ISSN: 2091-2331 (Print) 2091-234X (Online)

Journal of Nobel Medical College

Volume 14, Number 02, Issue 27, July-December 2025, 42-46

Original Article

Association between Adiposity Indices and Blood Pressure among Young Adults: A Cross Sectional Study

Reena Kumari Jha*[1], Prabod Risal [2], Sakshi Shah [3], Chiranjeet Kumar Singh [1], Abadhesh Kumar Mishra [4], Ojashwi Nepal [1]

[1]Department of Physiology, [2]Department of Biochemistry, [3]Department of Physiotherapy, Kathmandu University School of Medical Sciences, Kathmandu University, Dhulikhel, Nepal, [4]Department of Medicine, Sukraraj Tropical and Infectious Disease Hospital, Teku, Kathmandu, Nepal

Article Received: 12th October, 2025; Accepted: 16th December, 2025; Published: 31st December, 2025

DOI: https://doi.org/10.3126/jonmc.v14i2.87908

Abstract

Background

The prevalence of obesity is rising rapidly in many low and middle income countries and is strongly linked to an increased risk of cardiovascular disease (CVD) and related health complications. Thus, this study aimed to see the association between adiposity indices and blood pressure using different markers of obesity among young adults.

Materials and Methods

A cross sectional study was carried out in the Kathmandu University School of Medical Sciences, from June to August 2025. A total of 426 participants, aged 18 – 30 years were enrolled through convenience sampling. The height in meter, weight in Kg, hip circumference and waist circumference in centimeter were recorded for each participant than body adiposity index, body mass index, waist hip ratio and waist height ratio were calculated. Blood pressure was recorded by digital sphygmomanometer. Gender comparison was made and independent sample t-test, ANOVA and Pearson's correlation analysis was used.

Results

Out of total 426 participants, 174 were males and 252 were females. 24.71% males and 12.30% females were overweight/obese. Body adiposity index, hip circumference, waist circumference, waist to height ratio and waist to hip ratio were higher in males compared to females. Considering BMI, systolic and diastolic blood pressure tends to increase in overweight/obese participants but insignificant. Mean BAI was 22.00±6.14, whilst 29.17% had a body fat percentage in the overweight/obese category. Considering BAI, overweight/obese female had higher systolic and diastolic blood pressure.

Conclusion

Our findings concludes that overweight/obese females are more prone to develop hypertension in future.

Keywords: *Blood pressure, Cardiovascular disease, Obesity*

***Corresponding Author:**
Dr. Reena Kumari Jha
Associate Professor
Email: reena@kusms.edu.np
ORCID: https://orcid.org/0009-0008-5496-7539

Citation
Jha RK, Risal P, Shah S, Singh CK, Mishra AK, Nepal O, Association between Adiposity indices and Blood Pressure among Young Adults: A Cross sectional Study. JoNMC.14:2 (2025) 42-46. DOI: https://doi.org/10.3126/jonmc.v14i2.87908.

Introduction

Now a days the prevalence of overweight and obesity is rapidly increasing among young adults which is attributable to the epidemiological transition driven by urbanization, sedentary lifestyles, unhealthy dietary habits, and stress [1]. Evidences showed that obesity are associated with several disorders like hypertension, diabetes, and cardiovascular disease [2, 3]. Adiposity indices are the commonly used to estimate body fat and identify individuals at risk for cardiometabolic condition [4, 5]. Previous research showed BMI, WC, and WHtR are associated with elevated blood pressure in adolescents [6, 7].

Obesity is one of the best predictors for development of hypertension [8]. Obesity stimulates both the sympathetic nervous system and the renin angiotensin aldosterone system that causes the body to retain excess sodium and raise arterial blood pressure [9]. In addition, Obese individuals often become resistant to hormone leptin's appetite reducing effects, and their bodies still respond to leptin's ability to activate the sympathetic nervous system. As a result, sympathetic activity increases, driving up arterial pressure and contributing to hypertension [10].

Hypertension is rapidly increasing in developing countries among young and middle-aged populations and are associated with excess weight [11]. Thus, the aim of this study was to find out the relationship between adiposity indices and blood pressure among medical students.

Materials and Methods

This is a cross-sectional study that was conducted among medical students, aged 18 to 30 years in the department of physiology, Kathmandu University school of medical sciences, Dhulikhel from June to August 2025 after taking ethical clearance from Institutional Review Committee, Kathmandu University School of Medical Sciences (IRC, KUSMS 150/25). Participants suffering with cardiorespiratory disease and autonomic dysfunction were excluded from the study however young adults, aged 18 to 30 years, nonsmoker and non-alcoholics, having no previous history of diabetes, hypertension, and other cardiovascular illness were included in the study. Sample size was calculated by following formula.

