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CARDIOMETABOLIC HEALTH RISKS AMONG UNIVERSITY-GOING STUDENTS: A CROSS-SECTIONAL STUDY FROM LAHORE, PAKISTAN

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Abstract

Background: Obesity, hypertension, and hyperglycemia are three conditions that are progressively affecting people's health, including university students. University students around the globe are affected by prevalent health issues like hypertension, hyperglycemia, and obesity. A number of variables, such as poor nutrition, inactivity, stress, and genetic predisposition, can put university students and other young people at risk for having these health issues. **Method:** Data was collected from students (n=150) in Riphah International University in Pakistan 2023 which was conducted on the subjects with the age of 18-25 years old to determine the frequency

of hypertension, hyperglycemia and obesity in students and their risk factor. Blood pressure, sugar level, height and weight of students was also measured to calculate body mass index (BMI) In addition, we were using questionnaire. **Objective**: To determine frequency of hypertension, obesity and hyperglycemia in university going students. **Result:** Total 150 university going student was analyzed out of those students 53 (35.3%) were males and 97(64.7%) are females. Over all 75% of under study students were having normal BP and only 24.7% were hypertensive. About 93.3% of under study students were having normal blood sugar and only 6.7% were pre-diabetic. Also there is significant association between hyperglycemia and cold drinks (*p=0.05)*, hypertension and obesity (*p=0.000)* and hypertension and gender (p=0.006) as hypertension frequently observe in male students. About of the total study subjects only 13 reported smoking which shows that there is no significant association between tobacco usage and gender(p=0.68), It may be because of a very small amount (only 13) participant reported tobacco usage. **Conclusion:** This study creates a strong association between hypertension and obesity and gender (male) among university students and demonstrated that hyperglycemia and common use of cold beverages illustrate the harmful nature of unhealthy eating behaviors. Such results emphasize the necessity to adopt specific health and wellness policy by universities that stimulates the development of active lifestyle, nutrition education, and preventive screening programs to reduce the increasing risks of metabolic and cardiovascular diseases among young adults.

Keywords: Hypertension, Hyperglycemia, Body Mass Index (BMI), Obesity, Cardiometabolic risk

INTRODUCTION

Hypertension, Hyperglycemia and Obesity, are three conditions that are progressively affecting people's health, including university students. The general health and quality of life may suffer long-term negative impacts from these conditions [1]. When the blood pushes too hard against the walls of the arteries, it can damage them and the organs inside the body over time. This condition is called hypertension or high blood pressure [2]

The state of a person's physical development can be used as a measure for their

population's general health. The most prevalent chronic and metabolic lifestyle disease is obesity, which is characterized by an abnormal accumulation of fat in adipose tissue. Being a complex disease, obesity has doubled in frequency worldwide during the previous two decades, reaching epidemic levels [15]. It is a situation in which a person has too much body fat, which can cause other health issues like diabetes, heart disease, and joint issues. Both adults and children are growing increasingly prone to obesity and overweight. On all continents today, with the exception of sub-Saharan Africa and Asia, more people are overweight than underweight. This is a component of the double burden of malnutrition. Overweight and obesity, formerly thought to be an issue exclusively in high-income nations, are now considerably increasing in low- and middle-income nations, particularly in metropolitan areas [12].

Overweight and corpulence, as anthropometric risk determinants, have more advantage of hypertension [7]. Systolic and diastolic pressures, which represent the greatest and minimum pressures, respectively, are used to categorized blood pressure [8]. Blood pressure that is regularly too high is referred to as hypertension, whereas normal blood pressure is referred to as norm tension[9].

Blood pressure criteria are suggested by a new categorization to distinguish between normal blood pressure, prehypertension, hypertension (stages I and II), and isolated systolic hypertension, which is frequent in older people. These findings are based on the average of sitting blood pressure measurements taken correctly during the course of two or more doctor visits. People over 50 have high blood pressure if their blood pressure is usually 140 mmHg or higher for the top number or 90 mmHg or higher for the bottom number. Patients who have Type 1 or Type 2 diabetes, renal disease, and blood pressure that is may be responsible for 65% to 78% of the risk for primary hypertension [3].

In South India, the overall occurrence of glucose intolerance among teenagers was found to be 3.7%. The prevalence of hypertension was found to be 9.4% among toddlers and teenagers in north India [4]. The increasing prevalence of hypertension and diabetes in India, as well as their onset in adolescence and co-occurrence of the two disease entities, is reason for worry.[1]

From 1990 to 2019, the age-standardized prevalence rate of hypertension stayed stable,

whereas the total number of people with hypertension doubled from 648 million to almost 1.3 billion. In South Asia, in contrast, more than the past 30 years has witnessed a steady rise in hypertension, which has outpaced the declines observed in higher-income countries, as a result of high rates of urbanization and lifestyle changes. Similar to the situation at the regional level, the burden of hypertension in Pakistan has steadily been rising during the same time period with high levels of under-diagnosis and very low levels of hypertension medical control [6].

