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Original Research Article

Prevalence and Associated Risk Factors of Prehypertension among Young College Women in South Kerala: A Cross-Sectional Study

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Conflict of interest: Nil

Abstract:

Background: Prehypertension is an early indicator of future hypertension and cardiovascular morbidity. Young women, despite being considered a low-risk group, are increasingly exposed to lifestyle factors that predispose them to elevated blood pressure. Early identification of prehypertension and its correlates is crucial for initiating preventive strategies in this population.

Methods: A cross-sectional study was conducted among 334 college-going women aged 18–22 years in Pathanamthitta district, Kerala, from December 2017 to May 2019. Participants were selected through multistage cluster sampling. Data on sociodemographic factors, dietary habits, physical activity, and family history were collected using a semi-structured questionnaire. Anthropometric measurements and blood pressure were recorded using standard procedures. Prehypertension was defined as systolic BP 120–139 mmHg and/or diastolic BP 80–89 mmHg (JNC-8). Data were analyzed using chi-square and t-tests, with $p < 0.05$ considered statistically significant.

Results: The prevalence of prehypertension was 40.7% among the study participants. A total of 56% reported a family history of hypertension. Prehypertension showed a significant association with certain dietary factors, including frequent consumption of fish, eggs, and vegetables, while no significant associations were observed with socioeconomic status, family type, or marital status. Although 33.2% of participants had a moderate risk of future type 2 diabetes mellitus (based on IDRS), no significant association was found between prehypertension and diabetes risk.

Conclusion: The high prevalence of prehypertension among young college women in South Kerala highlights the urgent need for targeted lifestyle interventions, regular screening, and awareness programs. Early risk modification may help prevent the progression of hypertension and reduce long-term cardiovascular burden.

Keywords: Prehypertension, Young Women, Blood Pressure, Risk Factors, Kerala, Cross-Sectional Study, College Students.

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Introduction

Non-communicable diseases (NCDs), especially cardiovascular diseases, are rising sharply in India, in part due to changing lifestyles among younger populations.[1] Prehypertension, defined as systolic blood pressure of 120–139 mmHg or diastolic BP of 80–89 mmHg, is a crucial precursor to hypertension and is associated with an elevated risk of future cardiovascular disease.[2] Large-scale surveys in India have documented that prehypertension is highly prevalent: for example, the National Family Health Survey-5 (NFHS-5) reported a national prehypertension prevalence of approximately 33.7%, with clear sociodemographic and behavioural determinants.[3]

In Kerala, a recent study of young adults aged 20–39 found that 33.3% had prehypertension, while 11.2% already had hypertension; women had significantly lower rates of hypertension compared with men, but elevated BP in young women remains a concern.[4] Among adolescents in rural Kerala, a school-based study showed that 24.5% had prehypertension, with risk factors including overweight/obesity, low fruit consumption, and high soft drink intake.[5] These data suggest that elevated blood pressure begins early in life and that modifiable lifestyle factors might already be operating in younger age groups.

In female college students, anthropometric risk factors such as higher BMI, waist circumference, and waist–hip ratio are strongly associated with elevated blood pressure. A study in a pre-university girls' college in Bengaluru found significant associations between obesity measures and prehypertension.[6] Moreover, national analyses have shown that women with higher education may paradoxically have relatively high odds of

prehypertension, highlighting complex gender- and socioeconomic-based determinants.[3]

Despite their vulnerability, young college women in Kerala have received little attention in BP-screening research. Understanding the prevalence of prehypertension and its correlates in this group is essential for guiding early preventive interventions.

Aims and Objectives: The present study aims to determine the burden of prehypertension and its associated risk factors among young college women in South Kerala. Specifically, it seeks to estimate the prevalence of the prehypertension as well as the prevalence of risk of the type II diabetes mellitus in this population, and to assess the association between prehypertension and type II diabetes risk. Additionally, the study intends to examine how prehypertension and diabetes risk are influenced by socio-demographic characteristics, dietary habits, physical activity levels, and family history of non-communicable diseases, thereby providing essential evidence to guide early preventive strategies for this vulnerable age group.

