and obesity has not yet been studied among students in the Faculty of Natural Sciences at the University of Jos. This study aims to determine the relationship between overweight/obesity and blood pressure among a cross-section of students in this Faculty at the University of Jos.

MATERIALS AND METHODS

This study involved university students from various departments within the Faculty of Natural Sciences at the University of Jos, Nigeria. Participants were selected based on specific inclusion and exclusion criteria: only apparently healthy students both male and female aged 16 years and above were included, while pregnant female students were excluded.

Data Collection

A structured questionnaire was administered to gather demographic and behavioral information, including sex, age, state of origin, smoking status, alcohol use, physical inactivity, and family history of cardiovascular disease (CVD).

Anthropometric Measurements

Height was measured using a locally made stadiometer.

Waist circumference was measured using a non-stretchable measuring tape, with participants standing and measurements taken after exhalation.

Body mass was recorded using a Hana bathroom scale placed on a flat surface. Participants were instructed to remove shoes, bags, and other items that could affect their weight. The scale was calibrated to zero before each measurement.

The body mass index (BMI) was computed using the equation (1). The body mass was measured in kg while height was measured in cm and converted to m.

$$BMI = \frac{\text{Body Mass}}{\text{Height}^2} \quad (1)$$

These calculations, along with the average systolic and diastolic blood pressures and pulse rate, were performed using Microsoft Excel 2016.

Blood Pressure Measurement

Blood pressure was measured twice using an automatic digital sphygmomanometer (model KD-595 DC6V 600mA), with participants seated in a relaxed position. The average of the two readings was recorded.

Data Analysis

All collected data were recorded in Microsoft Excel 2016, and statistical analyses were conducted using IBM SPSS (version 22). The analysis focused on correlations between study parameters (SBP, DBP, AGE, WC, and BMI) and the relationship between clinically diagnosed hypertensive students and traditional CVD risk factors.

RESULTS

In this study, a total of 170 consenting students of the Faculty of Natural Sciences, University of Jos were selected. A total of 83 males and 87 females of aged between 16-49 years with a mean \pm SD of 23.8 ± 4.3 years. From the questionnaires, the percentages of traditional risk factors of hypertension such as status of smoking, alcohol use, physical inactivity, family history of CVD and the consumption of processed food were found to be 2.40%, 10.00%, 37.70%, 39.40% and 63.50% respectively.

Tables 1, 2 and 3 show the descriptive statistics of study parameters, correlation between all the study parameters and correlation between clinically diagnosed hypertensive students with traditional CVD risk factors respectively.

Figure 1 represents the distribution of gender percentage of students. Out of 170 students, 51% are females and 49% are males. Figure 2 represents the total number of hypertensive students found in this study. A total of nineteen (19) students were found to be hypertensive. Figure 3 represents the total number of pre-hypertensive students found in this study. A total of Fifty-three (53) students were found to be pre-hypertensive. Figures 4 and 5 represent the distribution of BMI categories of the students and the percentages of traditional risk factor distribution of students respectively.

DISCUSSION

This study investigated the anthropometric measurements and blood pressure of a diverse group of students from the Faculty of Natural Sciences at the University of Jos, Nigeria. The ages of the participants ranged from 16 to 49 years, with an average age of 23.8 ± 4.3 years. Systolic blood pressure (SBP) varied between 74.5 and 145.0 mmHg, with a mean of 111.4 ± 13.8 mmHg, while diastolic blood pressure (DBP) ranged from 41.0 to 135.0 mmHg, averaging 75.4 ± 11.5 mmHg. Notably, 13 students were diagnosed with hypertension due to elevated DBP, while 3 students had hypertension caused by both high DBP and SBP. The heart rate of the participants varied from 51 to 127 beats per minute (bpm), with an average of 77.2 ± 10.2 bpm. The normal resting heart rate for adults falls between 60 and 100 bpm; heart rates outside this range can signal potential health issues. Tachycardia, where the heart exceeds 100 bpm at rest, occurred in 16 students. This condition can prevent the heart from properly filling with blood, limiting oxygen delivery to the body's cells. On the other hand, bradycardia where the heart beats fewer than 60 times per minute was observed in 9 students. If severe, this condition can reduce the flow of oxygen-rich blood to vital organs. In total, 145 students had normal heart rates, falling within the healthy range.

