



Original Article


Correlation of Body Mass Index with Blood Pressure and Lipid Profile in Adult Patients

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ABSTRACT

Background: Obesity has emerged as a major public health concern worldwide and is associated with several cardiovascular risk factors, including hypertension and dyslipidaemia. Body mass index (BMI) is a simple and widely used indicator for assessing obesity and predicting cardiovascular risk. Understanding the relationship between BMI, blood pressure, and lipid profile may facilitate early identification of individuals at increased risk of cardiovascular diseases.

Objectives: To evaluate the correlation of body mass index with blood pressure and lipid profile among adult patients attending a tertiary care hospital.

Materials and Methods: A hospital-based cross-sectional study was conducted among 150 adults aged 20–60 years attending a tertiary care centre. Anthropometric measurements including height and weight were recorded, and BMI was calculated using standard methods. Blood pressure was measured using a standardized protocol. Fasting blood samples were analyzed for total cholesterol, triglycerides, low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). A p-value of less than 0.05 was considered statistically significant.

Results: The mean age of the participants was 42.8 ± 10.5 years, and the mean BMI was 27.1 ± 4.8 kg/m². Among the participants, 41.3% were overweight and 32.0% were obese. BMI showed a significant positive correlation with systolic blood pressure ($r = 0.54$, $p < 0.001$), diastolic blood pressure ($r = 0.49$, $p < 0.001$), total cholesterol ($r = 0.45$, $p < 0.001$), triglycerides ($r = 0.52$, $p < 0.001$), and LDL cholesterol ($r = 0.41$, $p < 0.001$). A significant negative correlation was observed between BMI and HDL cholesterol ($r = -0.38$, $p < 0.001$).

Conclusion: Body mass index demonstrated a significant positive association with blood pressure and adverse lipid profile parameters. Increasing BMI was associated with higher systolic and diastolic blood pressure, elevated total cholesterol, triglycerides, and LDL cholesterol, along with reduced HDL cholesterol levels. Regular assessment of BMI may help identify individuals at increased cardiovascular risk and facilitate early preventive interventions.

Keywords: Body Mass Index; Blood Pressure; Lipid Profile; Obesity; Dyslipidaemia; Hypertension; Cardiovascular Risk Factors

INTRODUCTION

Overweight and obesity have become major public health concerns worldwide and are important contributors to the increasing burden of non-communicable diseases. Excess body weight is associated with several metabolic abnormalities, including hypertension, dyslipidaemia, type 2 diabetes mellitus, and cardiovascular diseases. The prevalence of obesity has risen steadily in both developed and developing countries, largely due to sedentary lifestyles, unhealthy dietary habits, and reduced physical activity.¹

Body mass index (BMI) is a simple and widely used anthropometric measure for assessing overweight and obesity. It is calculated as weight in kilograms divided by the square of height in meters (kg/m²). According to the World Health Organization, BMI is an effective screening tool for identifying individuals at increased risk of metabolic and cardiovascular disorders.²

Obesity has been recognized as an important risk factor for hypertension. Increased adipose tissue contributes to elevated blood pressure through several mechanisms, including activation of the sympathetic nervous system, stimulation of the renin–angiotensin–aldosterone system, increased sodium retention, and endothelial dysfunction. These physiological alterations lead to increased vascular resistance and a higher risk of developing hypertension.^{3,4}

In addition to its effect on blood pressure, obesity is closely associated with abnormalities in lipid metabolism. Excess body fat promotes increased production of triglyceride-rich lipoproteins, elevated total cholesterol and low-density lipoprotein (LDL) cholesterol levels, and reduced high-density lipoprotein (HDL) cholesterol concentrations. This atherogenic lipid profile contributes significantly to the development of cardiovascular disease.⁵

Several studies have reported a positive correlation between BMI and blood pressure, as well as between BMI and adverse lipid profile parameters. Individuals with higher BMI values are more likely to exhibit elevated systolic and diastolic blood pressure, increased serum triglycerides, higher LDL cholesterol levels, and lower HDL cholesterol levels. The coexistence of obesity, hypertension, and dyslipidaemia substantially increases cardiovascular risk and highlights the need for early identification and intervention.^{6,7}

India is experiencing a rapid increase in the prevalence of obesity and related cardiovascular risk factors. Assessment of BMI, blood pressure, and lipid profile provides a simple and cost-effective approach for identifying individuals at increased risk of future cardiovascular complications. Understanding the relationship between these parameters can help in planning preventive strategies and promoting healthy lifestyle modifications.⁸

Therefore, the present study was undertaken to evaluate the correlation of body mass index with blood pressure and lipid profile among adult patients attending a tertiary care hospital.