Materials and Methods

Study Design: This cross-sectional study was conducted among young women aged 18–22 years enrolled in colleges located in the Pathanamthitta district of South Kerala. Data collection was carried out over an eighteen-month period from December 2017 to May 2019. The study design enabled the assessment of the prevalence of prehypertension and associated risk factors, including type II diabetes mellitus risk, as well as relevant socio-demographic, lifestyle, and family history variables at a single point in time within the target population.

Inclusion and Exclusion Criteria: The study included young women aged 18–22 years who were currently enrolled in colleges within the Pathanamthitta district of South Kerala, had been residing in the district for at least one year, and provided informed consent to participate. Women were excluded if they were previously diagnosed with hypertension or diabetes mellitus, were pregnant at the time of data collection, or declined voluntary participation.

Sample Size Calculation: Figures from a previous study have shown a prevalence of prehypertension among young women to be 36.5%. [7] Taking a confidence level of 95% and allowable error as 20% of prevalence,

Sample size is calculated as 167 using the following formula

$$n = \frac{Z^2_{1-\alpha/2} * p\,(1-p)}{d^2}$$

Where, n=sample size

Z21-α/2=3.84

p=prevalence=0.365, q=1-p=0.635

d=allowable error=20% of p=0.073

The multistage cluster sampling method was used to calculate and select the required study participants.[8]

Design effect (DEFF) is calculated using the following formula:[9]

DEFF = 1 + ρ (m – 1),

Where:

- ρ = intracluster correlation for the statistic [10]
- m = average size of the cluster.

Here, ρ is taken as 1/6 and m=7

DEFF = 2

Thus, sample size obtained was 167*2=334, which was the minimum sample size for the study.

Data Collection Tools: Data were collected using a pilot-tested semi-structured questionnaire to obtain information on socio-demographic characteristics, dietary habits, substance use, physical activity, and family history, which was administered in English as it was easily comprehensible to the college students. Socioeconomic status was assessed using the Modified Kuppuswamy Scale (as per the 2017 Consumer Price Index), while the risk of type II diabetes mellitus was evaluated using the Indian Diabetes Risk Score (IDRS) developed by Mohan et al. Anthropometric measurements were obtained using a standard Sknol weighing scale for weight and a non-stretchable measuring tape to record height, waist circumference, and hip circumference. Body mass index (BMI) was calculated according to WHO criteria, and waist–hip ratio was computed to categorize central obesity. Blood pressure was measured using a calibrated mercury sphygmomanometer (Elkometer) following standard guidelines; two readings taken five minutes apart were averaged for accuracy. All measurements were performed by the principal investigator to minimize inter-observer variation.

Data Collection Procedure: Following approval from the institutional research and ethics committee and permissions from the participating colleges, written informed consent was obtained from all participants. Data were collected using a pilot-tested semi-structured questionnaire to obtain socio-demographic details, lifestyle factors, and family history. Anthropometric measurements were then recorded, with weight measured to the nearest 100 g using a calibrated weighing machine and height measured to the nearest 0.5 cm with participants standing upright against a flat wall. Blood pressure was measured under standard conditions: participants were seated comfortably with their back

supported, legs uncrossed, and their right arm bared and positioned at heart level. Using an appropriately sized cuff, systolic pressure was intially estimated by the palpatory method, followed by systolic and diastolic measurements using the auscultatory method. The first and last audible Korotkoff sounds were recorded as systolic and diastolic pressures, respectively, to the nearest 2 mmHg. Three readings were taken at least three minutes apart, and the average of these measurements was used for analysis.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Categorical variables were summarized using frequencies and percentages, while quantitative variables were presented as mean and standard deviations. Associations between categorical variables were assessed using the Chi-square test, and differences in quantitative variables were evaluated using the independent sample t-test. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

Table 1: Sociodemographic Profile of Study Participants (n = 334)

