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Prevalence of cardiovascular risk factors among adolescents in north coastal Andhra Pradesh -A cross- sectional study

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ABSTRACT

Background

Cardiovascular disease is the world's leading killer, accounting for 16.7 million deaths, or 29.2%, of the total number of global deaths in 2003. In India, in the past five decades, rates of coronary disease among the urban population have risen from 4% to 11%. Most of the deaths due to CVD at a young age are preventable by early identification of the risk factors and adapting healthy lifestyles.

Objective

To estimate and compare the prevalence of cardiovascular risk factors among adolescents attending public and private educational institutions in the age group of 17 to 19 years.

Results

The mean age of males was 17.05+/-0.7 and that of females was 17.87+/-0.72. Mean Systolic and diagnostic blood pressures (SBP and DBP) were found to be 120.1+/-11.6 mm Hg. and 76.9+/-8.1 mm Hg. among males and females. The mean heart rate of males and females was 81.4+/-9.6 and 83.4+/-10.1 per minute, respectively. The prevalence of risk factors such as hypertension, obesity, overweight, increased waist circumference, and sedentary lifestyle was observed to be high among students attending private institutions as compared to those in public institutions.

Conclusion

The prevalence of cardiovascular risk factors is higher among students attending private institutions than public institutions.

Key-words *Prevalence of cardiovascular risk factors, private institution, public institution, students, adolescents*

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INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of death worldwide, and the burden of these diseases falls mainly on low- and middle-income countries. CVDs are a group of disorders of the heart and blood vessels that include coronary heart disease, cerebrovascular disease, rheumatic heart disease, and other conditions. Cardiovascular risk factors such as hypertension, dyslipidaemia, diabetes, smoking, obesity, sedentary lifestyle, and family history of CVD, are the underlying factors for most cardiovascular events. Families affected by these diseases face catastrophic social and economic consequences.

Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality globally [1]. According to the WHO report, an estimated 17.9 million people died from CVDs in 2019, representing 32% of all global deaths. Of these deaths, 85% were due to heart attacks and strokes. Over three quarters of CVD deaths take place in low- and middle-income countries. Out of the 17 million premature deaths (under the age of 70) due to noncommunicable diseases in 2019, 38% were caused by CVDs [1]. According to a WHO report, the annual number of deaths from CVD in India has increased from 2.2 million in 1990 to 4.8 million in 2020. 1 in 4 deaths are due to cardiovascular diseases. The incidence of CVD is 7.4% in rural areas and 13.2% in urban areas. Projections show that deaths due to CVD will increase to approximately 23 million by 2030, when CVD will remain the leading cause of mortality [2].

Though cardiovascular diseases manifest in the elderly usually after the 3rd decade of life, the in-sighting event of atherosclerosis is an inflammatory result that occurs decades before the disease becomes clinically apparent. Adolescence is the time in a young person's life when they transition from childhood into young adulthood and experience physical, behavioural, cognitive, emotional, and social developmental changes [1].

- Ages 10 to 13: Early Adolescence
- Ages 14 to 16: Middle Adolescence
- Ages 17 to 19: Late Adolescence

This can be a phase to manage modifiable risk factors. A fatty streak is the earliest feature of atherosclerosis, whose occurrence has been noted in adolescents. Over time, consumption of alcohol, tobacco, and junk food has greatly increased among adolescents. These add to the factors obesity, family history, etc. Adolescents are also known to pick up the habits of smoking, and drinking in the upcoming years of life. The incidence of diabetes, hyperlipidemia, and hypertension is very low in the age group of 12 to 18 years. If the risk factors can be identified early, the propagation of fatty streaks into atherosclerotic plaque can be reduced. Hence, the study of risk factors among adolescents helps in getting a better perspective on cardiovascular diseases.

Though cardiovascular diseases and their pathogenesis, epidemiology, occurrence, prevalence, risk factors, management, and other aspects have been widely explored and studied among adults, very limited literature is available in the late adolescent age group. So, this study might help in getting a better perspective and understanding of cardiovascular risk factors among adolescents.

The rationale behind the study is that if cardiovascular risk factors could be identified in early stages of life, then potential public health education could be given to reduce the increasing prevalence of cardiovascular diseases and also to reduce the financial burden on the country.