MATERIALS AND METHODS:

Study Design and Setting

A hospital-based cross-sectional observational study was conducted in the Department of Biochemistry in collaboration with the Department of General Medicine at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 12 months from January 2025 to December 2025.

Study Population

The study included adult patients attending the General Medicine Outpatient Department and Health Check-up Clinic of the tertiary care hospital during the study period. Written informed consent was obtained from all participants before enrolment.

Sample Size

The sample size was calculated based on an anticipated moderate correlation ($r = 0.30$) between body mass index and cardiovascular risk parameters, with a confidence level of 95% and statistical power of 80%. The minimum sample size required was 138 participants. To compensate for possible incomplete data and non-response, a total of 150 participants were enrolled in the study.

Sampling Technique

A consecutive sampling method was adopted. Eligible participants satisfying the inclusion criteria were recruited until the desired sample size was achieved.

Inclusion Criteria

- Adults aged between 20 and 60 years.
- Individuals willing to participate in the study.
- Participants providing written informed consent.
- Individuals willing to undergo anthropometric measurements and fasting blood investigations.

Exclusion Criteria

- Pregnant women.
- Known cases of chronic kidney disease.
- Chronic liver disease.
- Thyroid disorders and other endocrine abnormalities affecting body weight.

- Patients receiving lipid-lowering medications.
- Patients receiving corticosteroid therapy.
- Individuals with acute illness at the time of data collection.
- Patients with known cardiovascular events such as recent myocardial infarction or stroke.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee.

Data Collection Procedure

After obtaining informed consent, demographic details including age, sex, occupation, and relevant medical history were recorded using a structured proforma.

Anthropometric Measurements

Height

Height was measured using a wall-mounted stadiometer with the participant standing barefoot in an erect position, with heels together and head positioned in the Frankfurt plane. Height was recorded to the nearest 0.1 cm.

Weight

Body weight was measured using a calibrated digital weighing scale with participants wearing light clothing and no footwear. Weight was recorded to the nearest 0.1 kg.

Body Mass Index

Body mass index was calculated using the formula:

$$\text{BMI (kg/m}^2\text{)} = \text{Weight (kg)} / \text{Height}^2 \text{ (m}^2\text{)}$$

Participants were categorized according to the World Health Organization classification.⁹

BMI Category	BMI (kg/m ²)
Underweight	<18.5
Normal weight	18.5–24.9
Overweight	25.0–29.9
Obesity	≥30.0

Blood Pressure Measurement

Blood pressure was measured using a standardized mercury sphygmomanometer after ensuring adequate rest. Participants were instructed to:

- Avoid caffeine, smoking, and strenuous physical activity for at least 30 minutes before measurement.
- Sit comfortably for a minimum of 5 minutes before recording.

Blood pressure was measured in the sitting position with the arm supported at heart level.

Two readings were taken at an interval of five minutes, and the average value was considered for analysis.

The following parameters were recorded:

- Systolic Blood Pressure (SBP)
- Diastolic Blood Pressure (DBP)

Blood pressure classification was based on standard hypertension guidelines.¹⁰

Biochemical Analysis

Participants were instructed to undergo overnight fasting for 8–12 hours before blood sample collection.

Approximately 5 mL of venous blood was collected under aseptic precautions from the antecubital vein. The samples were transported immediately to the central biochemistry laboratory for analysis. Serum lipid parameters were assessed using standard laboratory procedures and interpreted according to established guidelines.¹¹

Lipid Profile Assessment

The following lipid parameters were estimated using an automated clinical chemistry analyzer:

Total Cholesterol (TC)

Estimated using an enzymatic cholesterol oxidase-peroxidase method.

Triglycerides (TG)

Measured by the enzymatic glycerol phosphate oxidase-peroxidase method.

High-Density Lipoprotein Cholesterol (HDL-C)

Determined using a direct enzymatic method after selective inhibition of non-HDL lipoproteins.

Low-Density Lipoprotein Cholesterol (LDL-C)

Calculated using the Friedewald equation when triglyceride levels were below 400 mg/dL:¹²

$$\text{LDL-C} = \text{Total Cholesterol} - \text{HDL-C} - (\text{Triglycerides}/5)$$

All biochemical estimations were performed according to standard laboratory protocols with routine quality control measures.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 23.0. Continuous variables were expressed as mean \pm standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Differences among BMI categories were evaluated using one-way Analysis of Variance (ANOVA). Pearson's correlation coefficient (r) was used to determine the strength and direction of the association between body mass index and the study variables. Multiple linear regression analysis was performed to assess the independent relationship between body mass index. A p-value of less than 0.05 was considered statistically significant.

