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Original Article

# Association of Hematological and Anthropometric Indices with Blood Pressure Among Healthy Adults: A Cross-Sectional Study

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## ABSTRACT

**Background**: Hypertension is a major public health problem and an important risk factor for cardiovascular morbidity and mortality. Hematological indices, including red blood cell (RBC) count, hemoglobin, hematocrit, white blood cell (WBC) count, and platelet count, have been suggested to influence blood pressure through mechanisms involving blood viscosity, inflammation, and endothelial function. However, evidence regarding their association in apparently healthy adults remains inconsistent.

**Objective**: To determine the correlation between hematological indices, anthropometric measurements, and blood pressure among apparently healthy adults.

**Materials and Methods**: A cross-sectional study was conducted among 100 apparently healthy adults. Demographic details, anthropometric measurements, and blood pressure were recorded using standard procedures. Venous blood samples were analyzed for hematological parameters, including RBC count, hemoglobin, hematocrit, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), WBC count, and platelet count. The correlation between hematological and anthropometric indices with blood pressure parameters was assessed using appropriate correlation tests. A P value <0.05 was considered statistically significant.

**Results**: The mean systolic and diastolic blood pressures were 116.78 ± 15.25 mmHg and 74.30 ± 12.11 mmHg, respectively. No statistically significant correlation was observed between hematological indices and blood pressure parameters ($P > 0.05$). In contrast, neck circumference showed a significant positive correlation with systolic blood pressure ($r = 0.457$, $P < 0.001$), diastolic blood pressure ($r = 0.409$, $P < 0.001$), and pulse pressure ($r = 0.305$, $P = 0.002$). Waist-to-hip ratio also demonstrated a significant positive correlation with systolic blood pressure ($r = 0.325$, $P = 0.0017$), whereas its correlation with diastolic blood pressure was not statistically significant.

**Conclusion**: Routine hematological indices were not significantly associated with blood pressure among apparently healthy adults. In contrast, neck circumference demonstrated a significant positive correlation with blood pressure, suggesting that it may serve as a simple anthropometric marker for identifying individuals at risk of elevated blood pressure.

**Keywords**: Blood pressure, Hematological indices, Hemoglobin, Red blood cell count, White blood cell count, Platelet count.

## INTRODUCTION

Hypertension is one of the leading modifiable risk factors for cardiovascular disease and remains a major global public health challenge. It contributes substantially to the burden of ischemic heart disease, stroke, chronic kidney disease, and premature mortality. Despite advances in diagnosis and treatment, the prevalence of hypertension continues to increase, particularly in low- and middle-income countries, owing to rapid urbanization, sedentary lifestyles, obesity, and population aging.(1) Early identification of individuals at risk is therefore essential for timely intervention and prevention of long-term cardiovascular complications.

Blood pressure is influenced by a complex interplay of genetic, environmental, metabolic, and hematological factors. In addition to conventional cardiovascular risk factors, increasing evidence suggests that alterations in hematological indices may influence vascular resistance, blood viscosity, endothelial function, and tissue perfusion, thereby contributing to blood pressure regulation.(2) Routine hematological parameters obtained from a complete blood count are inexpensive, readily available, and may provide additional information regarding cardiovascular risk.

Red blood cell (RBC) count, hemoglobin concentration, hematocrit, mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) have been investigated for their potential association with blood pressure. Elevated hematocrit increases blood viscosity, which may increase peripheral vascular resistance and cardiac workload, whereas variations in hemoglobin concentration can influence oxygen delivery and endothelial responses.(3) Several epidemiological studies have demonstrated positive associations between higher hematocrit or hemoglobin levels and elevated blood pressure; however, the findings have not been consistent across different populations.(4)