Hyperglycemia is also a medical condition characterized by high blood sugar levels, which occurs when there is an imbalance between the body's insulin production and glucose utilization. It is a common complication in patients with diabetes mellitus and can lead to several serious health problems, such as cardiovascular diseases, neuropathy, retinopathy, and nephropathy [4].In severe cases, hyperglycemia can cause diabetic ketoacidosis (DKA), a serious complication that can lead to coma or death if left untreated [10].

The pathophysiology of hyperglycemia is complex, and it involves various factors, such as insulin resistance, impaired glucose uptake, and increased hepatic glucose production [5]. A number of variables, such as poor nutrition, inactivity, stress, and genetic predisposition, can put university students and other young people at risk for having these health issues [13]. It's critical that students are conscious of the symptoms, risk factors, and importance of keeping a healthy lifestyle through frequent exercise, a balanced diet, and stress management [10].

Although the long-term health implications of these conditions are indisputable, localized data that assesses the prevalence of obesity, hypertension, and hyperglycemia in relation to each other among University students in Pakistan is lacking. The available literature is limited to older populations or considers these conditions individually. This is urgently required to know the relationship between lifestyle behaviors like diet, mobile phone use, and aerobic exercise and early metabolic alterations among young adults in a fast growing urban city like Lahore.

Hence, the objective of this study was to establish the prevalence of hypertension, hyperglycemia and obesity among the university going students and their related risk factors. The outcomes of reseach will provide baseline data for the specific population

to help inform campus-based health interventions and preventive programs.

MATERIALS AND METHODS

Study Design and Setting: It was a cross-sectional study of observation that was conducted at Riphah International University, Lahore. Data was gathered over four months following the official approval of the IRB to the study synopsis at the university.

Sampling Strategy and Sample Size: However, university level students (n=150) were sampled using convenience sampling. The a priori statistical power calculation was not performed on sample size of 150; it was selected due to the logistical feasibility and resource limitation within the four month's time frame of data collection.

Design and Setting: The study design was cross-sectional observational and targeted Riphah International University in Lahore. Data were gathered in a period of four months after a formal approval of the study synopsis by the university Institutional Review Board (IRB).

Target Population and Demographic Profile: It was an active male and female student population of a university. This particular demographic was selected in order to estimate the prevalence and the main onset of lifestyle related health conditions namely hypertension, hyperglycemia, and obesity among young adults involved with higher education.

Inclusion and Exclusion Criteria

Inclusion Criteria: The participants were active university students who were both of the genders, 18-28 years old. There was no use of baseline body mass index (BMI) as a screening criterion because one of the key outcome measures of the study was the assessment of obesity.

Exclusion criteria: Students over 28 years and under 18 years were excluded. The age restriction of the age group of 28 years was very strict to focus on the average undergraduate and postgraduate population, reducing age related cardiovascular and metabolic confounders. Any other subjects who had any known existing medical conditions were also excluded to assure the study of the primary, lifestyle-related development of hypertension and hyperglycemia and not the secondary effects of underlying illnesses.

Ethical Issues and Informed Consent: All students participated in the study after giving

informed consent, which was written and explained in more detail. Participants were also told about their right to withdraw anytime. A referral pathway was developed whereby all the participants who were found to have had abnormal clinical results (pre-diabetic or hypertensive levels) during the screening phase would be directly referred to the university student health clinic to be further diagnosed.

Data Collection and Questionnaire: The data collection was done using a self-administered standard questionnaire. Students were requested to report on the following lifestyle habits which comprised history of tobacco use, number of hours of aerobic exercise, average sleep duration, daily usage of mobile/screen and food (eating of vegetables, fruits, bakery food and cold beverages).

Standardized measurement procedures: To enhance reliability and to ensure that measured physiological data was free of diurnal effects, all physiological measurements were performed in the morning under standardized conditions.

Timing of Measures: The participants were requested to arrive in a fasting condition (at least 8 hours) to get the correct baseline blood glucose levels.

Blood Pressure (BP): Morning BP was measured with Dr Morepen BP 02 microfile automatic sphygmomanometer. Participants were allowed to sit at least 5 min prior to testing. The last documented value was the average of two consecutive sitting blood pressure readings.

Blood Sugar: Fasting capillary blood glucose screening was done with a FreeStyle glucometer. These readings were then verified with the glucose oxidase kit method to give a standard accurate reading.