OBJECTIVES

- Estimation of prevalence of cardiovascular risk factors among adolescents attending public and private educational institutions in age group of 17 to 19 years.
- To compare the cardiovascular disease risk factors among the study subjects attending public institutions and students attending private institutions

METHODOLOGY

Type of study: A Cross- sectional comparative descriptive study

Study population

Adolescents of age group 17 to 19 years attending public and private educational institutions in Visakhapatnam city

Sample size

A sample size of 200 students was calculated; ,100 students were chosen randomly from each public and private institution to carry out the study.

Sampling method

The sample size was calculated using the available information regarding the prevalence of pre-obese and obese categories, which was 9% with an allowable error of 6%. The result is 91 and is rounded off to 100 in public and private institutes using the formula [3].

$N = Z^2 * p * (1-p) / d^2$

where Z=1.96, d=6, p=9

Data collection

Using standardized questionnaire educational institutes were randomly selected for the study. From each institute, 100 students were randomly chosen for data collection after obtaining prior permission from the concerned authorities. Informed consent was taken from the study subjects aged 18 years and older, and assent forms were taken from the subjects below 18 years of age who were willing to participate in the study. Data was collected with the help of a standardized questionnaire containing basic anthropometric measurements and considered study variables.

Inclusion criteria

All the subjects in the age group of 17 to 19 years who are willing to participate were included in the study.

Exclusion criteria

- Subjects who are already having heart problems and secondary hypertension
- Subjects who are having chronic diseases and are using continuous medication.
- Subjects who are unwilling to participate in study

Study variables

Age, gender, type of educational institution and other variables such as weight, height, BMI, blood pressure (Systolic BP, Diastolic BP), heart rate, intake of alcohol, smoking, stress (**Cohen et al 1983**)[4], Sedentary lifestyle, number of hours of sleep and diet were collected. Information on Family history of Obesity, Hypertension, Diabetes mellitus, Stroke, Myocardial infarction, Dyslipidaemia was also collected. Height and waist circumference were calculated in centimetres using standard measuring tape and are rounded off to the nearer digit. Weight was measured using digital weighing machine. Body mass index (BMI) was calculated using formula weight of the subject in kgs divided by square of the height of the subject in meters (m^2). According to criteria provided by CDC, BMI less than 18.5 is considered as underweight, from 18.5 to 24.9 is considered as normal, BMI ranging 25 to 29.9 as overweight and greater than 30 as obese.

Stress score was measured using **Cohen et al questionnaire**[4] and scale. Individual scores on perceived stress scale were calculated. Scores ranging from 0 to 13 were considered as low stress, from 14 to 26 as moderate stress and scores greater than 27 were considered high perceived stress.

According to WHO, a smoker is someone who smokes daily or occasionally. Every day smoker and occasional smoker were considered for the present study[5]. According to CDC definition four or more drinks in a time period of 2 hours in the past 30 days was considered as alcohol drinking [6] for females and five or more drinks in a time period of 2 hours in the past 30 days for males.

Heart rate and blood pressure were noted using the automated digital BP apparatus with cuff wrapped around the right arm. According to WHO approved grading, SBP of 130 to 139 mm Hg and DBP of 85 to 89 mm Hg is considered as a pre hypertensive condition and SBP of >140 mm Hg and DBP of > 90 mm Hg as hypertension condition.

Data analysis

Data was entered in to excel spread sheet and analysed in Microsoft® Excel® 2016 Analysis was done using SPSS software version 18. Descriptive data was expressed as mean values and standard deviation. Differences in Gender distribution of study participants was per anthropometry and vitals in public and private institution was analysed using t test.

RESULTS

The study was conducted in Visakhapatnam city with a representative sample of 200 students aged 17–19 years from public and private educational institutions to assess multiple cardiovascular risk factors and its related factors. A total of 200 students attending private educational institution (100) and public educational institution (100) with mean age groups of 17.96+/-0.85 and 17.87+/-0.79 respectively were interviewed.

The overall mean age of students in public institutes was 17.87+/-0.79 years in the present

study. The overall mean age of students in private institution was 17.96+/-0.85 in this study. The mean age of males was 17.05+/-0.7 and mean age of females was 17.87+/-0.72.