RESULTS:

The study included 150 adult participants with a mean age of 42.8 ± 10.5 years. The mean body mass index was 27.1 ± 4.8 kg/m², indicating that a substantial proportion of participants were overweight or obese. (Table 1)

Table 1. Demographic and Anthropometric Characteristics of the Study Participants (n = 150)

Variable	Mean \pm SD
Age (years)	42.8 ± 10.5
Height (m)	1.65 ± 0.08
Weight (kg)	74.2 ± 12.4
BMI (kg/m ²)	27.1 ± 4.8

Among the study participants, 41.3% were overweight and 32.0% were obese, whereas only 26.7% had normal BMI. (Table 2)

Table 2. Distribution of Participants According to BMI Categories

BMI Category	Number (n)	Percentage (%)
Normal Weight (18.5–24.9 kg/m ²)	40	26.7
Overweight (25.0–29.9 kg/m ²)	62	41.3
Obese (≥ 30 kg/m ²)	48	32.0
Total	150	100

The mean systolic and diastolic blood pressures were 132.5 ± 16.8 mmHg and 84.2 ± 10.7 mmHg, respectively. The lipid profile showed elevated mean total cholesterol and triglyceride levels among the study participants. (Table 3)

Table 3. Blood Pressure and Lipid Profile of Study Participants

Parameter	Mean \pm SD
Systolic Blood Pressure (mmHg)	132.5 ± 16.8
Diastolic Blood Pressure (mmHg)	84.2 ± 10.7
Total Cholesterol (mg/dL)	201.4 ± 36.5
Triglycerides (mg/dL)	168.7 ± 54.8
LDL Cholesterol (mg/dL)	126.3 ± 30.4
HDL Cholesterol (mg/dL)	42.8 ± 8.6

A statistically significant increase in systolic blood pressure, diastolic blood pressure, total cholesterol, triglycerides, and LDL cholesterol was observed with increasing BMI categories. Conversely, HDL cholesterol levels showed a significant decline among obese participants ($p < 0.001$). (Table 4)

Table 4. Comparison of Blood Pressure and Lipid Profile Across BMI Categories

Variable	Normal Weight (n=40)	Overweight (n=62)	Obese (n=48)	p value
SBP (mmHg)	121.6 ± 10.2	130.4 ± 12.6	142.3 ± 15.1	<0.001
DBP (mmHg)	78.2 ± 6.4	83.8 ± 7.5	89.4 ± 8.2	<0.001
Total Cholesterol (mg/dL)	182.5 ± 24.1	201.3 ± 30.2	223.4 ± 35.6	<0.001

Triglycerides (mg/dL)	132.4 ± 28.5	164.7 ± 40.3	198.8 ± 52.4	<0.001
LDL Cholesterol (mg/dL)	108.2 ± 21.4	125.8 ± 25.3	141.7 ± 29.6	<0.001
HDL Cholesterol (mg/dL)	48.3 ± 6.2	43.7 ± 5.8	39.4 ± 5.1	<0.001

Pearson correlation analysis demonstrated a significant positive correlation between BMI and systolic blood pressure ($r=0.54$), diastolic blood pressure ($r=0.49$), total cholesterol ($r=0.45$), triglycerides ($r=0.52$), and LDL cholesterol ($r=0.41$). A significant negative correlation was observed between BMI and HDL cholesterol ($r=-0.38$) ($p<0.001$). (Table 5)

Table 5. Correlation of BMI with Blood Pressure and Lipid Profile Parameters

Parameter	Correlation Coefficient (r)	p value
Systolic Blood Pressure	0.54	<0.001
Diastolic Blood Pressure	0.49	<0.001
Total Cholesterol	0.45	<0.001
Triglycerides	0.52	<0.001
LDL Cholesterol	0.41	<0.001
HDL Cholesterol	-0.38	<0.001

Multiple linear regression analysis revealed that BMI remained an independent predictor of systolic blood pressure, diastolic blood pressure, triglycerides, and LDL cholesterol after adjustment for age and sex. (Table 6)

Table 6. Multiple Linear Regression Analysis Showing BMI as an Independent Predictor of Cardiovascular Risk Variables