Variable	Categories	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	19.90 ± 1.27	—
Religion	Hindu	71	21.3
	Muslim	7	2.1
	Christian	256	76.6
Marital Status	Unmarried	331	99.1
	Married	3	0.9
Family Type	Nuclear	294	88.0
	Joint	40	12.0
Socioeconomic Class	Upper	12	3.6
	Upper Middle	62	18.6
	Lower Middle	133	39.8
	Upper Lower	127	38.0
	Lower	0	0

Table 1 shows the basic sociodemographic characteristics of the 334 young women studied. Most were unmarried, from nuclear families, and belonged to lower-middle socioeconomic clas

Table 2: Lifestyle Factors and Dietary Habits

Variable	Categories	n (%)
Diet Preference	Vegetarian	23 (6.9)
	Non-vegetarian	311 (93.1)
Frequency of Fish Intake	≥5 times/week	99 (29.6)
Egg Consumption	≥1 per week	290 (86.8)
Tea/Coffee Intake	≥7 times/week	188 (56.3)
Carbonated Drinks	None	221 (66.2)
Extra Salt Use	Yes	123 (36.8)
Extra Sugar Use	Yes	36 (10.8)
Oil Used	Coconut oil	231 (69.2)

Table 2 illustrates the dietary and lifestyle patterns of participants. A large majority were non-vegetarians and had high intake of tea/coffee, coconut oil, extra salt, and frequent bakery use-factors potentially contributing to elevated BP.

Table 3: Physical Activity and Family History

Variable	Category	n (%)
Physical Activity	No Exercise	27 (8.1)
	Mild	147 (44.0)
	Moderate	149 (44.6)
	Vigorous	11 (3.3)
Family History of Hypertension	Present	187 (56.0)
Family History of Diabetes	Present	166 (49.7)

Table 3 shows that nearly half of the participants engaged in mild to moderate physical activity, while more than half had a family history of hypertension-a key risk factor.

Table 4: Anthropometric Characteristics

Variable	Mean ± SD
Height (cm)	158.77 ± 6.36
Weight (kg)	53.86 ± 10.49
BMI (kg/m²)	21.33 ± 3.73
Waist Circumference (cm)	71.47 ± 9.30
Hip Circumference (cm)	89.50 ± 8.67
Waist-Hip Ratio	0.79 ± 0.05

Table 4 indicates normal average anthropometric measures; however, central adiposity indicators such as WC and WHR may still contribute to elevated BP risk.

Table 5: Blood Pressure Classification (JNC-8)

BP Category	Systolic BP (%)	Diastolic BP (%)
Normal	74.6	62.9
Prehypertension	24.9	31.7
Stage 1 HTN	0.6	5.4
Stage 2 HTN	0	0

Table 5 shows that prehypertension was common, affecting nearly one-fourth by systolic criteria and one-third by diastolic criteria.

Table 6: Prevalence of Prehypertension and Diabetes Risk (IDRS)

Variable	Category	n (%)
Prehypertension (combined definition)	Present	136 (40.7)
	Absent	198 (59.3)
Diabetes Risk (IDRS)	Low Risk	223 (66.8)
	Moderate Risk	111 (33.2)

Table 6 demonstrates the key finding: 40.7% of college women had prehypertension, highlighting significant early cardiovascular risk.

Table 7: Significant Associations with Prehypertension

Variable	Comparison	p-value	Interpretation
Fish consumption	≥5 times/week vs ≤4/week	**<0.05**	Significant
Egg consumption	≥1/week	**<0.05**	Significant
Vegetable intake	Daily	**<0.05**	Significant
Diabetes risk (IDRS)	Low vs Moderate	0.170	Not significant
Marital status	Married vs Unmarried	NS	Not significant
SES	Upper vs Lower	NS	Not significant
Physical activity	Vigorous/moderate/mild	NS	Not significant

Table 7 highlights variables significantly associated with prehypertension—especially certain dietary patterns (fish, eggs, vegetables). No significant relationships were found with socioeconomic status, marital status, or diabetes risk.

