RESEARCH PAPER

Prevalence and Predictors of Cardiometabolic Risk in Southern Indian Medical Students: A Cross-Sectional Study at a Tertiary Care Teaching Hospital

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ABSTRACT

Background: Cardiometabolic risk factors, such as obesity, hypertension, dyslipidaemia, and insulin resistance, are becoming increasingly prevalent among young adults, including college students. This demographic is particularly vulnerable due to lifestyle changes and stress associated with academic pressures.

Objective: This study aims to determine the prevalence of cardiometabolic risk factors among college students and explore the associations with lifestyle behaviours and demographic characteristics.

Methods: A cross-sectional study was conducted with a sample of 215 college students aged 20-27 years from multiple universities. Data collection involved anthropometric measurements, blood pressure assessments, blood tests for glucose and lipid profiles, and a detailed questionnaire on dietary habits, physical activity, alcohol and tobacco use, and socioeconomic background. Data analyzed using descriptive statistics and logistic regression to identify significant predictors and to assess the prevalence and correlations between cardiometabolic risk factors and lifestyle behaviours.

Results: The study revealed a significant prevalence of cardiometabolic risk factors among college students. Obesity was identified in 41% of the participants, while 17% had hypertension. Elevated fasting blood glucose levels were found in 10 % of the cohort, and dyslipidaemia was present in 20%. Insulin resistance was detected in 12 % of the students. Poor dietary habits, lack of physical activity, high alcohol consumption, and smoking were significantly correlated with the presence of multiple cardiometabolic risk factors. Male students exhibited higher prevalence rates compared to female students.

Conclusion: The high prevalence of cardiometabolic risk factors among college students underscores the need for comprehensive health promotion strategies within the university setting. Interventions focusing on improving dietary habits, increasing physical activity, and reducing harmful behaviours like smoking and excessive alcohol consumption are crucial to mitigating long-term health risks.

Keywords: Cardiometabolic risk factors, college students, obesity, hypertension, dyslipidaemia, insulin resistance, lifestyle behaviours.

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INTRODUCTION

Cardiometabolic risk factors, including obesity, hypertension, dyslipidaemia, and insulin resistance, are increasingly being recognized among young adults worldwide.[1] These risk factors significantly contribute to the development of cardiovascular diseases and type 2 diabetes, which remain leading causes of morbidity and mortality.[2,3] In recent years, there has been a noticeable shift in the age of onset of these conditions, with younger populations being affected due to changes in lifestyle patterns.

College students represent a unique and vulnerable group, as they often undergo substantial lifestyle transitions during their academic years. Irregular dietary habits, reduced physical activity, increased screen time, and exposure to stress can collectively predispose them to metabolic disturbances. [4,5] Additionally, behaviours such

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as smoking and alcohol consumption may further aggravate these risks.

In the Indian context, rapid urbanization and adoption of westernized lifestyles have accelerated the emergence of non-communicable diseases among younger individuals.[6,7] Despite this, limited data are available regarding the burden of cardiometabolic risk factors among college students, particularly in South India. Assessing these risks at an early stage is essential for implementing timely preventive strategies.

Early identification of cardiometabolic abnormalities in young individuals is of great clinical importance, as many of these risk factors remain asymptomatic in the initial stages and often go unnoticed. If not addressed at an early stage, they may progress to overt cardiovascular disease and diabetes in later life.[8,9] Screening in college settings provides an opportunity to detect these risk factors early and initiate appropriate lifestyle modifications. Furthermore, understanding the relationship between behavioural patterns and metabolic risk can help in designing targeted interventions aimed at promoting long-term health among students.

Therefore, the present study was undertaken to evaluate the prevalence of cardiometabolic risk factors among college students in Southern India and to examine their association with lifestyle practices and demographic characteristics.

AIMS AND OBJECTIVES

Aim: To assess the prevalence of common cardiovascular risk factors among college students in Southern India.