$n_o = Z^2 \times p \times (1-p)/e^2$

$= (1.96)^2 \times (0.5) \times (1-0.5)/(0.05)^2$

$= 384$

Where,

n_o= required sample size

p= population proportion, 50%

e= margin of error, 5%

Thus, number of the sample size required is calculated as 384. By adding 10% as a non-response rate, the sample size was found to be 426.

Thus 426 medical students were enrolled in the present study using convenience sampling technique. First the participants were informed about the procedure and the consent was taken. Then the height was measured without shoes, to the nearest 0.5cm with participant standing erect against the wall with heels together and touching the wall and head held in upright position. Weight was measured with minimum cloths and no footwear on a standardized weighing machine marked from 0 to 130 kg and was recorded to the nearest 0.5 kg. Waist circumference (WC) was measured bet-ween the 10th rib and the iliac crest with a measuring tape. The hip circumference (HC) was measured with a measuring tape to the widest point on the greater trochanter. Body mass index (BMI) was then calculated using the formula weight in kilograms divided by the square of the height in meters {weight (kg)/ height (m^2)}. It was then summarized and categorized into three groups, underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5 to 24.9kg/m^2), overweight (BMI 25.0-29.9kg/m^2) and obese (BMI 30 – 34.9 kg/m^2) in accordance with the WHO recommendation [12].

Body adiposity index [13] was computed using the following standard equations: BAI = {hip circumference (cm)/ (height in meter) $^{1.5}$}–18. BAI results were interpreted as low body fat: < 8% (male); < 21% (female), Healthy body fat: 8-21% (male); 21% – 33% (female), Over weight body fat: 21-26% (male); 33–39% (female), and obese body fat: ≥27% (male); ≥40% (female). Waist to hip ratio [14] was computed using WHR = WC (cm)/HC (cm) and categories are: (i) normal WHR < 0.85 for female and < 0.90 for male; and (ii) high WHR, ≥ 0.85 for female and for male ≥ 0.90. Waist to height ratio [15] was computed using WHtR = WC (cm)/height (cm) [15]. The cut off point for WHtR is 0.5 for both male and female. WHtR categories are: (i) normal WHtR < 0.05 and High WHtR ≥ 0.05.

Blood pressure was recorded using a standard Omron (HEM711DLX) blood pressure apparatus on the left arm placed at heart level after 5-minute rest and using a cuff of appropriate size with the subject in the sitting position and legs uncrossed. Three separate measurements were obtained with a minimum interval of one minute and average of the last two BP reading was used in the present study.

Data were entered into Microsoft Excel and analyzed using IBM Statistical Package for the Social Sciences version 22 software. The data were analyzed using descriptive statistics and have been presented as means, standard deviations, frequencies, and percentages. Gender comparison was made and independent sample t-test and ANOVA was used. The relation between anthropometric indices and blood pressure were examined using Pearson's correlation analysis. Level of significance was set at p value of < 0.05.

Results

Out of 426 participants, 174 (40.8%) were male and 252 (59.2%) were female. The mean age of the total participants was 21.24±2.33 years. Age, weight, height, hip circumference, waist circumference, waist to height ratio and body adiposity index were higher in male compared to female participants shown in Table 1.

Table 1: Basic Characteristics of the participants (N = 426)7

Variables	Total (n=426) Mean ± SD	Male (n = 174) Mean ± SD	Female (n = 252) Mean ± SD	p-value
Age (years)	21.24 ± 2.33	21.55 ± 2.25	21.02 ± 2.35	0.02*
Weight (kg)	56.97 ± 9.32	63.56 ± 8.20	52.41 ± 7.04	<0.001*
Height (m)	1.61 ± 0.09	1.68 ± 0.06	1.56 ± 0.07	<0.001*
Hip Circumference (cm)	81.59 ± 13.06	88.29 ± 10.86	76.96 ± 12.44	<0.001*
Waist Circumference (cm)	64.09 ± 10.84	69.86 ± 9.89	60.11 ± 9.63	<0.001*
Waist-Height ratio	0.39 ± 0.06	0.41 ± 0.06	0.38 ± 0.06	<0.001*
Waist-Hip ratio	0.79 ± 0.05	0.79 ± 0.05	0.78 ± 0.05	0.13
BMI (Kg/M²)	22.01±3.29	21.93±3.45	22.06±3.18	0.000*
BAI (%)	22.00±6.14	22.82±5.37	21.44±6.58	0.02*
SBP (mmHg)	114.71 ± 10.68	114.77 ± 10.03	114.67 ± 11.13	0.92
DBP (mmHg)	75.20 ± 8.49	75.51 ± 8.93	79.98 ± 8.18	0.53

Values are mean ± standard deviation
BAI indicates body adiposity index, BMI indicates body mass index
SBP & DBP indicates systolic and diastolic blood pressure
* p-value <0.05 is significant

The distribution of adiposity indices and blood pressure of the participants is summarized in Table 2. Based on BMI, 24.71% (n = 43) of the male and 12.30% (n = 31) of the female were overweight/obese. Systolic and diastolic blood pressure tends to increase in overweight/obese participants but non-significant.

Table 2: Comparison of Blood pressure according to BMI categories

BMI Categories	N (%)	SBP Mean ± SD	DBP Mean ± SD
MALE (n = 174)			
Under weight	18 (10.3)	114.44±12.16	75.52±8.76
Normal weight	113 (64.9)	114.46±10.08	75.54±8.85
Over weight/obese	43 (24.71)	115.73±9.06	75.43±9.41
F		0.26	0.002
p-Value		0.77	0.99
FEMALE (n = 252)			
Under weight	45 (17.9)	113.39±9.78	74.51±8.98
Normal weight	176 (69.8)	114.49±11.94	74.73±8.07
Over weight/ Obese	31 (12.3)	117.54±7.31	77.05±7.45
F[a]		1.35	1.15
p-Value		0.26	0.31

Values are mean ± standard deviation or number (percentage)
SBP & DBP indicates systolic and diastolic blood pressure
[a]Analysis of variance (ANOVA) for continuous variable

Out of the total number of participants evaluated, 32.8% and 5.2% had high or over weight body fat percentage & 30.5% and only one (0.4%) had very high or obese body fat percentage. Systolic and diastolic blood pressure is significantly higher in female with overweight/obese body fat percentage compared to those having healthy and low body fat percentage (Table 3).

Table 3: Comparison of Blood pressure according to BAI categories

BAI Categories (%)	N (%)	SBP Mean ± SD	DBP Mean ± SD
MALE (n = 174)			
Low body fat	0	-	-
Healthy body fat	64 (36.8)	113.79±10.34	75.22±8.33
Overweight body fat	57 (32.8)	115.66±10.80	76.93±9.16
Obese body fat	53(30.5)	115.01±8.78	74.34± 9.33
F		0.543	1.208
p-Value		0.582	0.301
FEMALE (n = 252)			
Low body fat	122 (48.5)	114.69±10.45	74.85±8.34
Healthy body fat	116(46.0)	113.56±9.83	74.37±7.86
Overweight/obese body fat	14(5.5)	123.64±20.54	81.14±7.18
F		5.29	4.42
p-Value		**0.006**	**0.013**

Values are mean ± standard deviation or number (percentage)
SBP & DBP indicates systolic and diastolic blood pressure
[a]Analysis of variance (ANOVA) for continuous variable

Out of total participants, a very few 9.20% male and 5.16% females had high waist to height ratio. (Table 4). 4.6% male and 1.99% females had high waist to hip ratio (Table 5). Systolic blood pressure tends to increase in those having high

WHtR and WHR. Non-significant low positive correlation was found between BAI, BMI, WHtR and WHR with SBP and DBP (Table 6).

Table 4: Comparison of blood pressure according to WHtR

WHtR	N (%)	MALE (n = 174) SBP Mean ± SD	DBP Mean ± SD
Normal	158 (90.80)	114.74±10.21	75.85±8.75
High	16 (9.20)	115.08±8.31	72.19±10.20
p-Value		0.89	0.11
FEMALE (n = 252)			
Normal	239 (94.84)	114.36±10.13	74.78±8.06
High	13 (5.16)	120.38±22.79	78.55±9.77
p-Value		0.05	0.10

Values are mean ± standard deviation or number (percentage)
SBP & DBP indicates systolic and diastolic blood pressure
WHtR indicates waist to height ratio

Table 5: Comparison of blood pressure according to WHR

WHR	N (%)	MALE (n = 174) SBP Mean ± SD	DBP Mean ± SD
Normal	166 (95.4)	114.64±10.20	75.53±8.84
High	8 (4.6)	117.62±4.90	75.19±11.34
p-Value		0.41	0.91
FEMALE (n = 252)			
Normal	247 (98.01)	114.64±11.21	74.94±8.15
High	5 (1.99)	115.88±6.65	77.08±9.82
p-Value		0.80	0.56