In this study, waist circumference (WC) ranged from 60.0 to 119.5 cm, with an average of 77.2 ± 10.2 cm, while body mass index (BMI) varied from 18.3 to 38.7 kg/m², averaging 25.5 ± 4.6 kg/m². Health experts recommend that men maintain a waist circumference under 102 cm (40 inches) and women under 88 cm (35 inches) to reduce health risks. Among the students, 84 had normal body mass index, while 86 fell into abnormal categories: 1 student was underweight, 52 were overweight, and 33 were classified as obese. The fact that more students had abnormal body mass than normal has significant health implications. A BMI under 18.5 kg/m² indicates underweight, which may require medical attention to promote weight gain. A BMI between 18.5 and 24.9 kg/m² reflects a healthy weight, which helps reduce the risk of serious health problems. On the other hand, a BMI of 25.0 to 29.9 kg/m² signals overweight, and individuals may be advised to lose weight to prevent health issues. A BMI above 30 kg/m² indicates obesity, which poses serious health risks unless weight is reduced. Interestingly, WC showed a stronger correlation with systolic blood pressure (SBP) than BMI, supporting findings from similar studies by Achie et al. (2012), Okamkpa et al. (2016), and Sirisena &

Okeahialam (2022). A significant positive correlation was also found between age and WC ($R = 0.283$, $p = 0.000$), though no such link was observed between age and BMI. This aligns with research by Ono et al. (2022), which showed that, over time, body mass tends to decrease while waist circumference increases, regardless of lifestyle. The authors emphasized the importance of focusing on WC rather than BMI during health checkups for better risk assessment.

From this study, 53 students (31.1%) were identified as pre-hypertensive, with 19 showing elevated systolic blood pressure (SBP), 17 with elevated diastolic blood pressure (DBP), and another 17 experiencing both. Research, including that by Bruno et al. (2018), clearly indicates that lifestyle habits significantly influence blood pressure levels. Adopting healthier lifestyle choices can lower blood pressure and offer considerable benefits to pre-hypertensive and hypertensive individuals, reducing cardiovascular risk and overall mortality.

Of the 11.1% (19 students) found to be hypertensive, only 5.3% (9 students) had been clinically diagnosed and were aware of their condition prior to the study. These diagnosed hypertensive students showed significant correlations with traditional cardiovascular disease (CVD) risk factors: smoking ($R = 0.310$, $p = 0.000$), physical inactivity ($R = 0.196$, $p = 0.010$), and a family history of CVD ($R = 0.239$, $p = 0.002$). This suggests that many of these students are exposed to one or more of these key risk factors.

Alarming, 108 students reported regularly consuming processed foods, likely due to their convenience, affordability, and taste, while 64 students admitted to not engaging in regular exercise. The low awareness of hypertension among students is concerning, as many hypertensive individuals are often unaware of their condition, largely because hypertension rarely shows noticeable symptoms.

This underscores the critical importance of regular blood pressure monitoring for everyone. High blood pressure is a major risk factor for a range of serious health issues, including heart attacks, strokes, heart failure, brain hemorrhage, and kidney damage, which can eventually lead to dialysis. Early detection is key, as lifestyle changes can effectively manage high blood pressure if caught early. However, if left unchecked, treatment becomes more complicated, costly, and less effective.

CONCLUSION

Out of the 170 students screened, 19 were identified as hypertensive, alarming in itself. Even more concerning, 10 of these students were completely unaware of their condition. This silent threat doesn't just endanger their academic performance; it puts their very lives at risk if left unaddressed. The stark reality is that hypertension is no longer a disease confined to the elderly, it's now claiming the health of the young as well. Urgent action is needed to prevent this hidden danger from wreaking further havoc.