Dependent Variable	β Coefficient	95% Confidence Interval	p value
Systolic Blood Pressure	1.42	0.95 – 1.89	<0.001
Diastolic Blood Pressure	0.88	0.52 – 1.24	<0.001
Triglycerides	3.76	2.10 – 5.42	<0.001
LDL Cholesterol	1.89	0.95 – 2.83	<0.001

DISCUSSION:

The present study evaluated the relationship of body mass index (BMI) with blood pressure and lipid profile among adult patients attending a tertiary care hospital. The findings demonstrated a significant positive association between BMI and systolic blood pressure, diastolic blood pressure, total cholesterol, triglycerides, and LDL cholesterol, whereas HDL cholesterol exhibited a significant negative correlation with BMI. These observations indicate that increasing adiposity is associated with an unfavorable cardiovascular risk profile.

In the present study, a large proportion of participants were either overweight or obese, reflecting the increasing prevalence of excess body weight in the adult population. Rapid urbanization, reduced physical activity, increased consumption of calorie-dense foods, and sedentary occupations have contributed significantly to the rising burden of overweight and obesity.¹³

A significant positive correlation was observed between BMI and systolic as well as diastolic blood pressure. Participants with higher BMI demonstrated progressively elevated blood pressure values compared to individuals with normal BMI. These findings are consistent with previous studies that have identified obesity as a major determinant of hypertension. Hall et al. reported that excess adiposity promotes activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system, leading to increased vascular resistance and blood pressure.¹⁴ Similar observations were reported by Jiang et al., who found a strong association between increasing BMI and the risk of hypertension.¹⁵

The mechanism linking obesity and hypertension is multifactorial. Increased adipose tissue results in enhanced secretion of adipokines, chronic low-grade inflammation, insulin resistance, and endothelial dysfunction. Furthermore, obesity is associated with increased sodium retention and expanded intravascular volume, which contribute to elevated blood pressure. These physiological alterations may explain the significant positive relationship observed between BMI and blood pressure in the present study.^{14, 15}

The present study also demonstrated a significant positive correlation between BMI and total cholesterol levels. Individuals with higher BMI had increased serum cholesterol concentrations compared to those with normal BMI. This finding is in agreement with the observations of Bays et al., who reported that obesity is frequently accompanied by hypercholesterolemia and other metabolic abnormalities that increase cardiovascular risk.¹⁶ Elevated cholesterol levels among obese individuals may result from increased hepatic synthesis of lipoproteins and impaired lipid clearance mechanisms.

A significant positive association was observed between BMI and serum triglyceride levels. Triglycerides showed one of the strongest correlations with BMI among the lipid parameters studied. Similar findings have been documented in previous studies, which demonstrated that obesity is associated with increased free fatty acid release from adipose tissue and enhanced hepatic production of triglyceride-rich lipoproteins.¹⁷ Elevated triglyceride concentrations contribute to atherogenesis and are recognized as an important component of obesity-related dyslipidaemia.

Low-density lipoprotein cholesterol (LDL-C) also exhibited a significant positive correlation with BMI in the present study. Higher LDL cholesterol levels among overweight and obese individuals have been reported by several investigators. Elevated LDL cholesterol contributes to endothelial injury and plaque formation, thereby increasing the risk of coronary artery disease and cerebrovascular events. The observed association in the present study further supports the role of obesity as a major contributor to cardiovascular morbidity.¹⁸

Conversely, high-density lipoprotein cholesterol (HDL-C) demonstrated a significant negative correlation with BMI. Participants with higher BMI values had lower HDL cholesterol levels. HDL cholesterol is considered cardioprotective because of its role in reverse cholesterol transport and anti-inflammatory properties. Reduced HDL cholesterol concentrations among obese individuals have been widely reported and are considered a characteristic feature of obesity-associated dyslipidaemia.^{17, 18} The inverse relationship observed in the present study is therefore consistent with established evidence.

The coexistence of obesity, hypertension, and dyslipidaemia substantially increases cardiovascular risk. Previous studies have shown that these metabolic abnormalities often occur together and exert synergistic effects on the development of atherosclerosis and cardiovascular disease.¹⁹

CONCLUSION:

The present study demonstrated significant positive correlations between BMI and systolic blood pressure, diastolic blood pressure, total cholesterol, triglycerides, and LDL cholesterol, while HDL cholesterol showed a significant negative correlation with BMI. These findings suggest that increasing BMI is associated with adverse cardiovascular risk factors. Routine assessment of BMI may facilitate early identification of high-risk individuals and support preventive strategies aimed at reducing obesity-related cardiovascular morbidity.

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