Values are mean ± standard deviation or number (percentage)
SBP & DBP indicates systolic and diastolic blood pressure
WHR indicates waist to hip ratio

Table 6: Correlation between Adiposity indices and blood pressure

	SBP		DBP	
	r	p-value	r	p-value
BAI	0.008	0.876	0.024	0.620
BMI	0.078	0.109	0.067	0.165
WHtR	0.017	0.732	0.042	0.382
WHR	0.046	0.348	0.055	0.259

SBP & DBP indicates systolic and diastolic blood pressure
BAI indicates body adiposity index, BMI indicates body mass index,
WHtR indicates waist to height ratio and WHR indicates waist to hip ratio

Discussion

The study showed that systolic as well as diastolic blood pressure was higher in female participants with a high body fat percentage. Conversely, insignificant higher blood pressure was found in overweight/obese participants calculated from other adiposity indices such as BMI, WHtR, and WHR. Our findings were supported by a study conducted among 957 working adults, mean aged 37.47 ± 7.66 years in Libreville. The researcher found that hypertension was strongly associated with BAI and WC in women [16]. Obesity activates the sympathetic nervous system and the renin-angiotensin-aldosterone system, leading to abnormal sodium retention and elevated arterial blood pressure. This contributes to hypertension, a common comorbidity in obese individuals [9]. In obesity, leptin levels are elevated, and despite resistance to its appetite suppressing effects, its capacity to stimulate sympathetic nervous system activity remains intact. This results in increased arterial pressure and hypertension [10].

Age, weight, height, hip circumference, waist circumference, waist to height ratio and body adiposity index were higher in males compared to females. This is in agreement with other several studies [17, 18, 19]. Males are more frequently classified as overweight or obese and tend to have higher waist circumference, indicating a greater likelihood of abdominal obesity [20]. This is partly due to fat deposition in the central region increasing with puberty and maturation in males, leading to a more android body shape [21]. Our study aligns with these findings as more boys exhibited abdominal obesity compared to girls. On the other hand, girls tend to be more conscious of their body shape, often leading to daily restrictions in food intake [17]. In this study, insignificant low positive correlation was found between adiposity indices and blood pressure presented in table 6. In contradictory to our study, a study done on Brazilian Men showed significant correlation between both systolic and diastolic blood pressure and all anthropometric measurements [22].

This may be due to the present study was conducted among healthy young adults including medical and paramedical students. Hence it would not be wrong to assume that the students involved in this study may have knowledge about lifestyle diseases such as hypertension and its effects.

Conclusion

Based on the present study higher systolic and diastolic blood pressure were found in overweight/obese female participants. However, the systolic as well as diastolic blood pressure tend to increase in male participants but insignificant.

Recommendation

It is recommended that factors affecting blood pressure such as body adipose indices should be explored further among different age and ethnic groups in large population between both genders and compared.

Acknowledgement: None

Conflict of interest: None

References

[1] Rawal LB, Kanda K, Mahumud RA. et. Al, Prevalence of underweight, overweight and obesity and their associated risk factors in Nepalese adults: Data from a Nationwide Survey. 13:11 (2016) 1-14. DOI: 10.1371/journal.pone.0205912. PMID: 30399189.

[2] Lavie CJ, Milani RV, Ventura HO, Obesity and cardiovascular disease: risk factor, paradox, and impact of weight loss, J Am Coll Cardiol. 53:21 (2009) 1925-32. DOI: 10.1016/j.jacc.2008.12.068. PMID: 19460605.

[3] Bjorndal B, Burri L, Staalesen V. et al, Different adipose depots: their role in the development of metabolic syndrome and mitochondrial response to hypolipidemic agents, J Obes. 2011(2011) 1-15. DOI: 10.1155/2011/490650. PMID: 21403826.

[4] Gallagher D, Visser M, Sepulveda D, et al, How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? Am j epidemiology. 143:3 (1996) 228-39. DOI: 10.1093/oxfordjournals.aje.a008733. PMID: 8561156.

[5] Heinrich KM, Jitnarin N, Suminski RR, et al, Obesity classification in military personnel: a comparison of body fat, waist circumference, and body mass index measurements. Military Medicine: International Journal of AMSUS. 173:1 (2008) 67-73. DOI: 10.7205/milmed.173.1.67. PMID: 18251334.

[6] Deng G, Yin L, Liu W, Liu X, Xiang Q, Qian Z, et al, Associations of anthropometric adiposity indexes with hypertension risk: A systematic review and meta-analysis including PURE - China. Medicine (Baltimore) 97:48 (2018) 1 - 10. DOI: 10.1097/MD.0000000000013262 PMID: 30508913

[7] Saad AH, Hassan AA, Al-Nafeesah A, AlEed A, Adam I, Prediction of Hypertension Based on Anthropometric Parameters in Adolescents in Eastern Sudan: A Community-Based Study, Vasc Health Risk Manag. 20:20 (2024) 511-519. DOI: 10.2147/VHRM.S491857. PMID: 39582713.

[8] Sharma S, Singh H, Mehta K, et. Al, Hypertension and its association with body mass index among the Indian population. Findings from a nationwide survey (NFHS-4), 2015-16, J Fam Med and Primary Care 11:9 (2022) 5826-33 DOI: 10.4103/jfmpc.jfmpc_168_22. PMID: 36505572

[9] Hall JE, Guyton and Hall Textbook of medical physiology, Second South Asia ed. Philadelphia: Elsevier; 2018.page no. 554, 623, 645

[10] Carlyle M, Jones OB, Kuo JJ, Hall JE, Chronic cardiovascular and renal actions of leptin: role of adrenergic activity. Hypertension. 39:2 (2002) 496-501. DOI: 10.1161/hy0202.104398. PMID: 11882597.

[11] Lategan R, Van den Berg VL, Walsh CM, Body adiposity indices are associated with hypertension in a black, urban Free State community, Afr J Prim Health Care Fam Med. 19:6 (2014)1-7. DOI: 10.4102/phcfm.v6i1.581. PMID: 26245400.

[12] World Health Organization. Diet. Nutrition and the Prevention of Chronic Diseases, Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series No. 916 [Internet]. Geneva: World Health Organization, 2003. Available on: https://apps.who.int/iris/bitstream/handle/10665/42665/WHO_TRS_916.pdf;jsessionid=F09056264A1209F4EFACA78766D6CD38?sequence=1.%20%5bFull%20Text%5d (Accessed 25.08.02 August 2025).

[13] Bergman RN, Stefanovski D, Buchanan TA, et al, A better index of body adiposity. Obesity (Silver Spring) 19:5 (2011) 1083-9. DOI: 10.1038/oby.2011.38. PMID: 21372804.

[14] World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008 [document on the internet]. Available from: whqlibdoc.who.int/ publications/2011/9789241501491_eng.pdf (Accessed 25.09.05 September 2025).

[15] Ashwell M, Hsieh SD, Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity, Int J Food Sci Nutr. 56:5 (2005) 303-307. DOI: http://dx.doi.org/10.1080/09637480500195066. PMID: 16236591.

[16] Assoumou NHG, Affane AN, Madingou K, Mewono L. Obesity and Hypertension: Importance of The Relationship Between Body Adiposity Index and Diastolic Blood Pressure in Women from Active Healthy Gabonese Adult's Population, JMEST. 6:6 (2019) 10247-10253

[17] Ahmad A, Zulaily N, Shahril MR, Syed Abdullah EFH, Ahmed A, Association between socioeconomic status and obesity among 12-year-old Malaysian adolescents, PLoS One. 13:7 (2018) 1-11. DOI: 10.1371/journal.pone.0200577. PMID: 30044842.

[18] Zalilah MS, Khor GL, Mirnalini K, Norimah AK, Ang M, Dietary intake, physical activity and energy expenditure of Malaysian adolescents. Singapore Med J. 47:6 (2006) 491-8. PMID: 16752017

[19] Poh BK, Ang YN, Yeo GS, et. Al, Anthropometric indices, but not birth weight, are associated with high blood pressure risk among Malay adolescents in Kuala Lumpur. Dialogues Health. 1:100006 (2022) 1-7. DOI: 10.1016/j.dialog.2022.100006. PMID: 38515871.

[20] Stevens J, Katz EG, Huxley RR. Associations between gender, age and waist circumference, Eur J Clin Nutr. 64:1 (2010) 6-15. DOI: 10.1038/ejcn.2009.101. PMID: 19738633.

[21] Taylor RW, Grant AM, Williams SM, Goulding A, Sex differences in regional body fat distribution from pre- to postpuberty, Obesity (Silver Spring). 18:7 (2010) 1410-6. DOI: 10.1038/oby.2009.399. PMID: 19893501.

[22] Cassani RS, Nobre F, Pazin-Filho A, Schmidt A, Relationship between blood pressure and anthropometry in a cohort of Brazilian men: a cross-sectional study, Am J Hypertens. 22:9 (2009) 980-4. DOI: 10.1038/ajh.2009.104. PMID: 19498339.