Discussion

The present cross-sectional study assessed the prevalence of prehypertension and associated risk factors among young college women aged 18–22 years in South Kerala. The overall prevalence of prehypertension observed in this study was 40.9%, indicating that nearly two out of every five young women already falls into a higher-risk blood pressure category. This finding is comparable to previous studies conducted in Kerala and other parts of India.

Similar prevalence levels have been reported among adult women in Kerala, such as the study by Mallika et al. which found a prevalence of 41.1% among female adults in Thiruvananthapuram. [11] Likewise, a household survey conducted in Trivandrum by Vimala et al. reported a significantly higher prevalence of 56% among women,[12] which aligning with the upward trend seen in Kerala. The similarity in prevalence across studies suggests that prehypertension is a growing concern among women in this region.

In the present study, consumption of fish, eggs, and vegetables showed statistically significant associations with prehypertension. These findings are consistent with the coastal lifestyle and dietary patterns in South India, where similar associations were found by Kini et al. in Udupi, Karnataka, reporting a prevalence of 43.4% among females aged 20–24 years.[7] The similarity in coastal dietary habits may explain the similarity of these findings.

Anthropometric indicators such as BMI, waist circumference, and waist-hip ratio were significantly higher among prehypertensive participants. This aligns with findings from a study among young female medical students in Wardha, where 58% were found to be prehypertensive, with BMI and central obesity significantly associated with elevated blood pressure.[13] However, some large-scale studies such as Yadav et al. reported BMI, WHR, and impaired glucose tolerance as independent predictors of prehypertension,[14] which were not consistently identified in the present study.

A significant proportion of the participants also exhibited moderate risk for future type 2 diabetes mellitus (T2DM), with 33.2% falling into this category. Studies conducted in Delhi,[15] North India,[16] and Chennai [17] have reported similar associations between diabetes risk scores, family history of diabetes, BMI, and physical inactivity-factors that were also found to have statistical significance in the present study. However, unlike some studies, no association was found between marital status or education and diabetes risk in this sample.

Several studies have shown that individuals with prehypertension are at higher risk of progressing to hypertension and developing cardiometabolic complications including diabetes mellitus. [18,19] Although the present study did not identify a statistically significant association between prehypertension and diabetes risk, the slight increase in moderate diabetes risk among prehypertensive participants indicates early metabolic disturbances that may require attention. Early identification and lifestyle modification in this age group could delay or prevent future complications.

The findings highlight the growing burden of prehypertension and metabolic risk among young women. Considering that this age group represents the future workforce, timely interventions focusing on healthy lifestyle habits-such as diet modification, increased physical activity, and regular screening-are essential to reduce long-term cardiovascular morbidity.

Limitations

The present study has several limitations that should be considered when interpreting the findings. First, the study was conducted in only a few colleges in the Pathanamthitta district because several institutions did not consent to participate, which may limit the generalizability of the results to all young college women in South Kerala. The use of a non-validated questionnaire and the limited assessment of dietary intake-captured only as frequency rather than quantity-may have contributed to the inability to detect traditional risk factors such as high consumption of red meat, salt, and sugar. Furthermore, the cross-sectional design restricts causal inference between identified variables and prehypertension. The reliance on self-reported data and the recording of dietary habits on a weekly basis may also introduce recall bias. Additionally, the absenteeism of some students on the day of data collection may have led to selection bias, further affecting the representativeness of the sample.

Conclusion

In this study, 40.9% of young college women in South Kerala were found to be prehypertensive, and one-third were at moderate risk for developing type 2 diabetes, underscoring a substantial cardiometabolic vulnerability in this population. While no significant association was observed between prehypertension and diabetes risk, prehypertension showed significant links with certain dietary patterns, and diabetes risk was associated with egg consumption, physical activity, family history, and BMI. These findings highlight the urgent need for early screening and targeted lifestyle interventions among young women to reduce long-term cardiovascular and metabolic risks.

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