The mean age for males was 17+/-0.8 years and for females was 17.7+/-0.75 years. Mean systolic blood pressure for males (SBP) was 117.2 +/-11.2 mm Hg. and for females was 115.6(+/-10.2). Mean diastolic blood pressure for males (DBP) was 74.7+/-8.7 mm Hg. & 72.3(+/-6.7) for females. Mean Systolic blood pressure (SBP) was 120.1+/-11.6 mm Hg. Mean Diastolic blood pressure (DBP) was 76.9+/-8.1 mm Hg.

Mean heart rate of males was 81.4+/-9.6 per minute and mean heart rate of females was 83.4+/-10.1 per minute. Mean heart rate for males was found to be 74.9(+/-7.4) per minute as compared to females which was 77.2+/-8.4 per minute.

The mean waist circumference among males was found to be 79.4+/-7.1 whereas it was 77.2+/- 6.5 among females in public institutions and the difference was found to be statistically significant with a p value of 0.01.

The mean waist circumference among males was found to be 80.4+/-6.9 whereas it was 79.4 +/- 7.2 among females in private institutions and the difference was found to be statistically significant with a p value of 0.04 as depicted in Table 1 and 2.

Table 1:Gender distribution of study subjects as per anthropometry and vitals in public institutions

PARAMETER	TOTAL	MALES	FEMALES	
	Mean(+/-SD) [n=100]	**Mean(+/-SD) [n=53]**	**Mean(+/-SD) [n=47]**	**p value**
Age (years)	17.87(+/- 0.79)	17(+/-0.8)	17.7(+/-0.75)	Less than 0.001
Height (m)	1.64(+/-0.15)	1.66(+/-0.16)	1.62(+/-0.14)	0.01890
Weight (kg)	59.7(+/-13.8)	61.8(+/-13.4)	57.5(+/-12.4)	0.0093
BMI (kg/sqm)	22.9(+/-3.2)	23.1(+/-3.8)	22.6(+/-3.4)	0.049
Waist circumference (cm)	78.4(+/-7.2)	79.4(+/-7.1)	77.2(+/-6.5)	0.011
Mean SBP (mm Hg)	117.2(+/-11.2)	117.5(+/-12.4)	115.6(+/-10.2)	0.04084
Mean DBP (mm Hg)	74.7(+/-8.7)	76.1(+/-7.8)	72.3(+/-6.7)	0.0109
Heart Rate (per min)	76.4(+/-8.1)	74.9(+/-7.4)	77.2(+/-8.4)	0.0148

Table 2:Gender distribution of study subjects as per anthropometry and vitals in private institution.

