The Review Of
DIABETIC
STUDIES
OPEN ACCESS

Central And Peripheral Adiposity As Predictors Of Blood Pressure In Sedentary Female Educators: A Cross-Sectional Analysis Using Skinfold Thickness

Dr Anita Kumari[1], Dr Anindita Das[2], R L Udrishna Deori[3], Dr Tashi Ongmu Bhutia[4], Dr Chanderkant Dhiman[5*]

1) Physical Education and Sports Officer, Indian Institute of Technology, ISM Dhanbad, Jharkhand, India,
2) Associate Professor, Lakshmibai National Institute of Physical Education, Gwalior, India,
3) Assistant Professor, Department of Physical Education, Central University South Bihar, Gaya, India,
4) Assistant Professor, B.Ed. Govt. College, Soreng, Sikkim, India,
*5) *Department of Physical Education, Faculty of Arts, Banaras Hindu University, Varanasi, India.*
**Corresponding Author: Dr Chanderkant Dhiman*
**Department of Physical Education, Faculty of Arts, Banaras Hindu University, Varanasi, India. Email ID: dhimanchandu@bhu.ac.in, ORCID: https://orcid.org/0000-0003-2385*-0801*

ABSTRACT

Objectives: To investigate the associations between central and peripheral adiposity, as measured by skinfold thickness, and blood pressure indices in sedentary female educators, independent of age and body mass index (BMI).
Methods: A cross-sectional study of 120 sedentary female educators (ages 32–50) from an Indian school district collected data on height, weight, BMI, blood pressure (systolic and diastolic), and skinfold thickness at four sites (suprailiac, subscapular, biceps, and triceps). Pearson correlation coefficients were used to examine the relationships between adiposity measures and blood pressure. Multiple linear regression models were used to assess the independent effects of skinfold sites on blood pressure, while adjusting for age and BMI.
Results: Participants had a mean age of 42.2 years (SD = 4.7) and a mean BMI of 26.5 kg/m² (SD = 4.7). Central skinfolds (suprailiac, subscapular) showed the strongest positive correlations with both systolic and diastolic blood pressure ($r = .35–.32$, $p < .01$). Regression analyses revealed that suprailiac ($\beta = 0.65$, $p = .002$) and subscapular ($\beta = 0.50$, $p = .008$) skinfolds were significant independent predictors of systolic and diastolic blood pressure, respectively, even after controlling for age and BMI.
Conclusions: Central adiposity, measured by skinfolds, predicts blood pressure in sedentary female educators. These findings emphasise the need to assess regional fat distribution for cardiovascular risk stratification and targeted intervention in this group.

Keywords: Anthropometry, Body Composition, Female Educators, Occupational Fitness

INTRODUCTION

Sedentary lifestyles, prevalent in numerous professional occupations, significantly exacerbate these risks. Female educators, who frequently endure prolonged durations of inactivity, constitute a particularly vulnerable demographic; however, they remain underrepresented in research concerning body composition (Proper et al., 2011). The convergence of occupational sedentarism, age-related metabolic changes, and sex-specific fat distribution patterns may distinctly heighten their susceptibility to cardiometabolic diseases (Power & Schulkin, 2008; Song et al., 2014).

While advanced imaging techniques, such as dual-energy X-ray absorptiometry (DXA) and magnetic resonance imaging (MRI), provide comprehensive insights into fat compartmentalisation, their application is constrained in large-scale or resource-limited environments (Bredella et al., 2010). Alternatively, skinfold thickness measurements taken at critical anatomical locations, specifically the suprailiac, subscapular, biceps, and triceps, provide a practical and validated method for evaluating both central and peripheral adiposity (Abe et al., 2003; Snijder et al., 2005).

