

## Original Article

# Determinants of Hypertension: A Cross-Sectional Analysis of Demographic and Physiological Predictors in a Referral Hospital in Iran

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## Abstract

**Background:** Hypertension is a leading risk factor for cardiovascular diseases, significantly contributing to global morbidity and mortality. Understanding the determinants of hypertension is crucial for effective prevention and management. This study investigates the relationships between demographic and physiological factors and hypertension status in a cohort of adults.

**Materials and Methods:** A cross-sectional study was conducted with 105 adult participants, comprising 47 hypertensive and 58 non-hypertensive individuals. Data on age, body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, and fasting blood sugar (FBS) were collected. Statistical analyses included summary statistics, Pearson correlation coefficients, and logistic regression to identify significant predictors of hypertension.

**Results:** There were significant differences between hypertensive and non-hypertensive groups regarding SBP, DBP, and BMI. Hypertensive individuals had higher mean SBP ( $141.4 \pm 10.5$  mmHg) and DBP ( $86.4 \pm 8.0$  mmHg) compared to non-hypertensive individuals ( $118.1 \pm 11.5$  mmHg and  $72.2 \pm 6.8$  mmHg, respectively;  $p < 0.001$  for both). BMI was also significantly higher in the hypertensive group ( $36.8 \pm 11.8$  kg/m<sup>2</sup> vs.  $32.6 \pm 9.8$  kg/m<sup>2</sup>;  $p < 0.001$ ). Age and BMI positively correlated with both SBP and DBP, while HDL showed a significant negative correlation with DBP. Logistic regression analysis identified age (OR = 1.07, 95% CI: 1.05-1.09,  $p = 0.02$ ), BMI (OR = 1.06, 95% CI: 1.01-1.15,  $p = 0.01$ ), and LDL (OR = 1.04, 95% CI: 1.00-1.02,  $p = 0.04$ ) as significant predictors of hypertension.

**Conclusion:** This study reinforces the significant roles of age, BMI, and LDL cholesterol in the risk of hypertension. These findings highlight the importance of targeting these modifiable risk factors through effective interventions to reduce the prevalence and impact of hypertension. Future research should explore the mechanisms linking these predictors to hypertension to develop comprehensive prevention and management strategies.

**Keywords:** Hypertension, Blood pressure, Body mass index, Lipid profile, Age, Cardiovascular risk factors, Predictors of hypertension

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## Introduction

Hypertension, a major global health concern, is a significant risk factor for cardiovascular diseases, including heart attack and stroke<sup>1-3</sup>. It is well-documented that elevated blood pressure contributes to the morbidity and mortality associated with these conditions<sup>4-6</sup>. Despite extensive research, the precise determinants and mechanisms underlying hypertension remain under ongoing investigation, necessitating further exploration into its risk factors and associated variables.

Several studies have highlighted the importance of demographic and physiological factors in the development of hypertension. Age and body mass index (BMI) are consistently identified as key determinants, with advancing age and higher BMI being strongly associated with increased blood pressure levels<sup>7-10</sup>. Moreover, lipid profile components such as total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides, as well as fasting blood sugar (FBS) levels, have been studied for their potential roles in hypertension, albeit with mixed results<sup>8,11-13</sup>.

Understanding the interplay between these variables is crucial for developing targeted interventions to manage and prevent hypertension. This manuscript aims to contribute to this understanding by examining the relationships between demographic and physiological factors and hypertension status in a cohort of adults.

## Methods

**Study Design and Population:** This cross-sectional study was conducted to investigate the determinants of hypertension and their relationships with blood pressure levels. One hundred five adult participants were recruited from a referral hospital in Tehran, Iran, consisting of 47 hypertensive individuals and 58 non-hypertensive individuals. Participants were selected from a primary care clinic, ensuring a diverse sample of age, BMI, and other relevant characteristics.

**Demographic and Clinical Variables:** Data were

collected using structured questionnaires and clinical examinations. Key demographic information, including age and gender, was obtained from participants. Clinical measurements included systolic blood pressure (SBP), diastolic blood pressure (DBP), BMI, total cholesterol (Chol), LDL, HDL, triglycerides (TG), and FBS. Blood pressure measurements were taken using a calibrated sphygmomanometer. Participants were seated and rested for at least 5 minutes before the measurements. SBP and DBP were recorded as the average of three readings taken at one-minute intervals. BMI was calculated using the weight (kg) / height (m<sup>2</sup>) formula. Blood samples were collected after an overnight fast to determine lipid profiles and FBS levels using standard laboratory techniques.

**Ethical Considerations:** The study was approved by the Institutional Review Board of the Shahid Beheshti University of Medical Sciences (IR.SBMU.RETECH.REC.1402.659). Informed consent was obtained from all participants before data collection. Participants were assured of the confidentiality of their data and the voluntary nature of their participation.

**Statistical Analysis:** Descriptive statistics summarized the key variables for hypertensive and non-hypertensive groups. Means and standard deviations (SD) were calculated for continuous variables. Independent t-tests were performed to compare the means between the two groups, and p-values were reported to indicate the level of statistical significance. Pearson correlation coefficients were computed to assess the relationships between SBP, DBP, and other variables such as age, BMI, cholesterol levels, and FBS. The strength and direction of these correlations were evaluated, and p-values were reported to determine the statistical significance of the correlations. Logistic regression analysis was conducted to identify significant predictors of hypertension. Hypertension status (hypertensive vs. non-hypertensive) was the dependent variable. The independent variables included age, BMI, total cholesterol, LDL, HDL, TG, and FBS. Odds ratios (OR) and 95% confidence intervals (CI) were

calculated for each predictor. P-values were used to assess the statistical significance of the predictors, with a p-value < 0.05 considered significant.

## Results

**Summary Statistics for Key Variables by Hypertension Status:** Table 1 provides the summary statistics for key variables comparing hypertensive and non-hypertensive participants. The hypertensive group had a mean age of 57.6 years (SD±8.9) compared to the non-hypertensive group with a mean age of 55.5 years (SD±10.3), though this difference was not statistically significant (p=0.2).

Significant differences were observed in SBP and DBP between the groups. The mean SBP for hypertensive individuals was 141.4 mmHg (SD±10.5), significantly higher than the 118.1 mmHg (SD±11.5) observed in the non-hypertensive group (p<0.001). Similarly, the mean DBP was higher in hypertensive participants (86.4 mmHg, SD±8.0) compared to non-hypertensive participants (72.2 mmHg, SD±6.8) with a significant p-value (p<0.001). BMI was also significantly higher in the hypertensive group, with a mean of 36.8 kg/m<sup>2</sup> (SD±11.8) versus 32.6 kg/m<sup>2</sup> (SD ± 9.8) in the non-hypertensive group (p<0.001). Cholesterol levels, including total cholesterol, LDL, HDL, and triglycerides, did not differ significantly between the groups. FBS levels were also comparable between the two groups.

**Correlation Analysis:** Table 2 presents Pearson correlation coefficients of various variables with SBP and DBP. Age significantly correlated with SBP (r=0.23, p=0.01) but not with DBP (r=0.03, p=0.7). BMI had a positive and significant correlation with both SBP (r=0.31, p<0.001) and DBP (r=0.32, p<0.001).

Cholesterol levels did not significantly correlate with either SBP or DBP. LDL showed no correlation with SBP (r=0.00, p=0.9) but had a non-significant trend towards a positive correlation with DBP (r=0.13, p=0.1). HDL showed no significant correlation with SBP (r=-0.01, p=0.9) but a significant negative correlation with DBP (r=-0.22, p=0.02). Triglycerides and FBS did not show significant correlations with either SBP or DBP.

**Logistic Regression Analysis for Predictors of Hypertension:** Table 3 summarizes the logistic

**Table 1.** Summary Statistics (Mean ± SD) for Key Variables by Hypertension Status.

| Variable | Hypertensive | Non-Hypertensive | p-value |
|----------|--------------|------------------|---------|
| Age      | 57.6 ± 8.9   | 55.5 ± 10.3      | 0.2     |
| SBP      | 141.4 ± 10.5 | 118.1 ± 11.5     | 0.00    |
| DBP      | 86.4 ± 8.0   | 72.2 ± 6.8       | 0.00    |
| BMI      | 36.8 ± 11.8  | 32.6 ± 9.8       | 0.00    |
| Chol     | 154.3 ± 38.3 | 160.3 ± 38.2     | 0.4     |
| LDL      | 102.6 ± 33.7 | 97.0 ± 32.0      | 0.3     |
| HDL      | 43.5 ± 11.9  | 47.0 ± 12.7      | 0.1     |
| TG       | 129.9 ± 51.6 | 126.6 ± 58.7     | 0.7     |
| FBS      | 98.4 ± 10.5  | 96.6 ± 13.5      | 0.7     |