Objectives:

- To evaluate the prevalence of smoking, alcohol intake, junk food consumption, physical inactivity, sedentary behavior, obesity, HT, dyslipidemia & insulin resistance.
- To compare the prevalence of these risk factors across gender.
- To analyze the association between these risk factors & preexisting conditions such as HT & obesity among medical students

MATERIALS AND METHODS

A cross-sectional study design was used to assess the cardio metabolic risk factors among college youth belonging to Southern India. The study was conducted over a period of 10 months after obtaining ethical approval. Of the 298 students 215 students (male126, female 89) from multiple universities consented to participate in the study. In the present study a detailed questionnaire was formulated to collect the background information, anthropometric data and medical history. The consumption pattern of foods, physical activity and diabetes risk was also assessed among the youth. Blood test was carried out to collect information regarding FBS, Lipid Profile, apo A, apo B, hs-CRP, and HOMA IR.

Ethical committee approval: Consent of the ethical committee was acquired prior to conducting the study [MMCH & RI IEC/PG/20/NOV/24]. A written consent was also acquired from the subjects.

Statistical analysis: The data was entered into excel and then analyzed using Microsoft excel (2021) and SPSS (IBM SPSS statistics v29). Mean, standard deviation and percentages were calculated for all parameters that were exposed numerically.

RESULTS

Socio-demographic characteristics: Out of the total 298, 215 students (male126, female 89) studying in multiple universities of Southern India and residing in the hostels of the university consented to participate in the study.[Fig.1] Majority of the population i.e. 68.53% were from [Northern India] Delhi, Gujarat, Maharashtra, and Himachal Pradesh and other students were from [Eastern India] West Bengal, Bihar, and Jharkhand (14.09%), [Central India] Madhya Pradesh and Chhattisgarh (6.74%), [Western India] Rajasthan (4.01%), [Northeastern India] Assam, Nagaland, and Meghalaya (6.63%).

Majority of the subjects 84.89% were enrolled in graduation courses in the university, 12.83% were doing their post-graduation and only 2.29% subjects were doing diploma.[Fig.2] All the subjects were unmarried and almost half of the population (56.66%) lived in nuclear family set up and 38.35% were living in a joint family. Other 5.65% of the subjects were found to be living in extended family.

