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Original research

The correlation between blood pressure, blood glucose, and body mass index: Analysis of a community-based survey in western Ethiopia

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ABSTRACT

Background: Blood pressure, blood glucose, and body mass index are important metabolic parameters associated with hypertension, diabetes, dyslipidemia, nutritional status, and other chronic diseases. The correlation between these parameters remains unclear among adults in western Ethiopia. Hence, this study examined the correlation between systolic blood pressure (SBP), diastolic blood pressure (DBP), blood glucose, and body mass index (BMI) among adults in western Ethiopia.

Methods: Secondary data collected through a descriptive, community-based survey conducted between 1 July and 15 September 2024. Data from 3908 participants from East**,** West, Qellem, and Horo Guduru Wollega administrative zones were included. Descriptive analysis of frequency, mean, and standard deviation was performed. Pearson correlation was computed to examine the relationship between SBP, DBP, blood glucose, and body mass index. ANOVA was done to compare the means of BMI and systolic and diastolic BP. In all tests, a p-value less than 0.05 indicates a statistically significant result.

Results: The analysis was performed on the data of 3,908 participants. The study found that there was a positive correlation between SBP, DBP, and body mass index. Overweight and obesity contributed to the higher SBP and DBP. Diastolic blood pressure positively correlated with blood glucose; however, SBP did not. There was no significant variation in SBP and DBP across residency.

Conclusion: Nearly 1 out of 5 had SBP of 140 or higher, and more than 1 out of 10 had DBP of 90 or higher. The correlation between SBP, DBP, and BMI was positive. Nearly half of the participants had a healthy weight. Being overweight and obese increases the risk of SBP and DBP. A stepwise survey is warranted to establish the correlation between these parameters.

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INTRODUCTION

Blood pressure, glucose, and body mass index are parameters that indicate the risk of hypertension, diabetes, dyslipidemia, and other chronic diseases. The correlation between these variables among the nondiabetic population is important. Hypertension and diabetes are the two common diseases associated with these parameters. Hypertension is defined as "systolic blood pressure (SBP) and diastolic blood pressure (DBP) 140/90 mmHg or higher"(1). Globally, more than one billion adults have hypertension, and two-thirds of them live in low and middle-income countries (1).

Worldwide, between 1990 and 2019, the number of adults living with hypertension doubled from 331 million to 626 million in women and from 317 million to 652 million in men because of population growth and aging (2). High blood pressure, diet, and high cholesterol will be the major risk factors for cardiovascular diseases from 2025 to 2050, suggesting the burden of hypertension is expected to rise in the coming decades (3). Diabetes is a metabolic disorder characterized by hyperglycemia. According to the International Diabetes Federation Atlas, 589 million adults were living with diabetes in 2025 (4). It is classified as diabetes if the Random blood glucose is greater than or equal to 200 mg/dL in the presence of hyperglycemia symptoms. The Centers for Disease Control and Prevention (CDC) suggests routine check-ups of blood glucose for adults (5).

Previous studies reported an inconclusive correlation between these parameters. While a positive and strong correlation between blood pressure and BMI has been reported in some studies (6-9), a study conducted by Zhang and Li (10) does not support these findings. The study also supports that fasting blood glucose and BMI are associated with blood pressure (7). A study reported that obesity and dyslipidemia are directly associated with an increase in blood pressure (6, 11). A population-based study involving children reported a positive correlation between SBP and BMI (12).

The correlation between hypertension and other parameters is increased if they coexist. The study reported that a complex of triglyceride, glucose, and BMI index is positively associated with the development of hypertension (13). Another study demonstrated that hypertension is strongly associated with BMI (14). Systolic blood pressure is associated positively with BMI (15).

Though the correlation between blood pressure, glucose, and BMI is inconclusive and may vary between gender and race, it is necessary to examine their correlation.

Hence, this study examined the correlation between BP, glucose, and BMI using survey data from western Ethiopia.

METHODS

Study design

A descriptive survey study was performed.

Setting

The survey was performed at a tentative survey center at Nekemte City, western Ethiopia, between July 1 and September 15, 2024. The participants come from four Wollega administrative zones, namely East, West, Qellem, and Horo Guduru Zones.

Participants

The survey used secondary data collected from adults living in four Wollega administrative zones to screen for diabetes, hypertension, and nutritional status. All participants were between 18 and 91 years; they resided in urban and rural areas.

Variables

The SBP, DBP, glucose level, and BMI are variables. Blood pressure was measured using a digital sphygmomanometer from the left arm at the sitting position, blood glucose was measured using a glucometer, and BMI was calculated from weight in kg and height in m^2. Age, gender, and address are predictors of the dependent variables.

Data source

Secondary data, which was collected to screen for hypertension, diabetes, and nutritional status, was used.

Bias

The screening was conducted at different centres with different health workers, and this might result in some technical measurement errors. To overcome these errors, we informed participating health workers to send people with abnormal measurement findings to Wollega University Comprehensive Specialized Hospital for re-evaluation.

Sample size

Three thousand nine hundred and eight individual samples were used to identify the correlation between BP, blood glucose level, and BMI.

Quantitative variables

Blood glucose levels into diabetes (≥200 mg/dL) (4), BMI was categorised into underweight if BMI is < 18.5 kg/m^2, healthy weight if BMI is 18.5 to < 25 kg/m^2, overweight if BMI is 25 to < 30 kg/m^2, obesity if BMI is 30 to < 40 kg/m^2 (5).