Assessment of pre-diabetic state:

The presence of pre-diabetic status in the study population was assessed based on self-reported medical history that was verified. Participants were asked to report on any prior clinical diagnosis or results from their last formal medical laboratory-based report.

Body Mass Index (BMI): Height (cm) and weight (kg) were taken and BMI (kg/m 2) was calculated. The anthropometric measurements were taken using a calibrated stadiometer and a digital scale weighing device, which the participants were fully clothed and without shoes.

Statistical Analysis: The prevalence of the targeted health conditions were obtained and

analysed. Besides the usual chi-square tests, we used multivariate logistic regression analysis (e.g., diet, physical activity) to deal with the possible confounding factors. All prevalence estimates are reported with corresponding 95% Confidence Intervals (CIs) and exact p-values are reported to show statistical significance.

RESULTS

Demographic and anthropometric profile

The cohort's demographic and anthropometric profile shown that n=150 university students were sampled and a baseline gender divide was observed in which the majority of the sample were females. As indicated in the Gender Distribution profile there were 97 females (64.7%) and 53 males (35.3%) as shown in figure.1. The physiological and anthropometric parameters (age, systolic and diastolic blood pressure (BP), weight, height, fasting blood glucose, body mass index (BMI)) of these students were presented as core physical parameters of the students and the mean value and the standard deviation (Mean \pm SD) were calculated for each core physical parameter as shown in Figure.2.

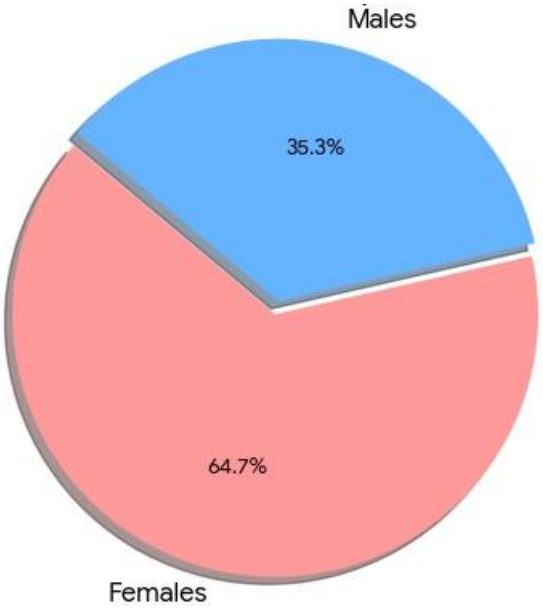

Figure 1. Illustrating the gender distribution among the surveyed university students (n = 150), showing a majority of female participants (64.7%) relative to male participants (35.3%).

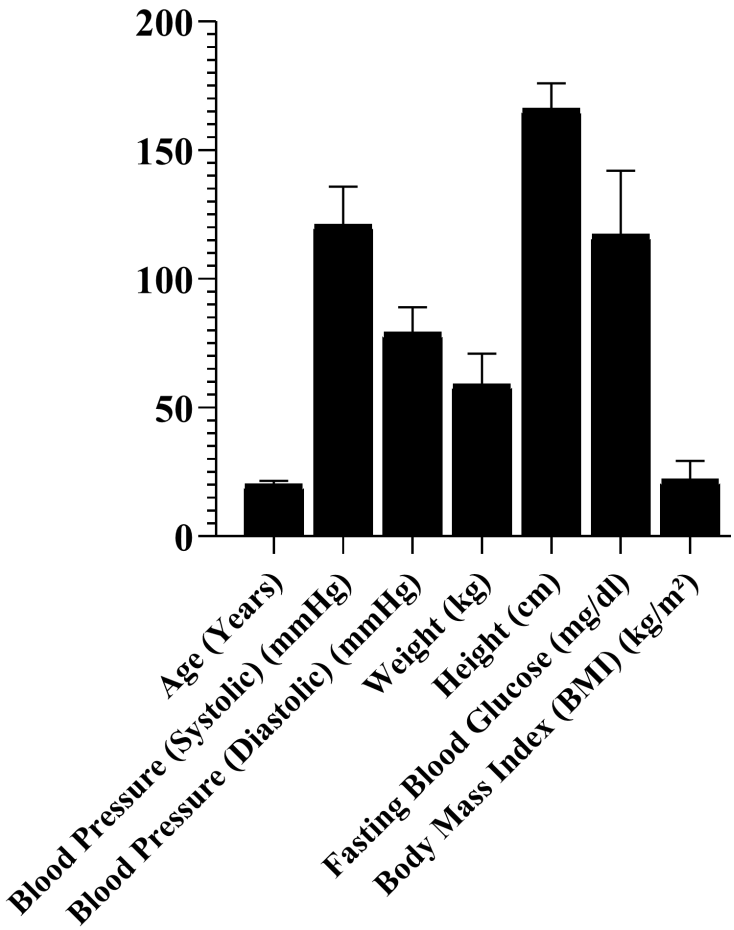

Figure 2. Anthropometric and physiological profile of the study cohort. Data represent the Mean ± SD of variables,