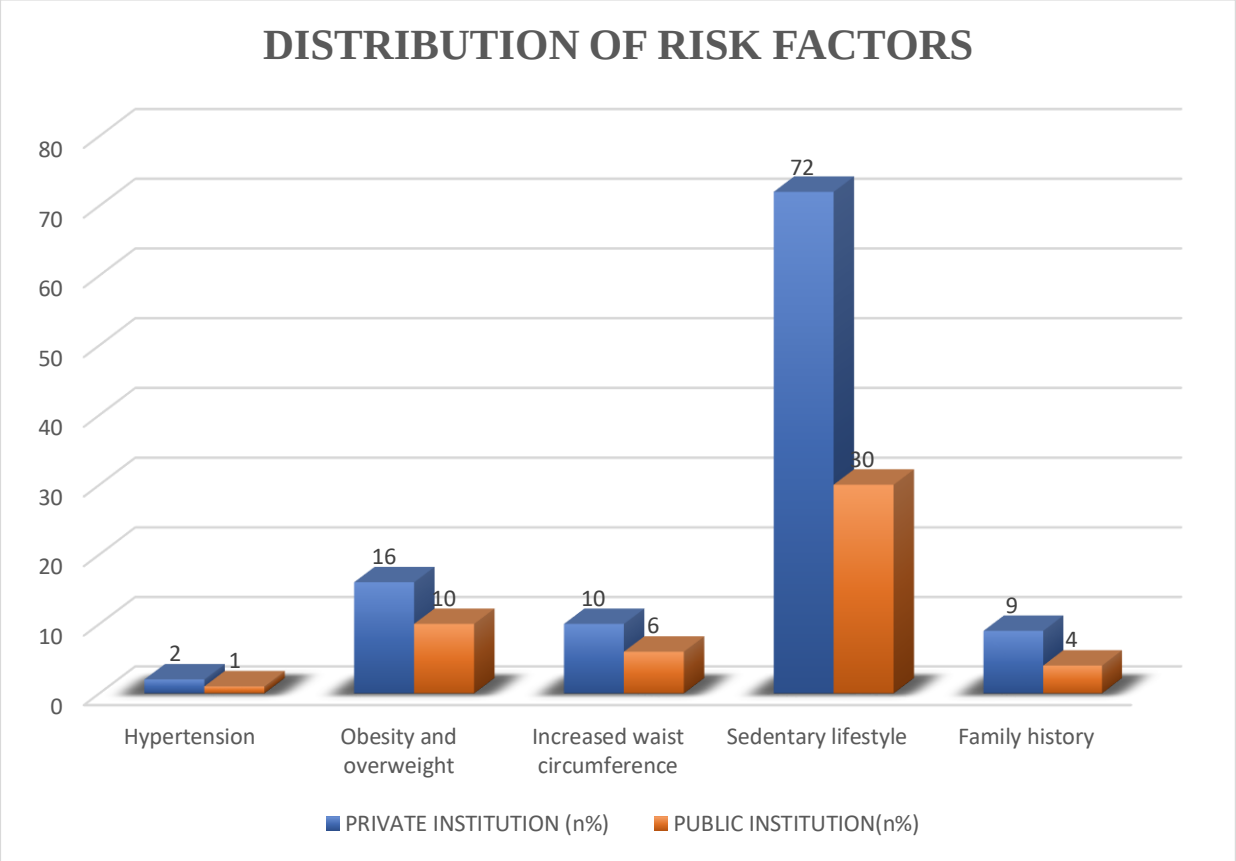
PARAMETER	*TOTAL*	*MALES*	*FEMALES*	
	Mean(+/-SD) [n=100]	**Mean(+/-SD) [n=48]**	**Mean(+/-SD) [n=52]**	**p value**
Age (years)	17.96(+/-0.85)	17.05(+/-0.7)	17.87(+/-0.72)	Less than 0.001
Height (m)	1.63(+/-0.14)	1.67(+/-0.17)	1.59(+/-0.12)	0.0074
Weight (kg)	63.87(+/-15.3)	65.8(+/-13.4)	62.1(+/-14.1)	0.01825
BMI (kg/sq m)	24.2(+/-4.5)	24.5(+/-3.6)	23.3(+/-3.4)	0.00897
Waist circumference (cm)	79.9(+/-7.2)	80.4(+/-6.9)	79.4(+/-7.2)	0.0481
Mean SBP (mm Hg)	120.1(+/-11.6)	121.5(+/-10.2)	118.6(+/-9.6)	0.0146
Mean DBP (mm Hg)	76.9(+/-8.1)	78.3(+/-8.6)	75.6(+/-6.8)	0.0836
Heart rate (per min)	82.44(+/-9.8)	81.4(+/-9.6)	83.4(+/-10.1)	0.0313

The mean BMI of study participants from public institutes was 22.9+/- 3.2 kg/m^3 as compared to 24.2+/- 4.5 kg/m^3 from private institutes.The mean BMI among males were found to be 23.1+/- 3.8 kg/m^3 whereas it was 22.6+/- 3.4 kg/m^3 among females in public institutions and the difference was found to be statistically significant with a p value of 0.04.The mean BMI among males in private institutions were found to be 24.5 +/- 3.6 kg/m^3 whereas it was 23.3+/- 3.4 kg/m^3 among females and the difference was found to be statistically significant with a p value of 0.008.Among the study participants 52% of the students from private and 47% from public institutions were females whereas 48% of the students from private and 53% from public institutions were males respectively.

The **figure 1** shows that the prevalence of risk factors such as hypertension, obesity and overweight, increased waist circumference, sedentary lifestyle was observed to be high among students attending private institution as compared to those in public institution. **Smoking and alcoholism were not observed among the study participants**.

Figure 1:Distribution of cardiovascular risk factors among the study subjects in public and private institutions

Figure 1:Distribution of cardiovascular risk factors among the study subjects in public and private institutions



On Comparison of perceived stress scale in private and public institutions. Number of subjects with perceived stress score ranging from 0 to 13 are 36% and 43% in private and public institutions respectively. Number of subjects with perceived stress score ranging from 14 to 26 were 40% and 36% in private and public institutions respectively. Number of subjects with perceived stress score greater than 26 are 24% and 21% in private and public institutions respectively.