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Table 1: Descriptive statistics of study parameters

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	170	16	49	23.76	4.249
SBP	170	74.5	145.0	111.432	14.8161
DBP	170	41.0	135.0	75.374	11.5200
HR	170	51.0	127.5	80.576	14.6360
BMI	170	60.0	119.5	77.151	10.2402
Valid (listwise)	N 170	18.26	38.71	25.5224	4.63058

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HR: Heart rate, WC: Waist circumference, BMI: Body Mass Index.

Table 2: Correlations between study parameters

SBP	Pearson	1	.610**	.150	.315**	.242**
	Correlation Sig. (2-tailed)		.000	.051	.000	.001
DBP	N	170	170	170	170	170
	Pearson Correlation Sig. (2-tailed)	.610**	1	.214**	.248**	.142
AGE	N	170	170	170	170	170
	Pearson Correlation Sig. (2-tailed)	.150	.214**	1	.283**	.117
WC	N	170	170	170	170	170
	Pearson Correlation Sig. (2-tailed)	.315**	.248**	.283**	1	.734**
BMI	N	170	170	170	170	170
	Pearson Correlation Sig. (2-tailed)	.242**	.142	.117	.734**	1
	N	170	170	170	170	170

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlation between clinically diagnosed hypertensive students with traditional CVD risk factors

		DIAGNOSED HYP	SMOKING	PHYSICAL INACTIVE	FAMILY CVD HISTORY
DIAGNOSED HYP	Pearson Correlation	1	.310**	.196*	.239**
	Sig. (2-tailed)		.000	.010	.002
	N	170	170	170	170
SMOKING	Pearson Correlation	.310**	1	.120	.034
	Sig. (2-tailed)	.000		.120	.663
	N	170	170	170	170
PHYSICAL INACTIVE	Pearson Correlation	.196*	.120	1	.044
	Sig. (2-tailed)	.010	.120		.568
	N	170	170	170	170
FAMILY CVD HISTORY	Pearson Correlation	.239**	.034	.044	1
	Sig. (2-tailed)	.002	.663	.568	
	N	170	170	170	170

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

FIGURES:

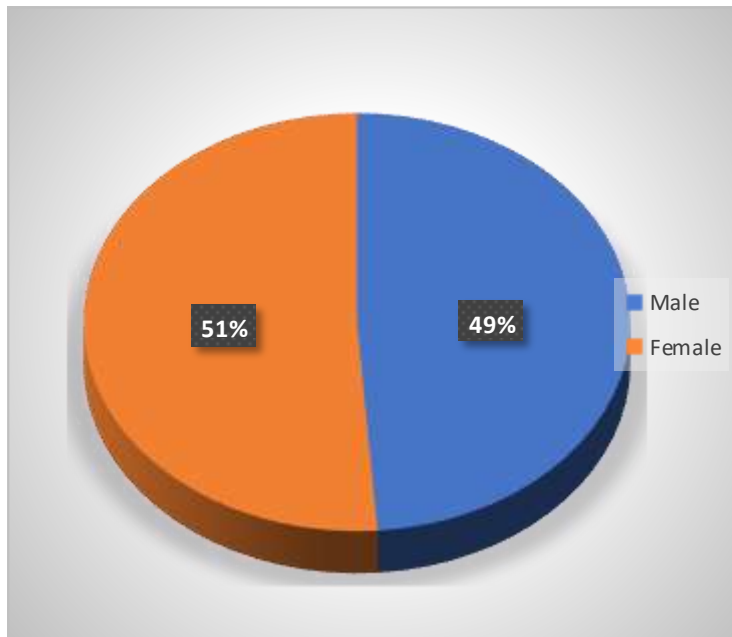


Figure 1: Distribution of gender percentages of students

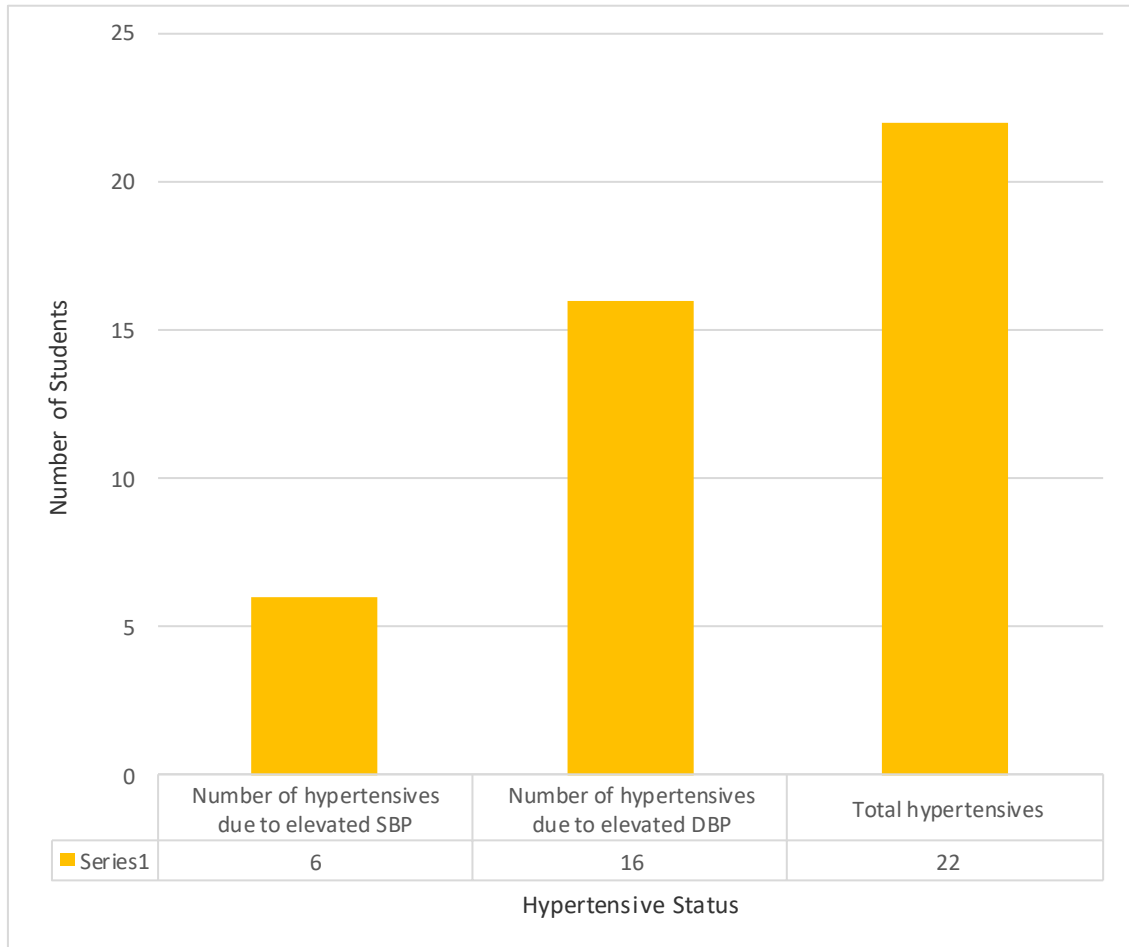


Figure 2: Bar Chart showing the percentages of hypertensive students found in this study