Sociodemographic and Lifestyle Characteristics:

Based on a lifestyle and sociodemographic evaluation of the cohort, the vast majority of the students were non-smokers (91.3%, n = 137), while the tobacco use was divided between those who were regular smokers (2%, n = 3), occasional smokers (3.3%) and passive smokers (3.3%, n = 5). A relatively high level of physical engagement was observed with 75.3% (n = 113) of the cohort engaged in aerobic physical activities and 24.7% (n = 37) not engaged. For sleep hygiene, 59.3% (n = 89) had a normal sleep time (6-8 hours); 15.3% (n = 23) had long sleep times (>8 hours); and 25.3% (n = 38) had short sleep times (<6 hours). Sedentary behavior using mobile technology is prevalent

with 62% (n = 93) of the students being sedentary for 6 hours a day, 24% (n = 36) for 3 to 4 hours, and 14% (n = 21) for 1 to 2 hours. The dietary pattern showed that 53.3% (n = 80) ate at least twice a week, 44% (n = 66) ate once a week and 2.7% (n = 4) rarely ate vegetables. 42.7% (n = 64) of the students consumed fruit frequently while 48.7% consumed fruit once in a week. Dietary indiscretions were also assessed: 27.3% (n = 41) and 55.3% (n = 83) of the participants reported eating bakery products at least twice a week and once a week, respectively. Likewise, soft drinks were extensively consumed with 40.7% (n = 61) consuming at least twice a week and 37.3% (n = 56) once a week. Concerning the frequency of meals, 80 % (n = 120) of the total population surveyed had three meals regularly.

Table 1: *Sociodemographic and Lifestyle Characteristics of the Study Cohort (n = 150)*

Variable	Baseline Category	Frequency (n)	Percentage (%)
Tobacco Usage Status	Regular Smoker	3	2
	Occasional Smoker	5	3.3
	Passive Smoker	5	3.3
	Non-Smoker	137	91.3
Aerobic Physical Activity	Engaged (Yes)	113	75.3
	Not Engaged (No)	37	24.7
Daily Sleep Duration	Short Duration (< 6 hours)*	38	25.3
	Normal Duration (6–8 hours)	89	59.3
	Extended Duration (> 8 hours)	23	15.3
Daily Mobile Phone Usage	1–2 hours	21	14
	3–4 hours	36	24
	⩾ 6 hours	93	62
Vegetable Consumption Frequency	Infrequently	4	2.7
	Once a week	66	44
	⩾ 2 times/week (At least twice a week)	80	53.3
Fruit Consumption	Infrequently	13	8.7

Frequency	Once a week	73	48.7
	Frequently	64	42.7
Bakery Product Consumption	Rarely	26	17.3
	Once a week	83	55.3
	⩾ 2 times/week (At least twice a week)	41	27.3
Soft Drink Consumption	Rarely	33	22
	Once a week	56	37.3
	⩾ 2 times/week (At least twice a week)	61	40.7
Daily Meal Frequency	1 meal/day	16	10.7
	3 meals/day	120	80
	> 3 meals/day	14	9.3

Family medical history: Family medical history to determine inherited risk factors for chronic metabolic and cardiovascular diseases. Among the study population 48.0% students reported family history of hypertension, 47.3% students reported family history of hyperglycemia, and 36.7% students reported family history of obesity. The result showed that there was no significant association between family history of hypertension and prevalence of hypertension among the students ($p = 0.6832$). Also, the glycemic status of the subjects did not have a significant correlation with family history of hyperglycemia ($p = 0.5678$). However, family history of obesity was a highly significant factor for the obesity prevalence in the participants ($p = 0.0014$), highlighting the strong familial association of obesity weight profile in the cohort.