The figure 2 shows the prevalence of family history of obesity, Hypertension, diabetes mellitus, stroke, myocardial infarction, and dyslipidaemia. It was observed that the family history of obesity, hypertension, diabetes mellitus and dyslipidaemia was higher among subjects studying in private institutions when compared to those in public educational institution.Among the students 28% from private and 61% from public educational institutions were not showing any risk factors for CVD.

Among the students 48% from private and 30 % from public educational institutions were having 1 risk factor and 24% from private and 9% from public educational institutions were having 2 and >2 risk factors for CVD as depicted in Table:3.

Figure 2:Distribution of study population as per family history of CVD in public and private educational institutions

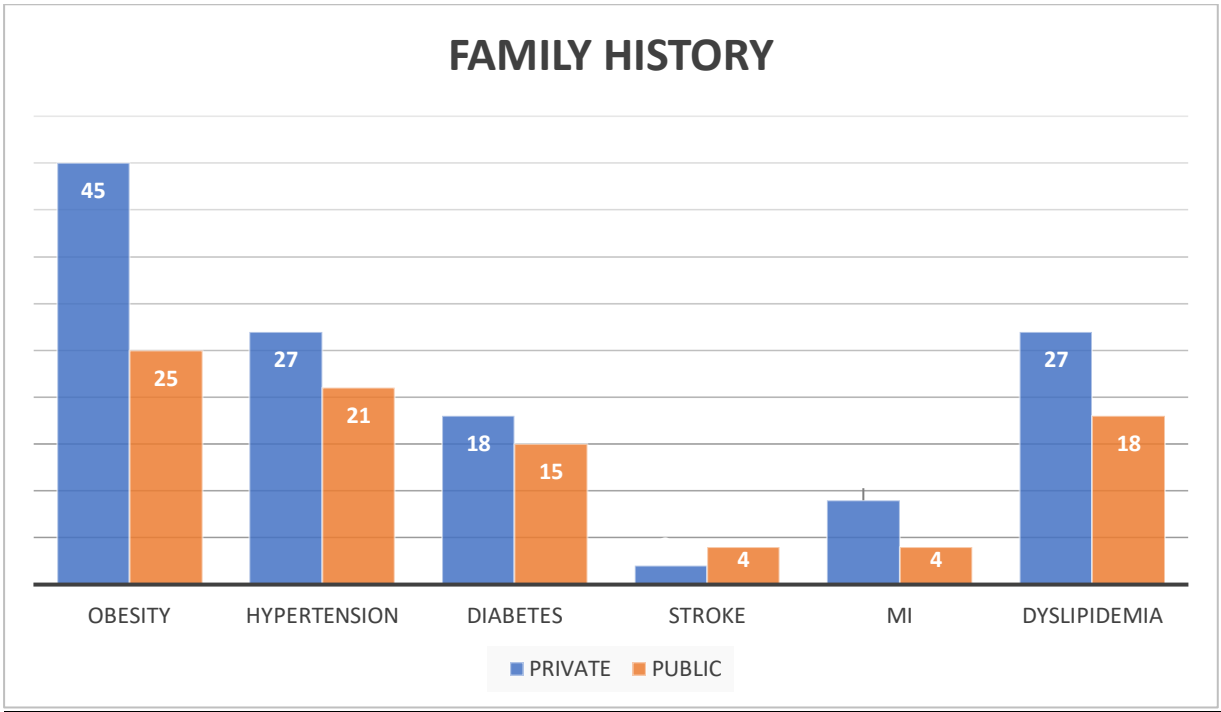


Table 3:Distribution of risk factors observed among students in Public and Private educational institutions

RISK FACTORS	PUBLIC	PRIVATE	TOTAL
ABSENT	61	28	89
1 RISK FACTOR	30	48	78
2 and more than 2	9	24	33
TOTAL	100	100	200

DISCUSSION

This study was conducted in the Visakhapatnam city with a representative sample of 200 students aged 17–19 years, 100 students each from public and private educational institutes to study the distribution of multiple cardiovascular risk factors and its related factors. About half of the students were males and half were females in private institute, like students in the public institute. A sedentary lifestyle is one of the major modifiable risk factors for cardiovascular diseases. In the present study, it was observed that 73% of the students from private institutes had a sedentary lifestyle when compared to 39% of students attending public institutes. Among the 73% of students from private institutions having a sedentary lifestyle, 43% were female and 30% were male. Among the students from public institutions, 39% were sedentary, of them, females were 25% and males were 14%. A sedentary lifestyle was observed to be more common among students attending private institutions, making them more vulnerable to cardiovascular diseases and related complications as compared to public institutions. Female students were found to be more in adapting to a sedentary lifestyle compared to male students. Similar findings were observed in a study done by **Swaminathan, S et al** [8]. The reasons for physical inactivity among students studying in private institutions might be longer hours at the institution and the absence of games, sports, and other extracurricular activities.