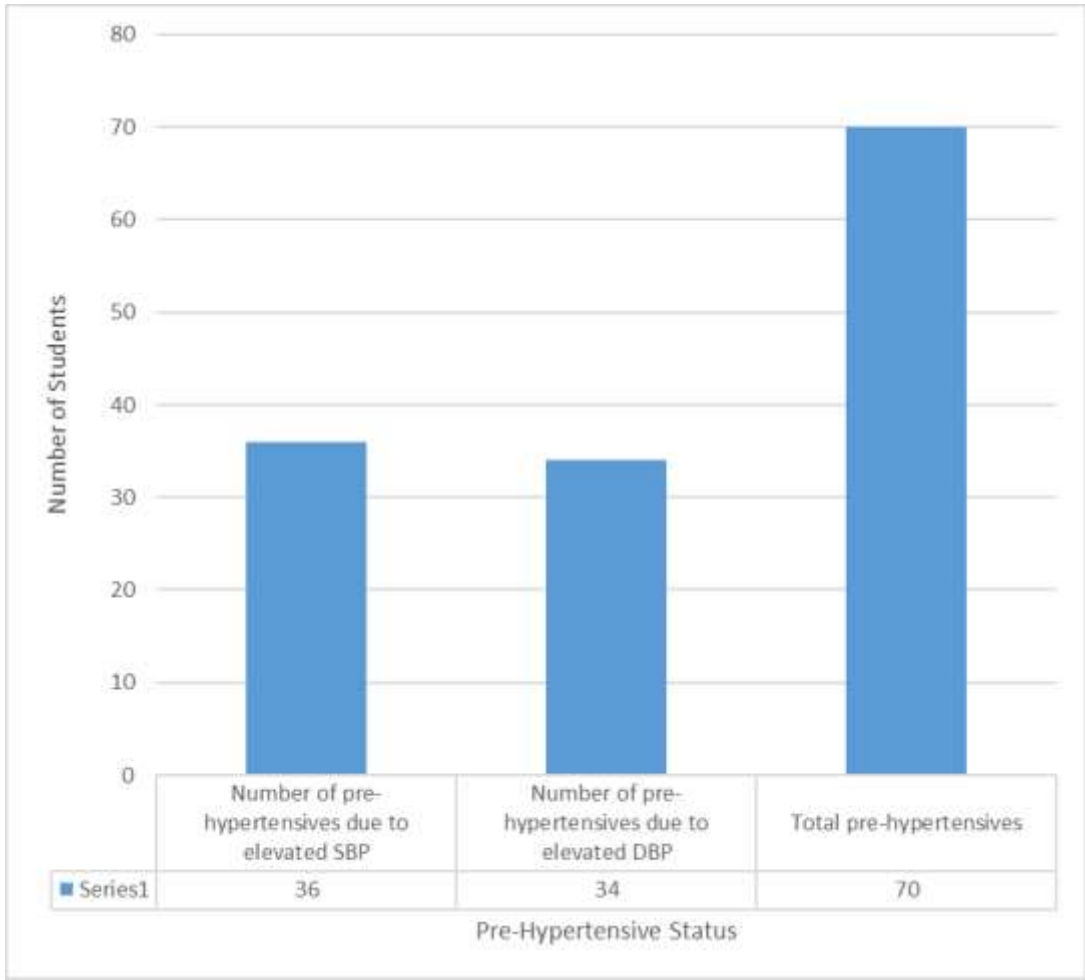


Figure 3: Bar Chart showing the percentages of pre-hypertensive students found in this study