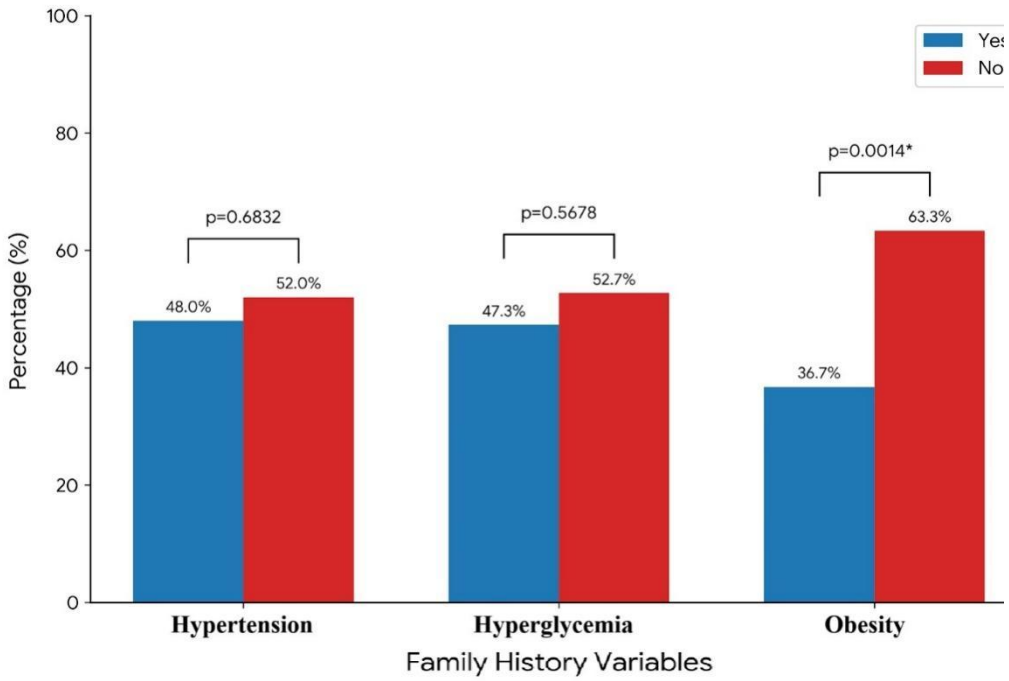

Figure 3. Distribution of family medical history on prevalence of hypertension, hyperglycemia, and obesity family history among the subjects. Statistical significance ($p < 0.05$).

Distribution of Cardiovascular and Metabolic Diseases

The subjects were divided based on major clinical parameters of hypertension and hyperglycemia and obesity. As to the blood pressure management, about 75.3% of the under-study students showed normotensive (normal) profile whereas 24.7% of them showed hypertensive profile. The distribution of gender across the categories revealed that in normal blood pressure group, there were 80 females and 33 males and in the hypertensive group, there were 17 females and 20 males. Blood glucose results showed that 93.3% (n = 140) of the students were normoglycemic (healthy controls) while having a small proportion of 6.7% (n = 10) prediabetic. The weight classification showed that 68% of the student population were classified as non-obese, 15.8% were categorized as underweight and 16.7% as overweight.

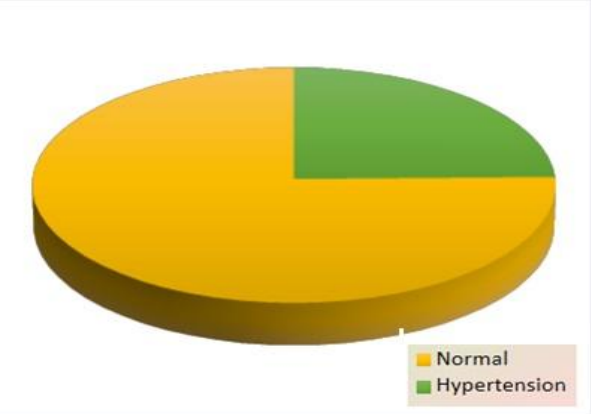

Figure 4: Distribution of hypertension prevalence within the study population.

Over all 68% of under study students were non obese, 15.8% were underweight and only 16.7% were overweight.

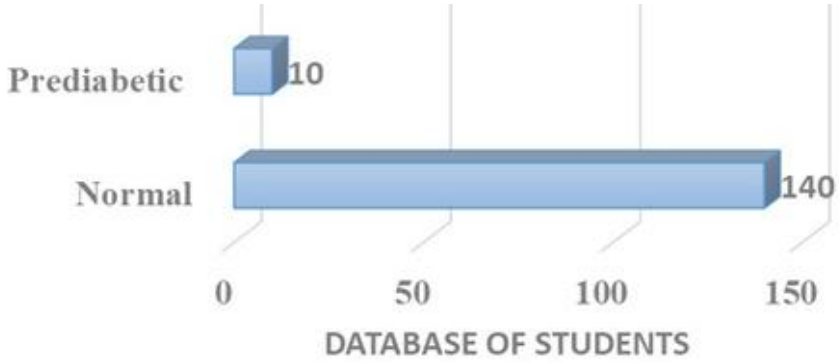

Fig. 5. Relative frequency distribution of hyperglycemic events for the normoglycemic (healthy control) and prediabetic student groups.