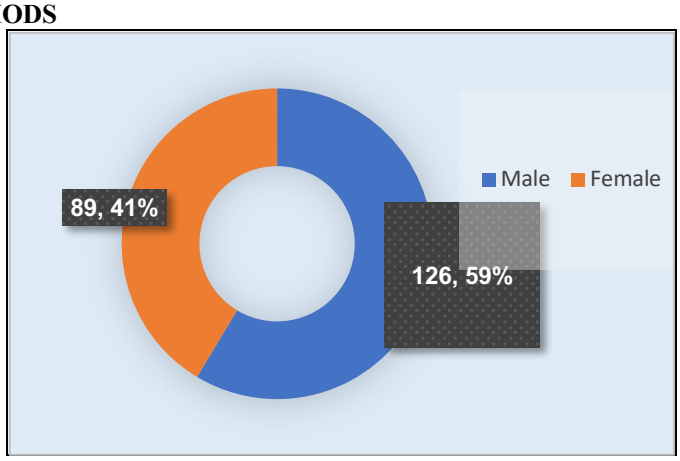

Fig.1: Gender Distribution of Study Participants

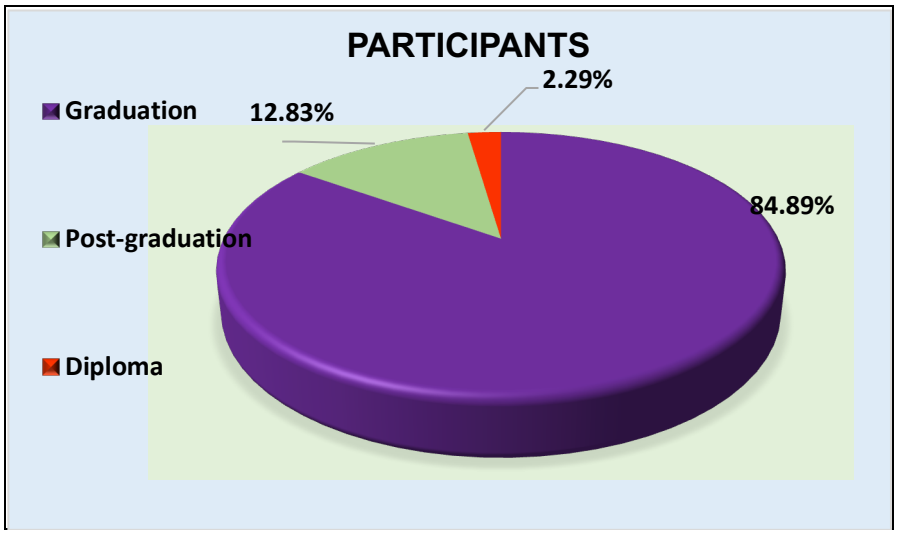

Fig.2: Educational Qualification of Study Participants

It was seen that 44.27% subjects were falling under upper class family and 38.64% were belonged to upper middle class family. The remaining 9.73%, 6.54% and 2.31% subjects were belonging to middle class, lower middle class and lower class respectively. Family history of diseases among the subjects: Information regarding the family history of diseases among the subjects showed that the family history was highest for diabetes mellitus (37.15%) followed by hypertension (29.08%). The prevalence of cancer, hypo/hyperthyroidism, coronary heart diseases (CHD) were 3.42%, 6.24% and 5.17% respectively. Other diseases prevailed among the subjects were asthma (12.76%), stroke (9.56%) etc.

The current and past addiction pattern of the subjects was taken. The current addiction of cigarette smoking was highest (15.62%) followed by alcohol consumption (13.84%). Addiction of tea and coffee was also found to prevail among the subjects covering 9.65% and 12.42% of the total population. The past addiction of alcohol (3.14%) and cigarette (4.68%) was also seen among the subjects.

Table 1: Anthropometric, bio-physical and biochemical characteristics of the subjects (Mean±SD)

Variables	Mean	SD
BMI (Kg/m2)		
Men	22.75	3.25
Women	23.00	4.00
WC (cm)		
Men	83.00	7.70
Women	80.50	10.90
WHR		
Men	0.90	0.06
Women	0.92	0.12
SBP (mmHg)	121.00	11.10
DBP (mmHg)	82.50	8.30
FBS (mg/dl)	81.50	7.10
Insulin (µIU/ml)	9.20	6.80
HOMA IR	1.18	0.88
Triglyceride (mg/dl)	104.00	57.00
Cholesterol (mg/dl)	168.00	30.00
HDL Cholesterol (mg/dl)		
Men	44.00	8.10
Women	52.00	10.30
LDL Cholesterol (mg/dl)	101.00	26.50
VLDL Cholesterol (mg/dl)	21.50	11.80
AIP	0.32	0.27
Apoa 1 (g/L)	1.36	0.20
Apob (g/L)	0.84	0.22

Table 1 presents the mean (± SD) values of various anthropometric, biophysical, and biochemical parameters among the study subjects. The BMI values were comparable between men (22.75 ± 3.25 kg/m²) and women (23.00 ± 4.00 kg/m²), with men showing slightly higher waist circumference (83.00 ± 7.70 cm) compared to women (80.50 ± 10.90 cm). Interestingly, the waist-hip ratio was higher in women (0.92 ± 0.12) than in men (0.90 ± 0.06), which may reflect gender-specific fat distribution patterns. The average systolic and diastolic blood pressures were within normal limits, at 121.00 ± 11.10 mmHg and 82.50 ± 8.30 mmHg, respectively. Fasting blood glucose (81.50 ± 7.10 mg/dl) and HOMA-IR (1.18 ± 0.88) indicate preserved insulin sensitivity in the cohort. Lipid profile analysis showed average triglycerides at 104.00 ± 57.00 mg/dl, total cholesterol at 168.00 ± 30.00 mg/dl, and LDL-C at 101.00 ± 26.50 mg/dl. Notably, HDL-C levels were higher in women (52.00 ± 10.30 mg/dl) compared to men (44.00 ± 8.10 mg/dl), suggesting a more favorable lipid profile in women. The Atherogenic Index of Plasma (AIP) was 0.32 ± 0.27, within the moderate-risk range. Additionally, levels of Apo a1 (1.36 ± 0.20 g/L) and Apo b (0.84 ± 0.22 g/L) further contribute to cardiovascular risk assessment.)