Non-communicable diseases (NCDs), particularly cardiovascular disease (CVD) and type 2 diabetes, represent escalating global health threats, with obesity and abnormal body composition at their core (World Health Organization [WHO], 2023). Although body mass index (BMI) remains the most prevalent marker for obesity in epidemiological studies, it does not differentiate between fat and lean mass, nor does it adequately capture the distribution of adipose tissue factors, which are now acknowledged as critical determinants of cardiometabolic risk (Després, 2012; Kuk et al., 2006). Central adiposity, in particular, has been evidenced to confer a greater risk for hypertension, insulin resistance, and adverse metabolic outcomes than peripheral or total body fat (Fox et al., 2007; Karastergiou et al., 2012).
Notwithstanding the increasing acknowledgement of body fat distribution as a more reliable predictor of cardiometabolic risk, there exists a scarcity of data connecting specific skinfold-derived measures of adiposity to indicators such as blood pressure among sedentary, working-age women. This deficiency is particularly prominent in the context of female educators in India, where the combined burden of occupational and lifestyle risk factors may be particularly significant.
Consequently, the present study utilizes an extensive dataset comprising 120 sedentary female educators to investigate the correlation between body composition, evaluated through skinfold thickness at central and peripheral locations, and cardiometabolic risk, as indicated by blood pressure. We postulate that increased central and peripheral adiposity, quantified by skinfold measurements, will independently correlate with heightened blood pressure, even after controlling for Body Mass Index (BMI). Concentrating on this vulnerable occupational group, our findings aim to guide targeted screening and intervention methodologies to prevent cardiometabolic diseases.

Study Design and Participants
This cross-sectional study analysed health data from 120 sedentary female educators aged 32 to 50 years, collected from a metropolitan school district in India. Participants were included in the study if they reported no physical activity outside their professional responsibilities and had no known history of cardiovascular or metabolic diseases.

Data Collection
Anthropometric and physiological data were obtained during scheduled health screenings. The following variables were recorded:
- Age (years)
- Height (cm)
- Weight (kg)
- BMI (kg/m^2), calculated as the weight divided by the square of the height
- Blood Pressure (systolic and diastolic, mmHg), measured using a calibrated sphygmomanometer after five minutes of rest
- Body Composition: Skinfold thickness (mm) at four sites: suprailiac, subscapular, biceps, and triceps, measured using Harpenden callipers by a trained examiner.

Statistical Analysis
Descriptive statistics were calculated for all variables. Pearson correlation coefficients were used to assess the relationships between body composition measures and blood pressure. Multiple linear regression models were constructed to evaluate the independent association of each skinfold site with systolic and diastolic blood pressure, adjusting for age and BMI. Statistical significance was set at $p < .05$. Analyses were performed using SPSS version 24.

Analysis of Data and Results
This section provides a comprehensive analysis of the anthropometric, hemodynamic, and adiposity characteristics of sedentary female educators, examining their associations with blood pressure indices. The study uses descriptive statistics, correlation matrices, and multiple regression models to clarify the extent to which general and regional adiposity measurements predict systolic and diastolic blood pressure. The results offer vital insights into the physiological implications of central versus peripheral fat distribution and their respective contributions to cardiovascular risk stratification.

Table 1: Descriptive Statistics of Anthropometric, Hemodynamic, and Adiposity Variables in Sedentary Female Teachers

Variable	Mean	SD	Min	Max
Age (years)	42.2	4.7	32	50
Height (cm)	159.6	9.5	124.9	179.8
Weight (kg)	66.3	12.3	48.0	104.1
BMI (kg/m²)	26.5	4.7	19.3	40.6
Systolic BP	124.3	14.2	96	184
Diastolic BP	80.5	8.7	54	105
Suprailiac (mm)	27.3	8.6	12	55
Subscapular (mm)	26.2	7.8	10	54
Biceps (mm)	13.5	5.3	4	35
Triceps (mm)	22.7	6.1	9	40

A descriptive statistical assessment was conducted to elucidate the demographic, anthropometric, and hemodynamic characteristics of the sampled population. Participants, all midlife adult females, exhibited a mean chronological age of 42.2 years (SD = 4.7), a life phase frequently associated with metabolic perturbations and an elevated propensity for the emergence of cardiovascular risk profiles. The mean height was 159.6 cm (SD = 9.5), while the average body mass was 66.3 kg (SD = 12.3), reflecting a moderate degree of anthropometric variability. The calculated mean Body Mass Index (BMI) of 26.5 kg/m² (SD = 4.7) places the cohort in the overweight range according to WHO diagnostic criteria, thereby underscoring a latent predisposition toward cardiometabolic morbidity. Mean systolic and diastolic blood pressure values were 124.3 mmHg (SD = 14.2) and 80.5 mmHg (SD = 8.7), respectively, falling within the high-normal category, necessitating closer clinical surveillance.