Over all 93.3% of under study students were having normal blood sugar and only 6.7% were pre- diabetic presented. During this study we tried to find out any associations of hypertension with different parameters including frequency of meal intake, bakery items and cold drink intake, it also includes tobacco usage, sleeping hours and participation in physical activity shown in the table 4.

Table 4: *Distribution of Various Variables Associated with Hypertension (%).*

Variables	Normal BP	Hypertension	P-values
Frequency of Meal Intake			
Once a day	12 (10.6%)	4 (10.8%)	0.344
3 times a day	92 (81.4%)	28 (75.7%)	

More than 3 times	9 (8%)	5 (13.5%)	
Frequency of Bakery Item Usage			
Rarely	19 (16.8%)	7 (18.9%)	0.728
Once a week	66 (58.4%)	17 (45.9%)	
⩾ 2 times/week (At least twice a week)	28 (24.8%)	13 (35.1%)	
Frequency of Cold Drinks			
Rarely	24 (21.2%)	9 (24.3%)	0.989
Once a week	42 (37.2%)	14 (37.9%)	
⩾ 2 times/week (At least twice a week)	47 (41.6%)	14 (37.8%)	
Frequency of Tobacco Usage			
Regular	3 (2.7%)	---	0.286
Occasional	8 (7%)	2 (5.4%)	
No Smoking	102 (90.3%)	35 (94.6%)	
Frequency of Sleeping Hours			
Less than 8 hours	33 (29.2%)	5 (13.5%)	0.405
6 to 8 hours	64 (56.6%)	25 (67.6%)	
More than 8 hours	16 (14.2%)	7 (18.9%)	
Physical Activity Per Week			
Less than 8	33 (29.2%)	5 (13.5%)	0.797

Out of 150 students only 13 reported smoking which shows that there is no significant association between tobacco usage and gender(p=0.68), It may be because of a very small amount (only 13) participant reported tobacco usage. No significant association was observed between hyperglycemia and sleeping hours (p=0.37), hyperglycemia and bakery intake (p=0.96), hyperglycemia and diabetic history of their families (p=0.23), obesity and hyperglycemia (p=0.25), hyperglycemia and gender ($p=0.749$), hypertension and hyperglycemia ($p=0.72$) and obesity and gender (p=0.56).

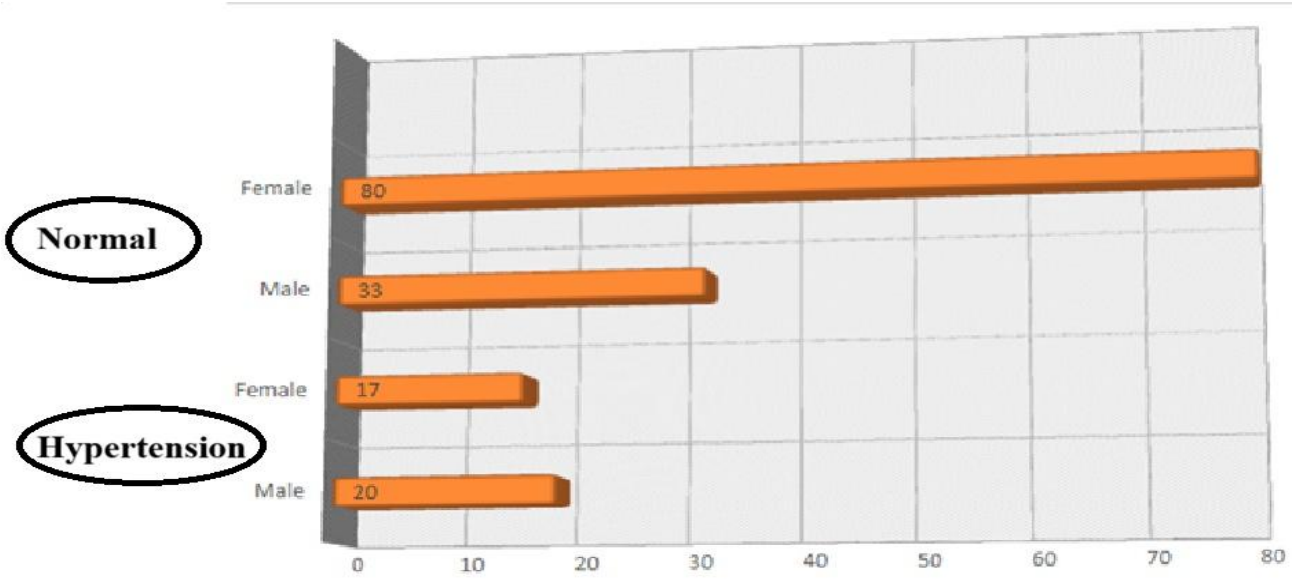

Fig. 6. Frequency distribution of blood pressure categories stratified by gender among normotensive and hypertensive student cohorts.