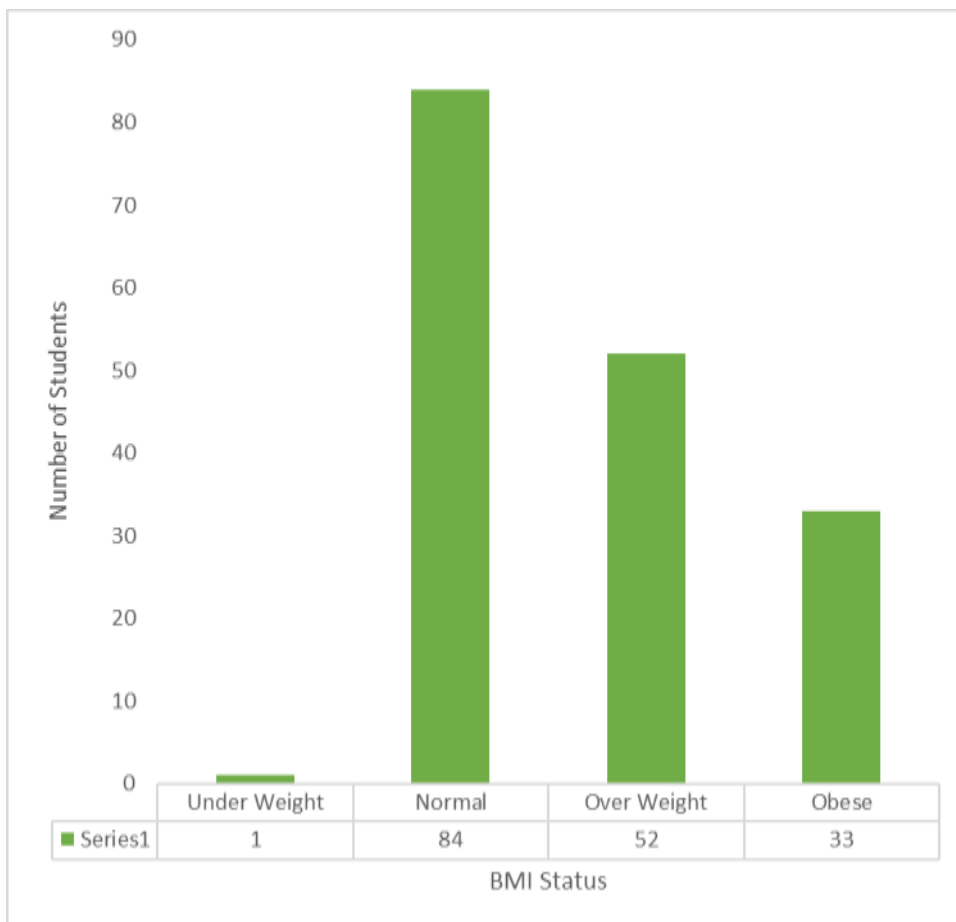


Figure 4: Distribution of BMI categories of the students

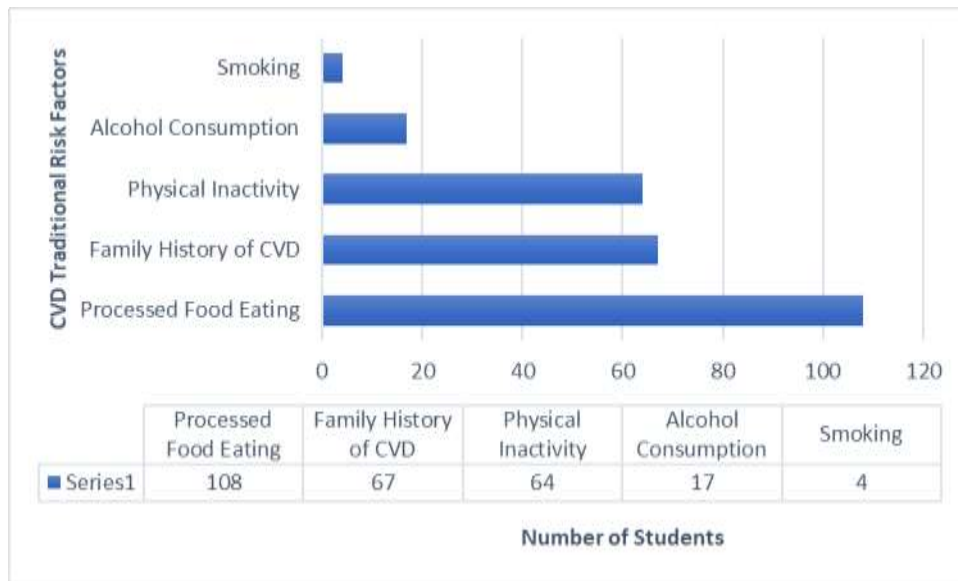


Figure 5: CVD Traditional Risk Factor distribution for the students