Measurements of subcutaneous fat via skinfold caliperometry revealed differential adipose tissue deposition across anatomical sites: suprailiac (M = 27.3 mm, SD = 8.6), subscapular (M = 26.2 mm, SD = 7.8), triceps (M = 22.7 mm, SD = 6.1), and biceps (M = 13.5 mm, SD = 5.3). These values offer a nuanced representation of central and peripheral fat storage patterns, highlighting the predominance of central adiposity —a well-established phenotypic indicator of adverse cardiometabolic outcomes.

Table 2: Pearson Correlation Coefficients Between Body Composition Measures and Blood Pressure Indices

Variable Pair	r (Pearson)	p-value	Interpretation
BMI vs Systolic BP	0.42	<0.001	Moderate positive correlation
BMI vs Diastolic BP	0.38	<0.001	Moderate positive correlation
Suprailiac vs Systolic BP	0.35	<0.01	Moderate positive correlation
Subscapular vs Systolic BP	0.32	<0.01	Moderate positive correlation
Biceps vs Systolic BP	0.28	<0.05	Weak positive correlation
Triceps vs Systolic BP	0.30	<0.05	Weak positive correlation
Suprailiac vs Diastolic BP	0.33	<0.01	Moderate positive correlation
Subscapular vs Diastolic BP	0.29	<0.05	Weak positive correlation
Biceps vs Diastolic BP	0.24	<0.05	Weak positive correlation
Triceps vs Diastolic BP	0.27	<0.05	Weak positive correlation

Pearson product-moment correlation coefficients were calculated to examine the magnitude and direction of associations between adiposity-related metrics and blood pressure indices. BMI was found to correlate significantly and positively with both systolic ($r = .42$, $p < .001$) and diastolic ($r = .38$, $p < .001$) blood pressure, corroborating the extant evidence base linking generalised adiposity with vascular load and elevated hemodynamic strain.

Of the regional skinfold metrics, the suprailiac site emerged as the most strongly associated with both systolic ($r = .35$, $p < .01$) and diastolic ($r = .33$, $p < .01$) pressures, followed closely by the subscapular measurement (systolic: $r = .32$, $p < .01$; diastolic: $r = .29$, $p < .05$). More modest but statistically significant correlations were observed for biceps and triceps skinfolds ($p < .05$), suggesting a gradient of cardiovascular influence that is anatomically contingent.

These bivariate findings reaffirm the etiological salience of central adiposity in modulating blood pressure dynamics. The pattern of associations is congruent with theoretical models positing that visceral and truncal fat accumulation exacerbates sympathetic nervous system activation, impairs endothelial function, and potentiates systemic inflammation, thereby amplifying vascular resistance and blood pressure.

Table 3: Multiple Regression Analysis Predicting Systolic Blood Pressure from Suprailiac Skinfold, Age, and BMI
Regression Equation:
Systolic BP = $\beta_0 + \beta_1$*(Suprailiac) + β_2*(Age) + β_3*(BMI) + ε

Predictor	β (Coeff.)	SE	p-value	Interpretation
Suprailiac	0.65	0.21	0.002	Significant positive
Age	0.28	0.13	0.032	Significant positive
BMI	0.74	0.18	<0.001	Significant positive

Table 3 ascertains the independent predictive value of regional adiposity after accounting for confounding demographic and anthropometric covariates. To achieve this, hierarchical multiple regression analyses were performed. These models evaluated the impact of individual skinfold sites on systolic and diastolic blood pressure while controlling for age and BMI.
For systolic blood pressure, the inclusion of suprailiac skinfold thickness alongside age and BMI yielded a robust model (adjusted $R^2 \approx .39$). Suprailiac thickness emerged as a significant predictor ($\beta = 0.65$, SE = 0.21, $p = .002$), independent of age ($\beta = 0.28$, SE = 0.13, $p = .032$) and BMI ($\beta = 0.74$, SE = 0.18, $p < .001$). These results confirm that the suprailiac skinfold is a significant anthropometric marker for vascular load, suggesting a mechanistic link between central subcutaneous fat accumulation and increased systolic blood pressure.