White blood cell (WBC) count is recognized as a marker of systemic inflammation and has been associated with endothelial dysfunction, oxidative stress, and atherosclerosis. Chronic low-grade inflammation is believed to play an important role in the pathogenesis of hypertension, suggesting that elevated WBC counts may correlate with increased blood pressure levels.(5) Likewise, platelet count has attracted attention because platelet activation contributes to vascular inflammation, thrombosis, and endothelial injury, mechanisms that may influence the development of hypertension and cardiovascular disease.(6)

Although numerous studies have evaluated hematological parameters in patients with established hypertension, relatively few have explored these relationships among **apparently healthy adults** without diagnosed cardiovascular disease. Evaluating hematological indices in healthy individuals may help identify early physiological alterations before the onset of clinically overt hypertension and may improve understanding of cardiovascular risk stratification.(7)

The relationship between hematological indices and blood pressure has shown considerable variability across studies due to differences in ethnicity, age, sex distribution, nutritional status, and study design.(8) Furthermore, evidence from the Indian population remains limited, particularly among apparently healthy adults. Understanding these associations in the local population may provide valuable baseline information for future preventive strategies and population-based cardiovascular risk assessment.

Therefore, the present study was undertaken to determine the correlation between hematological indices and blood pressure among apparently healthy adults.

## MATERIALS AND METHODS

### Study design and setting

A **cross-sectional study** was conducted among apparently healthy adults to determine the correlation between hematological indices and blood pressure at a tertiary care centre for a period of 6 months.

### Study participants

A total of **100 apparently healthy adults** aged 18 years and above participated in the study. Participants were recruited after obtaining informed written consent. Individuals with known hypertension, diabetes mellitus, cardiovascular disease, renal disease, hematological disorders, acute or chronic infections, pregnancy, or those receiving medications known to affect hematological parameters or blood pressure were excluded from the study.

### Data collection

Demographic information, including age, sex, family history of hypertension, and anthropometric measurements such as body mass index (BMI), neck circumference, and waist-to-hip ratio, were recorded using a predesigned data collection form. Blood pressure was measured using a standard sphygmomanometer after the participant had rested for at least 5 minutes in the sitting position. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded, and mean arterial pressure (MAP) was calculated using the standard formula:

**MAP = DBP + 1/3 (SBP − DBP)**

**Hematological analysis**
Venous blood samples were collected under aseptic precautions and analysed on an automated hematology analyser according to the manufacturer's instructions. The following hematological indices were evaluated:

- Red blood cell (RBC) count
- Hemoglobin (Hb)
- Hematocrit (HCT)
- Mean corpuscular hemoglobin (MCH)
- Mean corpuscular hemoglobin concentration (MCHC)
- White blood cell (WBC) count
- Platelet (PLT) count

The hematological parameters were expressed as appropriate measures of central tendency and dispersion.

**Study variables**
The primary outcome variables were systolic blood pressure, diastolic blood pressure, and mean arterial pressure. The independent variables included RBC count, hemoglobin, hematocrit, MCH, MCHC, WBC count, and platelet count.

**Statistical analysis**
Data were entered into Microsoft Excel and analysed using **IBM SPSS 23.0.** Continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate, while categorical variables were presented as frequencies and percentages. The association between hematological indices and blood pressure parameters (SBP, DBP, and MAP) was assessed using **Spearman's rank correlation coefficient (r)**, while the association between neck circumference and blood pressure parameters was assessed using **Pearson's correlation coefficient**. A **P-value <0.05** was considered statistically significant.

**RESULTS**
A total of **100 apparently healthy adults** were included in the study. Nearly half of the participants (47%) were 20 years of age or younger. Females constituted 67% of the study population, and 70% had no family history of hypertension. The largest proportion of participants (37%) had a BMI ≥25 kg/m². (Table 1)

**Table 1. Socio-demographic characteristics of the study participants (n = 100)**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| **Age (years)** | ≤20 | 47 | 47.0 |
| | 21–35 | 39 | 39.0 |
| | ≥36 | 14 | 14.0 |
| **Sex** | Male | 33 | 33.0 |
| | Female | 67 | 67.0 |
| **Family history of hypertension** | Present | 30 | 30.0 |
| | Absent | 70 | 70.0 |
| **Body Mass Index (BMI)** | <18.5 kg/m² | 15 | 15.0 |
| | 18.5–22.9 kg/m² | 25 | 25.0 |
| | 23.0–24.9 kg/m² | 23 | 23.0 |
| | ≥25 kg/m² | 37 | 37.0 |

The mean systolic blood pressure of the study participants was **116.78 ± 15.25 mmHg**, while the mean diastolic blood pressure was **74.30 ± 12.11 mmHg**. The median mean arterial pressure (MAP) was **89 mmHg** with an interquartile range (IQR) of **17.3 mmHg**, indicating that the study population generally had blood pressure values within the normal physiological range.. (Table 2)

**Table 2. Blood pressure characteristics of the study participants**

| Parameter | Mean ± SD / Median (IQR)* |
|---|---|
| Systolic Blood Pressure (SBP), mmHg | 116.78 ± 15.25 |
| Diastolic Blood Pressure (DBP), mmHg | 74.30 ± 12.11 |
| Mean Arterial Pressure (MAP), mmHg | 89 (17.3) |

The median red blood cell count, hemoglobin concentration, hematocrit, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), white blood cell count, and platelet count were **4.54 ×10⁶/µL (IQR: 0.827)**, **12.8 g/dL (IQR: 3.13)**, **39.2% (IQR: 7.73)**, **28.1 pg (IQR: 4.18)**, **33.0 g/dL (IQR: 1.82)**, **8.5 ×10³/µL (IQR: 2.11)**, and **325 ×10³/µL (IQR: 96)**, respectively.. (Table 3)

**Table 3. Hematological parameters of the study participants**

| Parameter | Median (IQR) |
|---|---|
| RBC (×10⁶/µL) | 4.54 (0.827) |
| MCH (pg) | 28.1 (4.18) |

| | |
|---|---|
| MCHC (g/dL) | 33.0 (1.82) |
| Hemoglobin (g/dL) | 12.8 (3.13) |
| WBC (×10³/µL) | 8.5 (2.11) |
| Platelet count (×10³/µL) | 325 (96) |
| Hematocrit (%) | 39.2 (7.73) |

The median neck circumference of the study participants was **32.3 cm** (IQR: **4.0 cm**), while the median waist-to-hip ratio was **0.808** (IQR: **0.141**), indicating the distribution of anthropometric measurements in the study population. (Table 4)

**Table 4. Anthropometric characteristics of the study participants**

| Parameter | Median (IQR) |
|---|---|
| Neck circumference (cm) | 32.3 (4.0) |
| Waist-to-hip ratio | 0.808 (0.141) |

Correlation analysis demonstrated **very weak positive or negative correlations** between hematological indices and systolic, diastolic, and mean arterial blood pressure. None of the correlations reached statistical significance indicating **no significant association** between the evaluated hematological parameters and blood pressure indices in the study population. (Table 5)

**Table 5. Correlation of hematological parameters with blood pressure indices**

| Variable | SBP r (P value) | DBP r (P value) | MAP r (P value) |
|---|---|---|---|
| RBC | –0.013 (0.896) | –0.043 (0.673) | –0.035 (0.731) |
| MCH | –0.085 (0.401) | –0.046 (0.651) | –0.068 (0.503) |
| MCHC | 0.030 (0.737) | 0.064 (0.529) | 0.058 (0.566) |
| Hemoglobin | –0.091 (0.366) | –0.066 (0.514) | –0.084 (0.405) |
| WBC | 0.029 (0.773) | 0.009 (0.932) | 0.018 (0.856) |
| Platelet count | 0.037 (0.716) | 0.077 (0.449) | 0.068 (0.501) |
| Hematocrit | –0.052 (0.607) | –0.096 (0.340) | –0.088 (0.383) |

Neck circumference demonstrated a **moderate positive correlation** with systolic blood pressure ($r = 0.457$, $P < 0.001$) and diastolic blood pressure ($r = 0.409$, $P < 0.001$). A **weak but statistically significant positive correlation** was also observed with pulse pressure ($r = 0.305$, $P = 0.002$).