Statistical analysis

Frequencies for sex and address variables were computed. The mean and standard deviation for age, systolic and diastolic BP, blood glucose level, and BMI were also calculated. Since the data were normally distributed and the variances were homogeneous, the Pearson correlation was

calculated between BP, blood glucose level, and BMI. ANOVA was computed to test the level of SBP and DBP within each BMI category. The p-value less than 0.05 indicates a statistically significant.

RESULTS

The data of 3908 adults were analysed. The mean age of the participants was 33.37 years (SD ± 13.86). The majority of participants were males (79.5%). More than half (57.4%) were rural residents. The means of SBP, DBP, and Blood Glucose level were 123.82 mmHg (SD ± 34.87), 77.84 mmHg (SD ± 22.71), and 121.17 mg/dl (SD ± 53.31), respectively. Nearly one out of five (15.8%) had SBP of 140 or higher, and 11.6% of them had DBP of 90 or higher. The mean weight and height were 60.71 kg (SD ± 9.44) and 167.11 cm (SD ± 8.79), respectively. The average of BMI was 21.83 (SD ± 3.54) (Table 1). The highest proportion of participants was those of a healthy weight (41.0%) (Table 2).

The correlation

The SBP (r=0.187, p < 0.001) and DBP (r=0.087, P < 0.001) were positively correlated with BMI. The risk of SBP and DBP increases as BMI increases. The increase in SBP and DBP occurs in adults with obesity (Table 2). On the other hand, SBP was non-significantly associated with blood glucose level (r=0.056, p = 0.211), and the DBP was positively associated with blood glucose level (r=0.186, P < 0.001). There was a significant correlation between age and BMI.

Table 1. The results of participants' characteristics and variables, Western Ethiopia, 2025.

Variables	Category	Frequency (Percentage)	Mean (SD)
Age			33.37 (SD ± 13.86)
Sex	Male	3105 (79.5)	
	Females	803 (20.5)	
Address	Urban	1666 (42.6)	
	Rural	2242 (57.4)	
SBP			123.82 (SD ± 34.87)
DBP			77.84 (SD ± 22.71)
RBS			121.17 (SD ± 53.31)
Weight			60.71 (SD ± 9.44)
Height			167.11 (SD ± 8.79)
BMI	Underweight	343 (8.8)	21.83 (SD ± 3.54)
	Healthy	1604 (41.0)	
	weight	369 (9.4)	
	Overweight	61 (1.6)	
	Obesity		

There were no statistically significant differences in SBP (t = -1.182, p = 0.298), DBP (t = -0.201, p = 0.787), blood glucose level (t = 4.53, p = 0.345), and BMI (t = 0.168, p = 0.248) across the participants' residency. A positive correlation was observed between blood glucose level and BMI, while a negative correlation was observed between blood pressure (SBP and DBP) and residency.

Table 2. The mean of SBP and DBP according to BMI category.

BMI category	SBP means in mmHg	DBP means in mmHg
Underweight	118.18	75.00
Healthy weight	122.29	76.80
Overweight	128.87	80.15
Obesity	132.73	82.50

DISCUSSION

The study aimed to examine the correlation between SBP, DBP, blood glucose level, and BMI among adults living in western Ethiopia. The study findings revealed that SBP and DBP were positively associated with BMI. An SBP had a positive correlation with blood glucose level, but DBP did not show any correlation with blood glucose level. There were no statistically significant differences in SBP, DBP, blood glucose level, and BMI across rural and urban areas. Individuals with overweight or obesity had higher SBP and DBP.

The study found that the SBP and DBP were positively correlated with BMI. The findings are consistent with studies conducted in Japan, China, France, Bangladesh, and India (6-9, 16, 17). However, this finding is inconsistent with another study conducted in China (10). This variation could be due to the age of the participants, as only the older age population participated in the previous study.

This study found that there is a linear and positive relationship between SBP and blood glucose level. This finding is in line with previous similar studies conducted in China, Italy, and Japan (18-20). These findings suggest that increased systolic blood pressure is directly related to changes in fasting blood glucose. Hence, individuals with raised blood pressure warrant blood glucose testing and vice versa. The current study found a statistically significant positive correlation between age and BMI. This study is similar to a previous study conducted in Australia (21).

Participants with obesity had a higher mean of SBP and DBP. This finding is

consistent with a study conducted in India (17). These findings affirm that obesity is one of the causes of increased blood pressure. This can lead to obesity related diseases. Thus, it is needed to reduce overweight and obesity to halt the rise in SBP and DBP.

Survey strengths and limitations

The study included large samples from broader areas of western Ethiopia and was able to show the correlation between BMI and other metabolic parameters. However, due to secondary data, there was high missing data in blood glucose levels. Moreover, the proportion of males and females was heterogeneous.

CONCLUSION

The correlation between SBP, DBP, and BMI was positive. Overweight and obesity were associated with higher blood pressure. There was no variation in SBP, DBP, and BMI across the residency of individuals. Age plays a vital role in changing SBP, DBP, and BMI. Further research is warranted to explain the correlation between DBP and blood glucose level.

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Ethical approval

Since the data is secondary, ethical approval was not needed.

Conflict of interest

None of the authors claims a conflict of interest.

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