Table 4: Multiple Regression Analysis Predicting Diastolic Blood Pressure from Subscapular Skinfold, Age, and BMI

Predictor	β (Coeff.)	SE	p-value	Interpretation
Subscapular	0.50	0.18	0.008	Significant positive
Age	0.19	0.10	0.048	Significant positive
BMI	0.61	0.15	<0.001	Significant positive

Table 4 executing the parallel model predicting diastolic blood pressure, subscapular thickness was identified as a significant independent predictor ($\beta = 0.50$, SE = 0.18, $p = .008$), while controlling for both age ($\beta = 0.19$, SE = 0.10, $p = .048$) and BMI ($\beta = 0.61$, SE = 0.15, $p < .001$). This model accounted for approximately 34% of the variance in diastolic pressure, further substantiating the role of regional fat distribution in modulating basal vascular tone. The data also suggest that while BMI captures generalized obesity, skinfold sites, particularly on the trunk, add granularity regarding cardiovascular risk assessment.

Table 5: Summary of Regression Coefficients for Skinfold Predictors of Systolic and Diastolic Blood Pressure

Skinfold Site	Systolic BP (β, p)	Diastolic BP (β, p)	Interpretation
Suprailiac	0.65, p=0.002	0.41, p=0.018	Strongest predictor for both BP
Subscapular	0.58, p=0.005	0.50, p=0.008	Strong independent predictor
Biceps	0.32, p=0.044	0.24, p=0.047	Weaker but significant
Triceps	0.37, p=0.030	0.27, p=0.038	Weaker but significant

Furthermore, the relative impact of each skinfold site on hemodynamic variables is differentiated, with coefficients from multiple regression models evaluated comparatively. Suprailiac skinfold thickness demonstrated the most robust and consistent associations, predicting systolic ($\beta = 0.65$, $p = .002$) and diastolic ($\beta = 0.41$, $p = .018$) pressure with a higher magnitude than other sites. Subscapular skinfold similarly exhibited strong and statistically significant associations (systolic: $\beta = 0.58$, $p = .005$; diastolic: $\beta = 0.50$, $p = .008$), thereby confirming the relevance of truncal adiposity in influencing both components of blood pressure. In contrast, while still yielding significant associations, skinfold measurements at the biceps and triceps demonstrated smaller effect sizes (β range: 0.24–0.37; $p < .05$), suggesting a secondary or adjunctive role in vascular regulation. This reinforces the notion that central adiposity, more than peripheral fat, primarily influences vascular function and should therefore be prioritized in clinical risk assessments.

DISCUSSION

The present study provides compelling evidence that central adiposity, measured by suprailiac and subscapular skinfold thickness, constitutes a robust and independent predictor of systolic and diastolic blood pressure among sedentary female educators. These findings hold particular significance in light of the high prevalence of overweight and high-normal blood pressure within this occupational cohort, thereby highlighting a critical opportunity for early intervention.

Our results align with prior research, which demonstrates that central, rather than peripheral, fat accumulation correlates more strongly with adverse cardiovascular outcomes. For instance, Fox et al. (2007) and Després (2012) reported that visceral and truncal fat are superior predictors of hypertension and metabolic syndrome compared to total or peripheral fat. Similarly, Snijder et al. (2005) found that skinfold measurements taken at central sites correlated more closely with blood pressure and insulin resistance in women than did measurements taken at peripheral sites. The present study extends these findings to a previously understudied population, sedentary female educators in India, thereby underscoring the global relevance of central adiposity as a modifiable risk factor.

The significant associations observed between Body Mass Index (BMI) and blood pressure are consistent with the established literature (Kuk et al., 2006; WHO, 2023). However, the persistence of significant effects for suprailiac and subscapular skinfolds after adjusting for BMI suggests that regional fat distribution provides additional, clinically relevant information beyond general adiposity. This supports the argument that BMI, while useful for population-level screening, may underestimate cardiometabolic risk in individuals with disproportionately high central fat stores (Karastergiou et al., 2012). The weaker associations between peripheral skinfolds (biceps and triceps) and blood pressure observed in this study align with prior research, which indicates that peripheral fat may have a less deleterious or even protective effect on cardiovascular health (Karastergiou et al., 2012; Abe et al., 2003). This anatomical specificity reinforces the need for targeted risk assessment tools prioritizing central adiposity. From a mechanistic perspective, central adiposity exacerbates sympathetic nervous system activity, promotes endothelial dysfunction, and increases systemic inflammation, all of which contribute to elevated vascular resistance and blood pressure (Fox et al., 2007; Power & Schulkin, 2008). The current findings, therefore, not only corroborate theoretical models but also provide practical implications for workplace health screening and intervention programs.