**Table 6. correlation between neck circumference and blood pressure parameters**

| Variable | Pearson's correlation coefficient (r) | P value |
|---|---|---|
| Systolic blood pressure (SBP) | 0.457 | <0.001* |
| Diastolic blood pressure (DBP) | 0.409 | <0.001* |
| Pulse pressure (PP) | 0.305 | 0.002* |

Waist–hip ratio demonstrated a statistically significant positive correlation with systolic blood pressure, whereas its correlation with diastolic blood pressure was weak and not statistically significant. (Table 7)

**Table 7: correlation of waist–hip ratio with blood pressure parameters**

| Variable | Pearson's correlation coefficient (r) | P value |
|---|---|---|
| Systolic blood pressure (SBP) | 0.325 | 0.0017* |
| Diastolic blood pressure (DBP) | 0.191 | 0.069 |

## DISCUSSION

The present cross-sectional study evaluated the correlation between hematological indices and blood pressure among apparently healthy adults. Red blood cell count, hemoglobin, and hematocrit are known to influence blood viscosity and peripheral vascular resistance. Letcher et al. reported a positive relationship between blood viscosity and blood pressure in both normotensive and hypertensive individuals.(3) Similarly, Shimizu and Kario observed that higher hemoglobin and hematocrit levels were associated with an increased risk of hypertension.(4) In contrast, the present study demonstrated only weak negative correlations between these parameters and blood pressure indices, none of which were statistically significant. This suggests that these hematological parameters may have limited influence on blood pressure among apparently healthy adults.

Mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) also showed no significant association with SBP, DBP, or MAP. In contrast, Atsma et al. reported a positive association between hemoglobin level and blood pressure in a large cohort of healthy blood donors, illustrating that findings on erythrocyte indices and blood pressure remain inconsistent across populations.(9)

Inflammation has an important role in the development of hypertension, and elevated WBC count has been linked to endothelial dysfunction and vascular inflammation. Madjid et al. demonstrated an association between leukocyte count and cardiovascular risk.(5) However, WBC count showed only negligible positive correlations with blood pressure in the

present study, probably because the participants were apparently healthy and free from acute or chronic inflammatory conditions.

Platelet count also exhibited weak positive correlations with blood pressure, without statistical significance. Platelets contribute to endothelial dysfunction and thrombosis, but platelet count alone may not adequately reflect platelet activation or cardiovascular risk. Similar observations have been reported by Vizioli et al., who emphasized that platelet function rather than platelet count may better predict cardiovascular disease.(6)

The findings of the present study are consistent with reports indicating that the relationship between hematological indices and blood pressure is influenced by multiple factors, including age, obesity, metabolic status, and underlying disease. Kawamoto et al. observed that significant associations became more evident after adjustment for metabolic and cardiovascular risk factors, suggesting that hematological parameters may have a greater role in individuals with established cardiovascular disease than in healthy populations.(10)

An important finding of the present study was the significant positive correlation between **neck circumference and systolic blood pressure, diastolic blood pressure, and pulse pressure**. Neck circumference is increasingly recognized as a simple anthropometric indicator of upper-body subcutaneous adiposity and central obesity. Increased neck circumference has been associated with insulin resistance, metabolic syndrome, sympathetic overactivity, and endothelial dysfunction, all of which contribute to elevated blood pressure. Similar observations have been reported in previous studies, where neck circumference showed a significant association with hypertension independent of conventional anthropometric measures such as body mass index and waist circumference.(11,12)