Body mass index (BMI) is calculated using the height and weight of the individual. Obesity is another cardiovascular risk factor which has become more prevalent in recent times [9].

In the present study, among the students attending private institutions, 8% of female and 5% of male students were overweight, making a total of 13% overweight. Our observation was like that of WHO criteria, around 14.5% of the population was overweight. But our findings contrasted with Asian standards; the prevalence of overweight was 24.31% in a study done by **Kar S et al** [10].

In the present study, about 2% female and 1% male students were obese, making a total of 3% obese. Among the students attending public institutions, 5% of female students and 3% of male students, making a total of 8%, were considered overweight; 1% of male and 1% of female students were obese, making a total percentage of 2%. So, the prevalence of obesity and overweight is higher in private institutions than in public institutions. Not much difference was observed in the prevalence of obesity when gender is considered. These findings correlate to the WHO reports. The prevalence in private institutions can be attributed to differences in socioeconomic status, diet, consumption of fast foods, sedentary lifestyle, and other factors. Obesity is closely linked to sedentary lifestyle and hypertension.

Coronary heart disease prevalence rates in India have been estimated over the past several decades and have ranged from 1.6% to 7.4% in rural populations and from 1% to 13.2% in urban populations The present study has revealed that family histories of myocardial infarction were given by 9% of private institutions and 4% of public institutions. It was found that students from private institutions are at higher risk for cardiovascular diseases than students from public institutions.

Educational status has been used the most in cardiovascular epidemiological studies as a marker of socioeconomic status as it is stable after early childhood and least influenced by social changes or illness in adulthood (21).

Low educational status subjects have a greater prevalence of central obesity (high waist-hip ratio), low HDL cholesterol, hypertriglyceridemia, smoking, tobacco use, and low physical activity. There is a greater clustering of three or more risk factors in low-educated men and women (22). Low educational status is associated not only with greater smoking and tobacco use and lower intake of fruits and vegetables but also with lower physical activity and a greater prevalence of central obesity (high waist-hip ratio), low HDL cholesterol, and hypertriglyceridemia. Also, at the same time, high socio-economic status has contributed to risk factors like increased intake of junk food, a sedentary lifestyle, irregular sleep, and poor diet habits, making them vulnerable to cardiovascular diseases.

A family history of obesity, hypertension, diabetes mellitus, stroke, dyslipidemia, and myocardial infarction predisposes to cardiovascular diseases in adulthood. This is due to the genetic predisposition, socioeconomic background, and educational background of the family.Evidence suggests that stress, social isolation, depression, anxiety, and loneliness play a vital role in the etiology of CHD (23). So, the students with high scores in the stress assessment questionnaire combined with other risk factors are at higher risk of developing atherosclerotic plaque and other disorders leading to occurrence of CVD.When the cumulative number of risk factors was assessed among students of public and private institutions, the prevalence of cardiovascular risk factors like hypertension, overweight, obesity, sedentary lifestyle, family history of CVD, and increased waist circumference was higher in students attending private institutions than public institutions. The prevalence of the seven cardiovascular risk factors assessed was very distinct. Since family history of cardiovascular disease is a non-modifiable risk factor and there is not much to be done to change its high prevalence, this result must be seen as an alert, since it increases the cumulative risk of these adolescents. Students with no risk factors are 28% and 61% in private and public institutions, respectively.

CONCLUSION

The prevalence of cardiovascular risk factors such as hypertension, obesity, overweight, increased waist circumference, and a sedentary lifestyle is higher in students attending private institutions than public institutions. Early assessment of risk factors in adolescents helps identify the extent of the risk of CVD. The students with risk factors are to be educated about the prevention of CVD at an early age. This would be helpful in reducing the incidence of cardiovascular diseases and reducing the financial burden on the country.

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