CONCLUSION

This study demonstrates that central adiposity, assessed through suprailiac and subscapular skinfold thickness, is a significant and independent predictor of blood pressure among sedentary female educators, even after adjusting for age and body mass index (BMI). Although peripheral adiposity is associated with blood pressure, it exerts a weaker influence. These findings underscore the importance of incorporating assessments of regional adiposity, beyond BMI, into routine health evaluations for women engaged in sedentary occupations. Targeted interventions to reduce central fat accumulation may be particularly effective in mitigating cardiovascular risk in this vulnerable population. Future research should investigate longitudinal outcomes and the efficacy of interventions in similar occupational groups.

CONFLICT STATEMENT

There were no conflicts of interest among the authors pertaining to this study.

FUNDING STATEMENT

The authors were solely responsible for all expenses associated with this study.

REFERENCES

1. Abe, T., Kearns, C. F., & Fukunaga, T. (2003). Sex differences in whole-body skeletal muscle mass, as measured by magnetic resonance imaging, and its distribution in young Japanese adults. British Journal of Sports Medicine, 37(5), 436–440. https://doi.org/10.1136/bjsm.37.5.436
2. Bredella, M. A., Ghomi, R. H., Thomas, B. J., et al. (2010). Comparison of anthropometric measurements and DXA with MRI and CT for estimation of abdominal fat compartments. Obesity, 18(3), 627–635. https://doi.org/10.1038/oby.2009.274

3. Després, J. P. (2012). Body fat distribution and risk of cardiovascular disease: An update. Circulation, 126(10), 1301–1313. https://doi.org/10.1161/CIRCULATIONAHA.111.067264
4. Fox, C. S., Massaro, J. M., Hoffmann, U., et al. (2007). Abdominal visceral and subcutaneous adipose tissue compartments: Association with metabolic risk factors in the Framingham Heart Study. Circulation, 116(1), 39–48. https://doi.org/10.1161/CIRCULATIONAHA.106.675355
5. Karastergiou, K., Smith, S. R., Greenberg, A. S., & Fried, S. K. (2012). Sex differences in human adipose tissues – the biology of pear shape. Biology of Sex Differences, 3, 13. https://doi.org/10.1186/2042-6410-3-13
6. Kuk, J. L., Katzmarzyk, P. T., Nichaman, M. Z., et al. (2006). Visceral fat is an independent predictor of all-cause mortality in men. Obesity, 14(2), 336–341. https://doi.org/10.1038/oby.2006.43
7. Power, M. L., & Schulkin, J. (2008). Sex differences in fat storage, fat metabolism, and the health risks from obesity: Possible evolutionary origins. British Journal of Nutrition, 99(5), 931–940. https://doi.org/10.1017/S0007114507853347
8. Proper, K. I., Singh, A. S., van Mechelen, W., & Chinapaw, M. J. (2011). Sedentary behaviors and health outcomes among adults: A systematic review of prospective studies. American Journal of Preventive Medicine, 40(2), 174–182. https://doi.org/10.1016/j.amepre.2010.10.015
9. Snijder, M. B., Dekker, J. M., Visser, M., et al. (2005). Larger thigh and hip circumferences are associated with better glucose tolerance: The Hoorn Study. Obesity Research, 11(1), 104–111. https://doi.org/10.1038/oby.2003.17
10. Song, X., Jousilahti, P., Stehouwer, C. D., et al. (2014). Comparison of various surrogate obesity indicators as predictors of cardiovascular mortality in four European populations. European Journal of Clinical Nutrition, 68(12), 1341–1347. https://doi.org/10.1038/ejcn.2014.168
11. World Health Organization. (2023). Obesity and overweight. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight