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Original Article

Assessment of Risk of Metabolic Syndrome and Cardio Vascular Diseases among Medical Students in India

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ABSTRACT

Background: Medical students are vulnerable to various lifestyle disorders due to improper diet, physical activity and inadequate sleep. **Aims:** To assess the risk status of components of metabolic syndrome and cardiovascular diseases among medical students. **Methods:** Information was collected using a standard self-administered questionnaire. Blood pressure, waist circumference, height and weight of students were measured using standard procedures. Fasting blood sample was taken for plasma glucose, lipid profile, cortisol levels and thyroid hormone assays. **Results:** Eighty-eight participants with mean age 21.9 ± 1.1 years took part in this study. Thirty-one (35.2%) participants reported fried food consumption every day. Majority of the participants 35(39.8%) reported moderate exercise less than once a week. Most participants 83 (94.3%) had sleep duration of ≤8 hours at night. Various components of metabolic syndrome like waist circumference (WC), triglyceride (TG) levels, high density lipoprotein (HDL) levels, blood pressure (BP) values and fasting blood glucose (FBG) levels were abnormal in 36 (40.9%), 2 (2.3%), 39 (44.3%), 21 (23.9%) and 7 (7.9%) participants respectively. Obesity was present among 33 (37.5%) students. Positive correlation between body mass index (BMI) with WC (p<0.001) and TG (p=0.011) and negative correlation between BMI and HDL levels (p=0.008) was observed. There was also a positive correlation between WC with SBP (p=0.006) and with DBP (p=0.049) values. One or more risk factors of metabolic syndrome was present among 67 (76.1%) participants. It was present among greater proportion of participants with sleep duration of ≤8 hours at night (p=0.05). Medium to high risk of cardiovascular diseases was observed among 30 (34.1%) participants. **Conclusion:** High proportions of students are vulnerable to develop metabolic syndrome and cardio vascular diseases in this setting. BMI assessment can be used as best predictor to identify the high-risk groups. Improvement in diet, physical activity and adequate sleep duration is required for risk mitigation.

Key words: Cardiovascular Diseases, Medical Students, Metabolic Syndrome, Risk Factors, Body mass index.

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INTRODUCTION

Metabolic syndrome constitutes abnormalities involving, any three parameters among: waist circumference (WC), blood pressure (BP), serum triglyceride (TG), high density lipoprotein (HDL) cholesterol and fasting blood sugar (FBS).[1] Although the exact cause of this syndrome is unknown, its manifestation is attributed to central obesity and insulin resistance.[2] It is estimated that one-fourth of adult population in south Asia have metabolic syndrome.[3] Cardio vascular diseases have also assumed epidemic proportion in India.[4] This again is an ultimate consequence of lifestyle related diseases like metabolic syndrome. Hence, timely identification of risk factors related to these disorders becomes important.

Universities form an ideal setting for early screening of various life style related risk factors and for framing suitable Interventions.[5] Students at this age are in a critical phase in their lives. They tend to exhibit independence in decision-making, regarding their lifestyle, which in future could affect their health.[6]

Lifestyle of a medical student is characterized by intense sedentariness owing to time spent in lecture halls and libraries. The associated stress and erratic sleeping habits during the period of training makes them vulnerable to metabolic syndrome.[7,8] Data on metabolic and cardiovascular risk factors among medical student population in India are very limited.[9] Recent standards recommend blood tests once every five years among individuals aged 20 years and above to assess risk of metabolic syndrome.[10] This study was therefore done to assess the risk status of various components of metabolic syndrome and cardiovascular diseases and to study the risk factors associated with these conditions among medical students.

MATERIALS AND METHODS

This cross sectional study was conducted among students of a private medical college in Mangalore city of south India during the months of July and August 2015. Institutional Ethics Committee approval was obtained for the conduct of this study.

Sample size of eighty participants was calculated based on 55.6% of medical students with abdominal obesity (an important determinant of metabolic syndrome) as reported in a previously done south Indian study[7] and at 95% confidence intervals and 20% relative precision. Adding a non-response rate of 10%, the final sample size was calculated as 88. These students were chosen from second, third and final year using stratified random sampling method. Only those randomly chosen participants who gave written informed consent for participation were enrolled in this study.

Students under 20 years were not included in this study because the diagnostic criteria for metabolic syndrome are different among them.[11,12] As majority of first year students belong to this age, they were excluded from this study. Students who were known cases of metabolic syndrome, who were using medication to treat any of the components of metabolic syndrome or on antidepressants, antipsychotics, antithyroid drugs were also excluded.

Cardiovascular risk assessment questionnaire was the instrument used for data collection.[13] The Part I of this questionnaire was self-administered to each participant to fill. It constituted information on age, gender, living environment, personal history of cardio vascular diseases, diabetes mellitus, gastro intestinal and respiratory symptoms, family history of cardiovascular diseases, average duration of sleep at night, history and

pattern of smoking and water consumption per day, history and pattern of physical activity, alcohol consumption and dietary habits per week and history of stressful events experienced over the past 6 months. Responses to each of these questions were assigned standard scores as stated in the questionnaire.

Part II of the questionnaire was for the investigator to fill. The blood reports of lipid profile (LDL, HDL, TGs, TC), FBS, TFTs and cortisol levels of each participant were recorded in this section. All participants were instructed to do an overnight fast of eight hours. In the following day, their fasting venous blood sample was drawn and these tests were done at various affiliated tertiary care hospitals of this institution.

The costs for these tests were borne by the institution as each student had medical insurance facility. Permission for this activity was obtained from the medical superintendents of these respective hospitals.

Tests such as APoB, lipoprotein, c reactive protein, homocysteine, fibrinogen, urinary pH, stool and bioimpedance analysis, even though mentioned in the standard questionnaire, were not done, either due to non-feasibility reasons or due to unavailability of the tests at these hospitals. Therefore, score corresponding to "don't know" response for these investigations as stated in this questionnaire was assigned to all participants in this study. History of autoimmune, chronic and recurrent diseases were also enquired by interviewing each participant and suitable scores were allotted as mentioned in the questionnaire.

Recording of height, weight, waist circumference and blood pressure values were done by standard procedures.[14,15]

IDF-2006 guidelines was used for the diagnosis of metabolic syndrome.[11] According to this criteria, waist circumference ≥90 cm in males or ≥80 cm in females, along with any two of the four criteria namely; TGs ≥150 mg/dl, HDL<40 mg/dl in males or <50 mg/dl in females; SBP ≥130 or DBP ≥85 mm Hg FBG ≥100 mg/dl was considered for the diagnosis. Cardiovascular risk was categorized as low, moderate, high and very high for scores <100, 101-220, 221-350 and >350 respectively as stated in this questionnaire.

Data was entered and analyzed using statistical software SPSS version 16. Chi square test and Fishers exact test were used to test association. Unpaired student t test was used for comparing the differences in the anthropometric and biochemical parameters. Correlation between anthropometric parameters with blood pressure and lipid parameters was done using Pearson's correlation coefficient. The significance level for all statistical analysis was set at $p \leq 0.05$.

RESULTS

The mean age of the students was 21.9±1.1 years. There were 40 (45.4%) students of age 21 years, 25 (28.4%) of age 22 years and 23 (26.1%) aged ≥23 years. The proportion of males was 44(50%). There were 29 (33%) participants of second year, 29 (33%) of third year and 30 (34%) of final year MBBS. Out of the total participants, two were known cases of cardiovascular diseases. Similarly, history of angina attack in the recent 3 months was present in two cases. Parental history of cardiovascular diseases in father at age less than 55 years was present in 38 (43.2%) cases, in mother at age less than 65 years was present in 29 (32.9%) cases. Parental history of type II diabetes mellitus in either of the parents was present in 31 (35.2%) cases.

Thirty-five (39.8%) participants reported moderate exercise less than once a week. Most participants 83 (94.3%) had sleep duration of eight hours or less per night (Table 1). The various sleep disturbance experienced by participants included snoring 11 (12.5%), obstructive sleep apnoea 1 (1.1%) and insomnia/interrupted sleep 17 (19.3%).

Thirty-one (35.2%) participants reported fried food consumption every day. Consumption of protective foods like fruits ≥4 pieces per day and vegetables 3-4 servings per day was reported by only 2 (2.3%) and 6 (6.8%) participants respectively. Only 45 (51.2%) participants reported water consumption of more than 1.25 litres per day (Table 2).

Among the environmental factors related to cardio vascular risk, 85 (96.6%) participants reported that they were currently residing in a city. Two (2.3%) each were living in an industrial area with gas emission; and living in an environment with chemicals, cleaners, pesticides, petrochemicals, paints or exhausts. However, none of the participants were living on a main road.