Table 2: Prevalence of obesity among the subjects as per Asia Pacific BMI criteria, 2004

Category	BMI(kg/m2)	Male (n=126) %	Female (n=89) %	Total(n=215) %
Underweight	<18.5	11 (8.73)	9 (10.11)	20 (9.30)
Normal	18.5 – 22.9	67 (53.17)	45(50.56)	112 (52.09)
Overweight	23 – 24.9	22 (17.46)	21 (23.59)	43 (20.00)
Obese	≥ 25	26 (20.63)	14 (15.73)	40 (18.60)

Table 2 illustrates the distribution of BMI categories among the study subjects based on the Asia Pacific criteria (2004). The majority were in the normal BMI range (52.09%), followed by overweight (20.00%) and obese individuals (18.60%). A small proportion were underweight (9.30%). Notably, the prevalence of obesity (20.63%) exceeds that of females (15.73%), indicating a higher vulnerability to CVD-related complications in the male population.

Table 3: Prevalence of abdominal obesity among the subjects (NCEP ATP III criteria, 2001)

Parameters	Cut Offs)		Male (n=126) %	Female (n=89) %	Total (n=215) %
	Male	Female			
WC	≥ 90cm	≥ 80cm	45 (35.71)	38(42.69)	83 (38.60)
WHR	≥ 0.90	≥ 0.85	88 (69.84)	69 (77.52)	157 (73.02)

Table 3 presents the prevalence of abdominal obesity based on NCEP ATP III criteria (2001). Using waist circumference (WC) cut-offs, 38.60% of subjects were identified with abdominal obesity, with higher prevalence among females (42.69%) than males (35.71%). Based on waist-hip ratio (WHR), the prevalence was notably higher at 73.02%, and was more common in females (77.52%) compared to males (69.84%). Individuals with elevated WC and WHR, particularly females, are at higher risk for cardiovascular disease (CVD).

Table 4: Physical activity profile of the subject

Category	Cut Offs)	Male (n=126) %	Female (n=89) %	Total (n=215) %
Sedentary	<600 MET minutes/week	17 (13.49)	41(46.06)	58 (26.97)
Moderate	600–3000 MET minutes/week	53 (42.06)	46 (51.68)	99 (46.04)
Heavy	>3000 MET minutes/week	56(44.44)	2 (2.24)	58 (26.97)

Table 4 presents the physical activity profile of the study subjects based on MET minutes/week. The majority of males (44.44%) engaged in heavy physical activity (>3000 MET minutes/week), while females (46.06%) were predominantly sedentary (<600 MET minutes/week). Overall, 26.97% of participants were sedentary, and 46.04% engaged in moderate physical activity. Sedentary individuals, particularly females (46.06%), are more likely to be at increased risk for cardiovascular disease (CVD) due to the lack of regular physical activity, which is a significant risk factor for CVD.

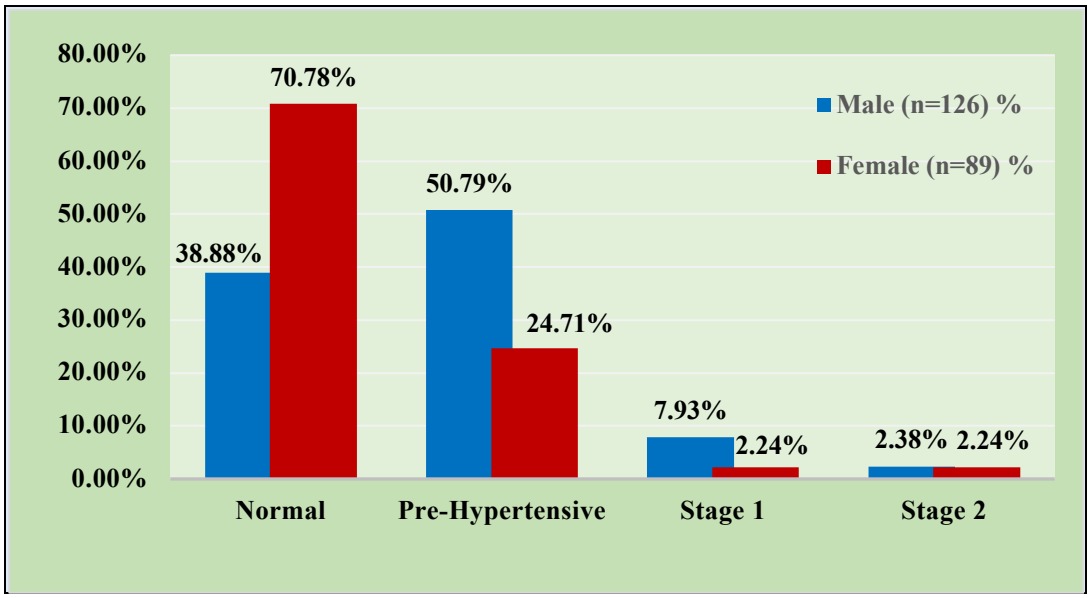

Fig 3: Prevalence of Hypertension [2001 NCEP ATP III Criteria]

Fig. 3 shows the gender-based distribution of prehypertension and hypertension, highlighting the increased risk of cardiovascular disease (CVD). Prehypertension was found in 40% of the population, with 5.58% having stage 1 hypertension and 2.32% stage 2 hypertension. Males had a higher prevalence of prehypertension (50.79%) and stage 1 hypertension (7.93%), indicating a greater CVD risk compared to females (24.71% and 2.24%, respectively). Stage 2 hypertension was similar across genders, with males at 2.38% and females at 2.24%.

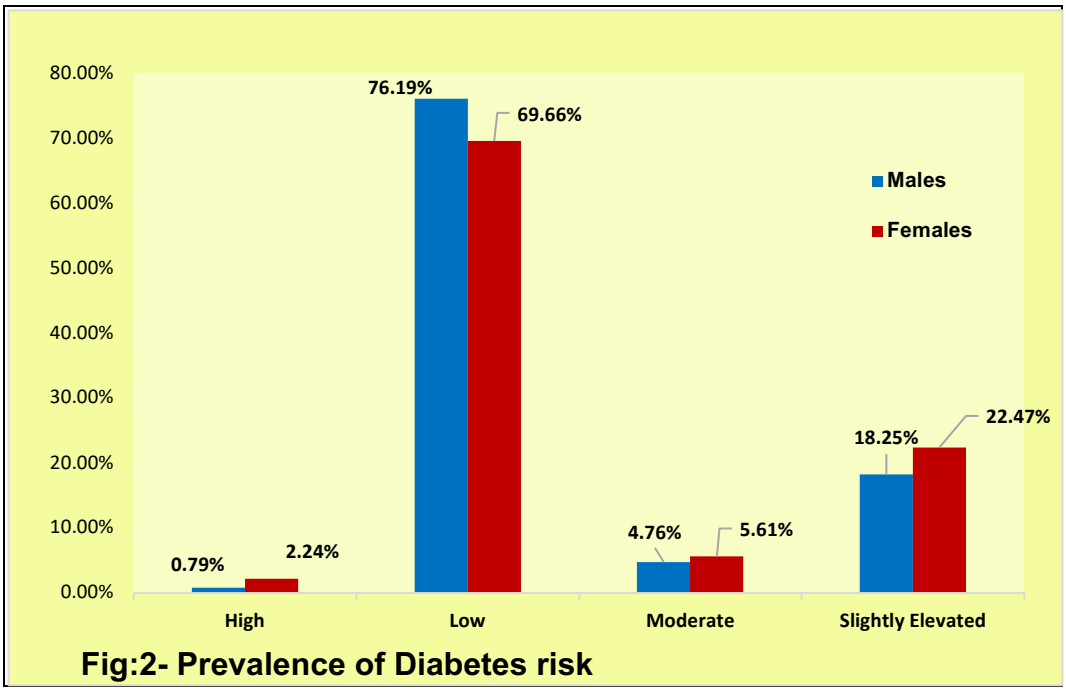

Fig 4: Prevalence of Diabetes Risk

As shown in Fig. 4, diabetes risk was assessed using the "Online Diabetes Risk Assessment" by IDF. Around 20.35% of subjects had a slightly elevated risk, 5.18% had moderate risk, and 1.51% were at high risk. Females exhibited a higher prevalence of slightly elevated (22.47%) and moderate (5.61%) diabetes risk compared to males (18.25% and 4.76%, respectively). Additionally, 2.24% of females were found to be at high risk for diabetes.

Table 5: Glycaemic profile of the subjects (NCEP ATP III criteria, 2001)

Variables	Cut Offs)	Male (n=126) %	Female (n=89) %	Total (n=215) %
FBS	≥ 110mg/dl	2(1.58)	1(1.12)	3 (1.39)
Insulin	≥37.6 µIU/ml	1(0.79)	0	1(0.79)
HOMA–IR	Optimal insulin resistance, <1.9	112 (88.88)	79 (88.76)	191(88.83)
	Early insulin resistance, ≥1.9	4 (3.17)	7(7.86)	11 (5.11)
	Significant insulin resistance, ≥2.9	7 (5.55)	2(2.24)	9 (4.18)

As per Table 5, 1.39% of subjects had elevated FBS (≥110 mg/dl), and 0.79% had high insulin levels, indicating early signs of metabolic imbalance. Notably, 9.29% of participants showed insulin resistance (HOMA-IR ≥1.9), a known risk factor for cardiovascular disease (CVD), with significant insulin resistance (≥2.9) observed more in males (5.55%) than females (2.24%).

Table 6: Prevalence of dyslipidaemia & inflammation among the subjects (NCEP ATP III criteria, 2001)

Variables	Cut offs	Male (n=126) %	Female (n=89) %	Total (n=215) %
Triglyceride	>150 mg/dl	20 (15.87)	11 (12.35)	31(14.41)
Cholesterol	>200 mg/dl	11 (8.73)	9 (10.11)	20 (9.30)
HDL Cholesterol	<40 mg/dl male, <50 mg/dl female	36 (28.57)	29 (32.58)	65 (30.23)
LDL Cholesterol	≥ 100 mg/dl	53 (42.06)	42 (47.19))	95 (44.18)
VLDL Cholesterol	>35 mg/dl	11 (8.73)	8 (8.98)	19 (8.83)
AIP	>0.21	84 (66.66)	49 (55.05)	133 (61.86)
Apoa1(g/L)	>2.05	17 (13.49)	9 (10.11)	26 (12.09)
Apob (g/L)	>1.3	44 (34.92)	21 (23.59)	65 (30.23)
Hs-CRP	>3	49 (38.88)	33 (37.07)	82 (38.13)

Table 6 shows that 30.23% of subjects had low HDL, and 44.18% had elevated LDL cholesterol, both key risk factors for cardiovascular disease (CVD). Raised triglycerides (14.41%) and cholesterol (9.30%) were also noted. Additionally, 38.13% of participants had elevated hs-CRP levels (>3 mg/L), indicating significant underlying inflammation linked to increased CVD risk.

Atherogenic Index of Plasma (AIP) was elevated (>0.21) in 61.86% of subjects, with a higher prevalence among males (66.66%) compared to females (55.05%). Elevated ApoB levels were found in 30.23% of the population, while 12.09% had increased ApoA1. These indices collectively point toward a substantial atherogenic burden and heightened cardiovascular risk in the study group.

DISCUSSION

Cardiometabolic disorders are increasingly being identified at a younger age, particularly in developing nations such as India. The present study demonstrates a considerable burden of risk factors, including obesity, elevated blood pressure, and physical inactivity, among college students in Southern India. These observations suggest that unhealthy lifestyle patterns are being established early in life, potentially increasing the risk of future cardiovascular and metabolic diseases.

A substantial proportion of participants reported a positive family history of diabetes mellitus and hypertension, indicating the combined influence of genetic predisposition and environmental factors. In addition, lifestyle-related behaviours such as unhealthy dietary practices, reduced physical activity, prolonged screen time, and substance use were commonly observed, all of which may contribute to the early development of metabolic abnormalities.

The findings emphasize the importance of early detection and preventive interventions within educational institutions. Promoting awareness regarding healthy lifestyle practices during the college years may play a crucial role in reducing the long-term burden of non-communicable diseases.

In the present study, family history was most frequently reported for diabetes mellitus (37.15%), followed by hypertension (29.08%). Substance use patterns revealed that cigarette smoking (15.62%) and alcohol consumption (13.84%) were the most prevalent habits. These findings are lower than those reported in a North Indian study, where alcohol use (53.5%) and smoking (27.3%) were more common among college students, indicating regional variation in behavioural risk factors.[10]

The prevalence of overweight and obesity in this study was 20% and 18.60%, respectively, with a higher proportion of obesity observed among males. Comparable findings have been reported in other Indian studies,[11] suggesting a rising trend of adiposity among young individuals. Abdominal obesity, assessed using waist circumference and waist-hip ratio, was notably high, with a greater prevalence among females. This pattern is consistent with previous studies,[12] highlighting gender differences in fat distribution and associated cardiovascular risk.

Blood pressure analysis showed a higher prevalence of prehypertension and hypertension among male participants compared to females, indicating a greater susceptibility among males. Similar gender-based differences have been

reported in other populations,[13] reinforcing the need for targeted preventive strategies.

Physical activity assessment revealed that more than one-fourth of participants were physically inactive, with females showing a higher tendency towards sedentary behaviour. The prolonged duration of sitting and relatively lower levels of physical activity may contribute to the increasing prevalence of overweight and obesity. These findings are in agreement with previous studies[14] that have identified physical inactivity as a major modifiable risk factor among students.

Assessment of diabetes risk indicated that a notable proportion of participants had slightly elevated to moderate risk, with a higher prevalence observed among females. Although the proportion of high-risk individuals was relatively low, the presence of early risk indicators highlights the need for timely intervention.[15]

The study also demonstrated a high atherogenic burden, as reflected by elevated Atherogenic Index of Plasma (AIP) and increased ApoB levels. These markers are well-recognized predictors of cardiovascular risk and suggest the presence of early subclinical atherosclerosis. Similar associations between AIP and cardiometabolic risk factors have been reported in previous studies. [16,17]

Dyslipidaemia was another significant finding, with low HDL cholesterol being the most common abnormality, followed by elevated LDL cholesterol and triglycerides. This pattern is consistent with observations from other international studies among university students,[18] where low HDL levels were identified as a predominant lipid abnormality associated with increased cardiovascular risk.

Dietary patterns observed in the study population indicated increased consumption of high-calorie, fat-rich, and sugar-containing foods. Additionally, behaviours such as skipping meals and reduced physical activity further contribute to the development of obesity and dyslipidaemia. Lifestyle changes associated with migration and adaptation to new environments may also play a role in the increasing prevalence of cardiometabolic risk factors among students.

Overall, the findings of this study highlight the early emergence of cardiometabolic risk factors and underscore the need for comprehensive preventive strategies. Implementation of regular screening programs, lifestyle modification initiatives, and health education within academic institutions may help in reducing the future burden of cardiovascular and metabolic diseases.

CONCLUSION

This study demonstrates a substantial prevalence of cardiometabolic risk factors, including dyslipidaemia, abdominal obesity, and adverse lipid parameters such as elevated triglycerides, total cholesterol, and LDL cholesterol along with reduced HDL levels among the study population. These findings indicate an increased susceptibility to non-communicable diseases, particularly cardiovascular disorders and diabetes, in later life.

The results highlight the importance of early preventive measures focusing on lifestyle modification. Interventions should emphasize the promotion of balanced dietary practices, increased physical activity, and reduction of unhealthy behaviours. Institution-based programs in schools and colleges can serve as effective platforms for fostering awareness and encouraging long-term healthy habits. Adoption of nutritious home-prepared meals and regular exercise may play a key role in minimizing future cardiometabolic risk.

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