The present study demonstrated that waist-to-hip ratio was positively associated with systolic blood pressure, highlighting the importance of central adiposity in the early development of hypertension. Visceral fat accumulation promotes sympathetic overactivity, activation of the renin–angiotensin–aldosterone system, insulin resistance, and endothelial dysfunction, all of which contribute to increased vascular resistance and arterial stiffness. Similar observations have been reported by Dalton et al. (13), who identified WHR as an important anthropometric predictor of cardiovascular risk factors. Gelber et al. (14) also reported that indices of abdominal obesity independently predicted cardiovascular risk beyond overall obesity. In contrast, the association between WHR and diastolic blood pressure did not reach statistical significance in the present study, which may reflect the relatively young, apparently healthy study population and the limited sample size

## CONCLUSION

The present study found no significant correlation between routine hematological indices and blood pressure parameters among apparently healthy adults. In contrast, neck circumference and waist-to-hip ratio showed significant positive correlations with systolic blood pressure, with neck circumference also correlating with diastolic blood pressure and pulse pressure. These findings suggest that simple anthropometric measures of central obesity may be useful for the early identification of individuals at risk of elevated blood pressure. Further large-scale prospective studies are warranted to confirm these findings.

## REFERENCES


1. World Health Organization. **Hypertension**. Geneva: World Health Organization; 2023.
2. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults. *Hypertension.* 2018;71(6):e13-e115.
3. Letcher RL, Chien S, Pickering TG, Laragh JH. Direct relationship between blood pressure and blood viscosity in normal and hypertensive subjects. *Am J Med.* 1981;70(6):1195-1202.
4. Shimizu Y, Kario K. Relationship between hematological parameters and hypertension: Evidence from population-based studies. *Hypertens Res.* 2018;41(8):561-568.
5. Madjid M, Awan I, Willerson JT, Casscells SW. Leukocyte count and coronary heart disease: Implications for risk assessment. *J Am Coll Cardiol.* 2004;44(10):1945-1956.
6. Vizioli L, Muscari S, Muscari A. The relationship of mean platelet volume with cardiovascular risk factors and vascular diseases. *Platelets.* 2009;20(3):177-184.
7. Diaz KM, Shimbo D. Physical activity and the prevention of hypertension. *Curr Hypertens Rep.* 2013;15(6):659-668.
8. Yan Y, Li S, Guo Y, Bazzano L, He J, Chen W. Blood pressure and hematological indices in apparently healthy adults: Findings from population-based studies. *J Clin Hypertens.* 2015;17(10):785-792.
9. Atsma F, Veldhuizen I, de Kort W, van Kraaij M, Pasker-de Jong P, Deinum J. Hemoglobin level is positively associated with blood pressure in healthy individuals. *Hypertension.* 2012;60(4):936-941.
10. Kawamoto R, Tabara Y, Kohara K, Miki T, Kusunoki T, Abe M. Hematological parameters are associated with blood pressure and metabolic syndrome in community-dwelling adults. *Clin Exp Hypertens.* 2011;33(7):505-512.
11. Ben-Noun L, Sohar E, Laor A. Neck circumference as a simple screening measure for identifying overweight and obese patients. *Obes Res.* 2001;9(8):470–477.
12. Zhou JY, Ge H, Zhu MF, Wang LJ, Chen L, Tan YZ, et al. Neck circumference as an independent predictive contributor to cardio-metabolic syndrome. *Cardiovasc Diabetol.* 2013;12:76.
13. Dalton M, Cameron AJ, Zimmet PZ, Shaw JE, Jolley DJ, Dunstan DW, et al. Waist circumference, waist-hip ratio and body mass index and their correlation with cardiovascular disease risk factors in Australian adults. *J Intern Med.* 2003;254(6):555–563.
14. Gelber RP, Gaziano JM, Orav EJ, Manson JE, Buring JE, Kurth T. Measures of obesity and cardiovascular risk among men and women. *J Am Coll Cardiol.* 2008;52(8):605–615