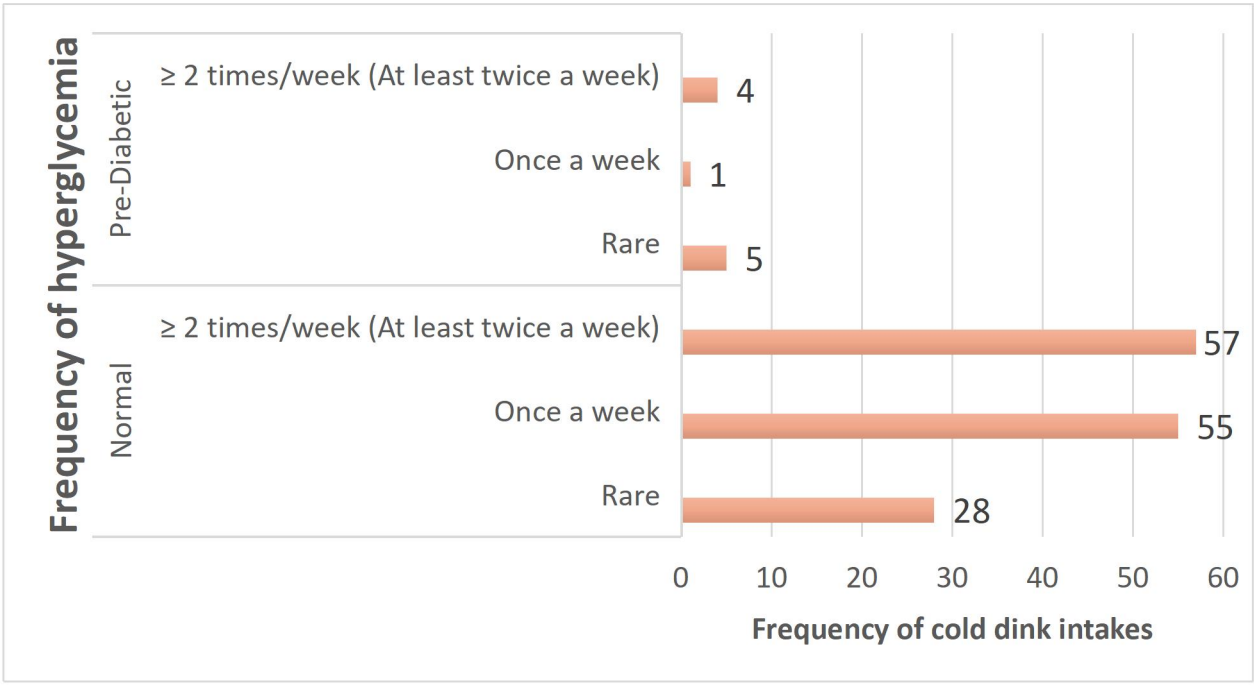

Fig. 7 illustrates the link between cold drink consumption frequency and hyperglycemia.

DISCUSSION

This cross-sectional study findings demonstrate that while the majority of university-going students exhibit normal physiological markers, there is a noteworthy segment of the population already displaying indicators of metabolic and cardiovascular risks. A significant finding of this study is the prevalence of hypertension (24.7%) among the participants. This aligns with global trends indicating an "epidemiological transition" where cardiovascular risks are increasingly observed in younger, university-aged populations in World Health Organization report of 2023 [16]. Hyperglycemia is the medical term used to describe elevated levels of sugar in the bloodstream, often linked to diabetes. It arises when the body either fails to produce sufficient insulin or is unable to utilize the insulin it generates effectively [17]. Obesity is a health problem when a person has too much fat in their body. Usually, it is measured using the body mass index (BMI), which is a number that is used often [18]. A study wanted to see how common and what causes obesity and high blood pressure (HBP) in university students. The study found that students' blood pressure (BP) was not related to how active they were, if their family had HBP, or how much fast food they ate. But the study did show that many university students had high BP and too much weight. In this study 53 (35.3%) were males and 97 (64.7%) females. About150 number of study subjects have 15.8% were overweight and 16.7% underweight. Our findings agree with those reported by (Al-Rukban et al.,) of Saudi Arabia, the incidence of overweight and obesity was 13.8% and 20.5%, accordingly [19].