About 10% students experienced symptoms suggestive of stress on a weekly basis (Table 3).

The various criteria used for diagnosis of metabolic syndrome like WC, TG levels, HDL levels, BP values and FBS levels were abnormal in 36 (40.9%), 2 (2.3%), 39 (44.3%), 21 (23.9%) and 7 (7.9%) participants respectively. Eight participants reported hypothyroidism (Table 4). Among the participants, 3 (3.4%) were under weight, 30 (34.1%) normal weight, 22(25%) over weight and 33(37.5%) were obese. Obesity was observed among 17(38.6%) males and 16(36.4%) females (p=0.144). There was strong positive correlation between BMI with WC (r=0.68, p<0.001) [Figure 1], BMI with SBP values (r=0.271, p=0.011), WC with SBP values (r=0.29, p=0.006) (Figure 2) and WC with DBP values (r=0.211, p=0.049) (Figure 3) among participants. There was also a strong positive correlation between BMI with VLDL levels (r=0.283, p=0.007) and BMI with TG levels (r=0.271, p=0.011) (Figure 4) and a strong negative correlation between BMI with HDL levels (r= -0.281, p=0.008) (Figure 5) among participants.

Abnormality with waist circumference was observed among no participants who were under weight, 6 (20%) out of those with normal weight, 10 (45.5%) out of those with overweight and 20 (60.6%) out of those who were obese (X^2=12.987, p=0.005). FBS was abnormal among 7 (19.4%) participants with raised WC compared to none among those with normal WC (p=0.001). The mean HDL was 48.2 ± 10.8 mg/dl, LDL was 95 ± 29.3 mg/dl, TG was 73.2 ± 30.7 mg/dl, VLDL was 14.2 ± 6.1 mg/dl and total cholesterol (TC) level was 151 ± 34.6 mg/dl. The mean triiodothyronine (t3) was 1.2 ± 0.2 µgms/dl, thyroxine (t4) was 7.6 ± 1.4 µgms/dl and thyroid-stimulating hormone (TSH) level was 2.3 ± 1.6 micro units/ml. The mean cortisol level was 16.6 ± 5.4 µgms/dl and FBS level was 91.7±5.2 mg/dl. The mean WC was 83.9 ± 8.0 cms.

HDL cholesterol level was low among 15 (34.1%) males and 24 (54.5%) females (X2=3.73, p=0.053). The mean HDL value among males was 46.0 ± 10.5 mg/dl and among females was 50.4 ± 10.8 mg/dl (t=1.947, p=0.05). WC was abnormal among 10 (22.7%) males and 26 (59.1%) females (X^2=12.034, p=0.001). Systolic or diastolic blood pressure values were abnormal among 20 (45.4%) males and 1 (2.3%) female (X^2=22.579, p<0.001).

Abnormality with BMI was seen among 17 (38.6%), LDL 17 (38.6%), SBP 17(38.6%), HDL 15 (34.1%), WC 10(22.7%), DBP 9 (20.4%), FBS 5 (11.4%), TG 2 (4.5%) and TC among 1 (2.3%) male participants. Among females, abnormality with WC was seen in 26 (59.1%), HDL 24 (54.5%), BMI 16 (36.4%), LDL 15 (34.1%), TC 3 (6.8%), FBS 2 (4.5%) and SBP in 1 (2.3%) participant. VLDL levels were normal in all participants. The mean number of risk factors for metabolic syndrome among males was 1.2 ± 1.0 and among females was 1.3 ± 0.8 (t=0.482, p=0.631). The mean number of risk factors among all the participants was 1.2 ± 0.9. As many as 31 (35.2%) had one and two risk factors each, 21 (23.9%) had no risk factors and 5 (5.7%) had three risk factors. At least one risk factor was seen in a greater proportion of females 36(81.8%) compared to males 31 (70.5%) (p=0.211). It was seen 1.9 times more among females than males.

Table 1: Lifestyle habits among participants (n=88).

Exercising habits	Number	Percentages
Moderate exercise less than once a week	35	39.8
Moderate exercise (average once per week	24	27.3
Moderate exercise (average 2 – 3 times per week)	14	15.9
Moderate exercise (average 4 – 5 times per week)	5	5.7
Moderate exercise (average 5 or more times per week)	10	11.4
Smoking habits		
Never smoked	82	93.2
Ex-smoker	2	2.3
Current smoker less than 20 cigarettes/day	4	4.5
Passive smoking (a non-smoker exposed to smoke most days at home or work)	68	77.3
Alcohol consumption habits		
Average of zero drinks daily	83	94.3
Average of one drink daily or 7 units per week	4	4.5
Average of two drinks daily or 14 units per week	0	0
Average three or more drinks daily or 21 or more units	1	1.1
Stress relieving activities (>1 hour/week)		
Meditation	33	37.5
Yoga	12	13.6
Participation in community events/social activities/sports	22	25.0
Playing with pets	3	3.4
Sleep duration per night (hours)		
0-4	1	1.1
5-6	27	30.7
7-8	55	62.5
>8	5	5.7

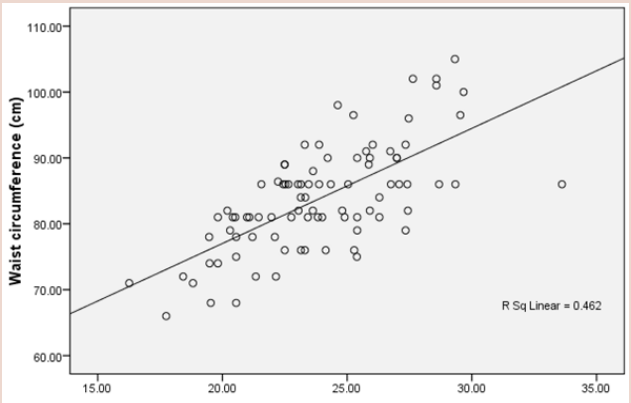

Figure 1: Correlation between body mass index and waist circumference of participants (n=88). **X axis**- Body mass index (kg/sq.m)

Table 2: Dietary habits among participants (n=88).

Type of diet	Number	Percentage
Fried food		
Less than once a week	13	14.8
1-2 times/week	27	30.7
3-6 times/week	17	19.3
Everyday	31	35.2
Starchy food		
0-1 servings/day	30	34.1
2 servings/ day	36	40.9
3 servings/ day	14	15.9
≥ 4 servings/ day	8	9.1
Sweet food substances		
Usually none	37	42.0
1-2 servings/ day	41	46.6
> 2 servings/ day	10	11.4
Sugar		
0-3 teaspoons/ day	75	85.2
4-6 teaspoons/ day	12	13.6
7-9 teaspoons/ day	1	1.2
Fish		
Rarely	77	87.5
1-2 times/week	10	11.4
3-6 times/week	1	1.2
Fruit		
Usually none	55	62.5
1-3 pieces daily	31	35.2
≥4 pieces daily	2	2.3
Vegetables		
Usually none	32	36.4
1-2 servings daily	50	56.8
3-4 servings daily	6	6.8
Coffee		
Usually none	56	63.6
1-2 cups daily	27	30.7
3-4 cups daily	3	3.4
≥5 cups daily	2	2.3
Soft drinks		
Less than 500 ml per week	60	68.2
1-2 litres per week	23	26.1
3-4 litres per week	3	3.4
≥5 litres per week	2	2.3
Water		
≤0.5 litres per day	9	10.2
0.501 – 1.25 litres per day	34	38.6
>1.25 litres per day	45	51.2

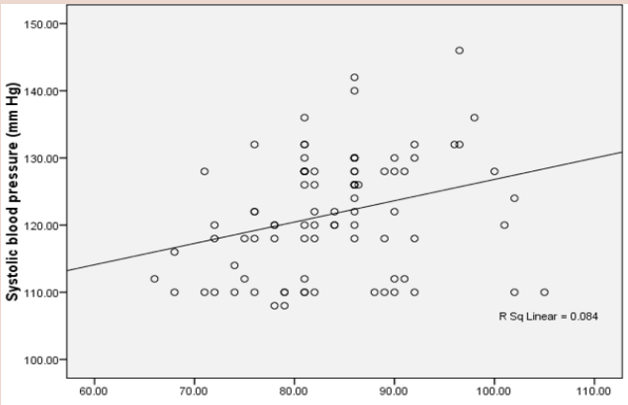

Figure 2: Correlation between waist circumference and systolic blood pressure values of participants (n=88). **X axis-** Waist circumference (cms)

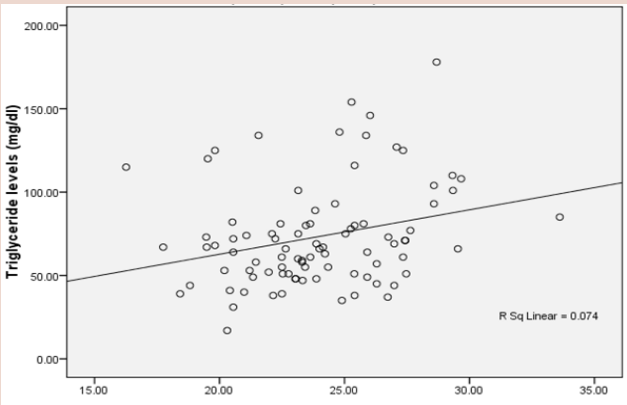

Figure 4: Correlation between body mass index and triglyceride levels among participants (n=88). **X-axis-** Body mass index (kg/sq.m).

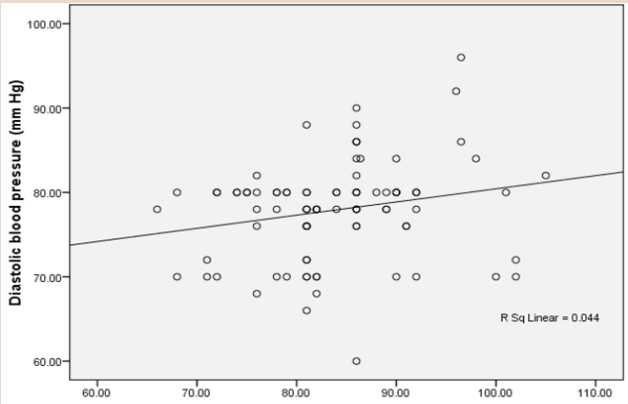

Figure 3: Correlation between waist circumference and diastolic blood pressure values of participants (n=88). **X axis-** Waist circumference (cms).

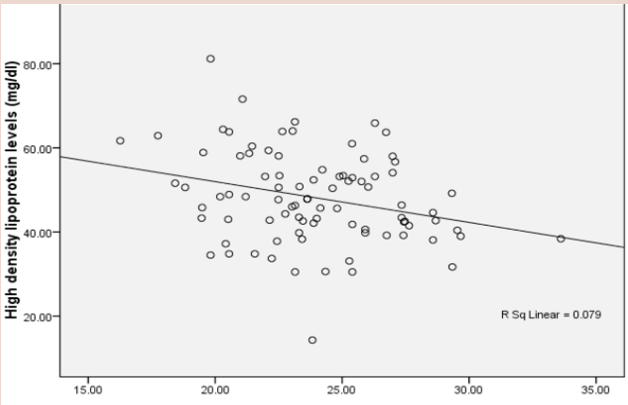

Figure 5: Correlation between body mass index and high density lipoprotein levels among participants (n=88). **X-axis-** Body mass index (kg/sq.m).

Table 3: Symptoms of stress experienced by participants (n=88).

Symptoms experienced	Frequency of experience	
	On a weekly basis	On a monthly basis
Inability to control breathing, acceleration in heart rate, recurrent feelings of unease, panicky	8(9.1)	17(19.3)
Feeling of sadness, hopelessness, loneliness, disinterest in social interaction	9(10.2)	25(28.4)
Feel of hostility towards others or frequently getting irritable or angry	7(7.9)	22(25)

Thirty six out of 88 students (40.9%) complained of asthma, allergies, hay fever, rhinitis, sinusitis and other hypersensitivity symptoms in the past.

Medium to high risk of cardiovascular diseases was observed among 30(34.1%) participants (Table 5).

Lifestyle risk status was found to increase with age (p=0.024) of the participants (Table 6).

Table 4: Biochemical parameters among medical students (n=88).

Biochemical parameters	Number	Percentage
HDL levels		
<1.1 mmol/l	1	1.1
>1.5 mmol/l	87	98.9
TG levels		
<1mmol/L	1	1.1
1-2mmol/L	2	2.3
2.1-3mmol/L	23	26.1
3.1-5mmol/L	44	50.0
>5mmol/L	18	20.5
LDL levels		
<2.5mmol/L	2	2.3
2.5-3.3mmol/L	3	3.4
3.4-4.1mmol/L	10	11.4
4.2-4.9mmol/L	20	22.7
>4.9mmol/L	53	60.2
Cortisol levels		

Normal	66	75.0
Abnormal	22	25.0
Thyroid function tests		
Normal	79	89.8
Subclinical hypothyroidism	1	1.1
Hypothyroidism	8	9.1
Fasting blood sugar levels		
Less than 5.5 mmol/l	81	92.0
Between 5.5-6.9 mmol/l	7	8.0

Table 5: Cardiovascular risk status among participants (n=88).