**Table 2.** Pearson Correlation Coefficients with SBP and DBP.

| Variable | Correlation with SBP | P value | Correlation with DBP | P value |
|----------|----------------------|---------|----------------------|---------|
| Age      | 0.23                 | 0.01    | 0.03                 | 0.7     |
| BMI      | 0.31                 | 0.00    | 0.32                 | 0.00    |
| Chol     | -0.11                | 0.2     | -0.07                | 0.4     |
| LDL      | 0.00                 | 0.9     | 0.13                 | 0.1     |
| HDL      | -0.01                | 0.9     | -0.22                | 0.02    |
| TG       | -0.05                | 0.5     | 0.06                 | 0.5     |
| FBS      | 0.15                 | 0.1     | 0.00                 | 0.9     |

**Table 3.** Logistic Regression Results for Predictors of Hypertension.

| Predictor | Odds Ratio | 95% CI      | p-value |
|-----------|------------|-------------|---------|
| Age       | 1.07       | 1.05 - 1.09 | 0.02    |
| BMI       | 1.06       | 1.01 - 1.15 | 0.01    |
| Chol      | 0.96       | 0.93 - 1.02 | 0.1     |
| LDL       | 1.04       | 1.00 - 1.02 | 0.04    |
| HDL       | 1.00       | 0.95 - 1.05 | 0.9     |
| TG        | 1.00       | 0.99 - 1.01 | 0.9     |
| FBS       | 0.99       | 0.95 - 1.03 | 0.5     |

regression analysis results for hypertension predictors. Age and BMI were significant predictors of hypertension. Each one-year increase in age was associated with a 7% increase in the odds of having hypertension (OR=1.07, 95% CI:1.05-1.09, p=0.02). Similarly, each unit increase in BMI was associated with a 6% increase in the odds of having hypertension (OR=1.06, 95% CI:1.01-1.15, p=0.01).

LDL cholesterol was also a significant predictor, with each unit increase associated with a 4% increase in the odds of hypertension (OR=1.04, 95% CI:1.00-1.02, p=0.04). In this analysis, other variables, such as total cholesterol, HDL, triglycerides, and fasting blood sugar, were not significant predictors of hypertension.

## Discussion

The findings of this study provide important insights into the determinants of hypertension and their relationships with blood pressure. Our results confirm that age and BMI are significant predictors of hypertension, aligning with existing literature. Additionally, we found that LDL cholesterol also serves as an important predictor, suggesting that lipid profile components contribute to the risk of hypertension.

**Age and Hypertension:** Our analysis indicates a robust association between age and hypertension, with each additional year of age increasing the odds of hypertension by 7%. This finding is consistent with previous studies highlighting the physiological changes associated with aging, such as increased arterial stiffness and reduced vascular compliance, contributing to elevated blood pressure. The aging process also often involves the cumulative effects of prolonged exposure to risk factors such as sedentary lifestyle, poor diet, and stress, further exacerbating hypertension risk<sup>14-20</sup>.

**BMI and Hypertension:** BMI was another strong predictor of hypertension in our study. Each unit increase in BMI was associated with a 6% increase in the likelihood of having hypertension. This supports the well-documented relationship between obesity and hypertension, likely mediated through mechanisms such as increased sympathetic nervous system activity, altered renal sodium handling, and inflammatory processes<sup>21-25</sup>. These findings underscore the importance of weight management as a key strategy in hypertension prevention and control.

**Lipid Profile and Hypertension:** Our study identified LDL cholesterol as a significant predictor of hypertension. This finding adds to the body of evidence suggesting a link between dyslipidemia and hypertension. While total cholesterol and HDL did not show significant associations, the role of LDL as a predictor highlights the potential impact of atherogenic lipoproteins on blood pressure regulation. Elevated LDL levels can lead to endothelial dysfunction and reduced nitric oxide availability, contributing to increased vascular resistance and hypertension<sup>26-28</sup>.

**Implications for Clinical Practice and Public Health:** Identifying age, BMI, and LDL as significant predictors of hypertension has important implications for clinical

practice and public health. These findings emphasize the need for regular monitoring and management of these risk factors to prevent hypertension. Interventions focusing on healthy aging, weight reduction, and lipid management could be effective strategies to mitigate the risk of hypertension and its associated complications.

**Limitations and Future Research:** Despite the strengths of our study, some limitations should be acknowledged. The cross-sectional design limits the ability to infer causality between the identified predictors and hypertension. Additionally, our study population may not represent the general population, potentially limiting the generalizability of our findings. Future research should include diverse populations and explore the mechanistic pathways linking these predictors to hypertension.

## Conclusion

In conclusion, this study reinforces the significant roles of age, BMI, and LDL cholesterol in the risk of hypertension. The findings underscore the importance of addressing these modifiable risk factors through targeted interventions to reduce the burden of hypertension. Further research is warranted to explore the underlying mechanisms and develop effective hypertension prevention and management strategies.

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None.

## Conflict of interest

The authors further declare that they have no conflict of interest.

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