Sabra et al., suggested that the rising prevalence of overweight and obesity among the younger generation can be attributed to two primary factors: a decline in physical activity levels and a significant increase in the consumption of fast food [20]. Ahmed Abu-Zaiton et al., conducted study to evaluate the occurrence of diabetes, obesity, hypertension, and related factors among 120 students enrolled at Al-albayt University (AABU) in Jordan. The result shows there is no significant association between prevelance of hypertension and diabeties [21].Results of this study was also show no significant association between hypertension and hyperglycemia. According to Iser et al., conducted a study to assess the prevalence of prediabetes and intermediate hyperglycemia among adults in Brazil, and identify factors associated with their

occurrence. The researchers analyzed laboratory data from the National Health Survey, which was conducted between 2014 and 2015. The result shows that a percentage of Brazilian adults, ranging from 7.5% to 18.5%, exhibited prediabetes and intermediate hyperglycemia. Additionally, the study successfully identified a risk score associated with the occurrence of this condition[22].Theresult of our study to analyzed over all 93.3% of 150 study subjects shows normal blood sugar and only 6.7% were pre-diabetic.

Everett et al., conducted to examine the emergence of gender differences in hypertension duringearly adulthood.And examine the relationship between gender and hypertension in young adults using objective blood pressure measurements. The findings revealed that young women have a significantly lower likelihood of being hypertensive compared to men. Specifically, 27 percent of men in their late twenties were found to be hypertensive, while only 12 percent of women were affected. To understand the potential factors contributing to these gender disparities, the researchers investigated various behavioral risk factors such as BMI (body mass index), smoking habits, and physical activity levels. These factors were hypothesized to play a role in the development of hypertension . Simultaneously, these behaviors exhibit intricate patterns between men and women. Specifically, men are more likely to be smokers and overweight (BMI $\geqslant$ 25 andless than 30), whereas women are more likely to be inactive and obese (BMI $\geqslant$ 30). The results indicate that both obesity and current smoking independently have a pivotal effect on hypertensive status[23]. The finding of this study also significant association between hypertension and genderas hypertensive (24.7%) frequently higher observe in male.

A cross-sectional study was conducted by Ali et al. to demonstrate the prevalence and associated risk factors for common obesity and hypertension among university students in all regions of Bangladesh. These results demonstrate the respective prevalence of general obesity and hypertension were found to be 18.2%, and 25.5%[24]. The current study shows significant association was found between hypertension (24.7%) and in obesity 15.8% were underweight and only 16.7% were overweight. Most of the hypertensive students (14) were found in overweight.

Tanu et al., conducted a study in India. The results shows significant association between smoking and gender [25]The findings of our study suggested that there is no

association between smoking and gender due to very low number of smoking students. This study highlights the need for further research to investigate the causes of increase hypertension, hyperglycemia and obesity in university students. The results can also raise awareness in young generation to adapt good practices in their routine life.

CONCLUSION

This study highlights a concerning prevalence of early metabolic and cardiovascular risk factors among university students, a demographic traditionally considered low-risk. The findings reveal a significant rate of hypertension (24.7%), which strongly correlates with increased body weight and the male gender. Furthermore, while the overall prevalence of pre-diabetes was lower (6.7%), it demonstrated a significant association with the frequent consumption of sugary cold beverages, underscoring the direct and detrimental impact of poor dietary habits on glycemic control. The early emergence of these conditions points to the compounding effects of sedentary behaviors, high screen time, and unhealthy nutrition prevalent in modern university environments. Consequently, these outcomes emphasize the urgent need for academic institutions to transition from passive observation to active intervention by adopting comprehensive health and wellness policies. By implementing routine preventive screenings, promoting targeted nutrition education, and fostering active lifestyle programs, universities can play a pivotal role in mitigating the long-term trajectory of chronic cardiovascular and metabolic diseases among young adults.

LIMITATIONS

Methodological Limitations: The study also had some methodological limitations, such as its small sample size, which might limit the generalizability of the findings to larger and more diverse populations.

Self-Reporting Bias: In part, data was collected using self-reported measures; such data can be influenced by social desirability bias and may lack accuracy in terms of participant recall. Temporal Limitations: The cross-sectional structure of the data means that it is just a snapshot of the phenomenon at one point in time, and that it is difficult to make definite causal inferences or make observations over time.

Measurement Variability: Some variables were measured by instruments that were standardized, but may not have fully captured the qualitative complexity of the

participants' experiences.

External Validity: These findings may not apply directly to other environmental, socioeconomic, and cultural contexts in which data is gathered.

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