Parameter	Low risk status (%)	Medium risk status (%)	High-risk status (%)
Cardiovascular history	84 (95.5)	0 (0)	4 (4.5)
Lifestyle	8 (9.1)	20 (22.7)	60 (68.2)
Stress	49 (55.7)	17 (19.3)	22 (25)
Sleep	77 (87.5)	11 (12.5)	0 (0)
Blood sugar	81 (92)	7 (8)	0 (0)
Diet	42 (47.7)	29 (33)	17 (19.3)
Lipids	1 (1.1)	9 (10.2)	78 (88.6)
Blood pressure	71 (80.7)	14 (15.9)	3 (3.4)
Thyroid function	79 (89.8)	0 (0)	9 (10.2)
Weight management	57 (64.8)	31 (35.2)	0 (0)
Overall	58 (65.9)	27 (30.7)	3 (3.4)

Table 6: Association between age and lifestyle risk status among participants (n=88).

	Lifestyle risk status		
Age (years)	Low risk No. (%)	Medium risk No. (%)	High risk No. (%)
21	5(12.5)	14(35)	21(52.5)
22	3(12)	4(16)	18(72)
≥23	0(0)	2(8.7)	21(91.3)
			X^2=11.276, p=0.024
	Blood pressure risk status		
Gender	Low risk No. (%)	Medium risk No. (%)	High risk No. (%)
Males	28(63.6)	13(29.5)	3(6.8)
Females	43(97.7)	1(2.3)	0(0)
			X^2=16.455, p<0.001
	Weight management risk status		
Gender	Low risk No. (%)	Medium risk No. (%)	High risk No. (%)
Males	39(88.6)	0(0)	5(11.4)
Females	18(40.9)	0(0)	26(59.1)
			X^2=21.963, p<0.001

Table 7: Association between self-reported sleep duration at night with one or more metabolic syndrome criteria.

Sleep duration	No risk factors (%)	One or more risk factors (%)	Total
0-4hrs	1(100)	0(0)	1
5-6hrs	7(25.9)	20(74.1)	27
7-8hrs	10(18.2)	45(81.8)	55
>8hrs	3(60)	2(40)	5
Total	21	67	88

X2=7.825, p=0.05

Presence of one or more metabolic syndrome criteria was found to be significantly more when students had sleep duration eight hours or less at night (p=0.05) (Table 7).

DISCUSSION

One of the most important responsibilities of health care professionals is to create awareness among people. The medical students who need to shoulder this responsibility in future are therefore expected to be more knowledgeable and to practice healthy life style habits themselves. However in this study, more than one-third of the participants consume fried foods every day and water consumption was inadequate among almost half of them. Similarly a study done in Karachi, Pakistan[16] reported that the overall dietary and life style habits of medical students were not healthy. There was high junk food, cola consumption and physical inactivity among them, leading to a predominance of overweight.[16]

In this study too one-quarter of participants were overweight and more than one-third were obese. Obesity was seen among 38.6% of males and 36.4% of females in the present study compared to other studies where it was 39.5%[17] and 51.3%[7] among males and 23.3%[17] and 32.5%[7] among females. However the differences in proportion of obesity between males and females was not significant here as also observed in other studies.[9,18] Central obesity was seen significantly more among females in this study as also reported in several studies.[9,19,20] On the contrary a Greek study found central obesity significantly more among males.[17]

Among the various parameters used for diagnosis of metabolic syndrome, previous studies reported abnormalities in 13.9% to 55.6% for WC[7,9,18,21,22], 5.1% to 29.2% for TGs[7,9,18], 29.5% to 37.2% for HDL[7,9,18], 8.4% to 21% for BP[7,9] and 3.3% to 17.6% for FBS levels[7,21] among university students.

Among these parameters, HDL followed by WC was abnormal among most participants in the present study which was similar to the finding of previous studies.[9,18] Abnormalities with WC followed by HDL levels was also reported by few other studies.[7,22]

The indicator of metabolic syndrome that was seen least common among medical students in this study was, elevated TG followed by elevated FBS in comparison to elevated FBS followed by elevated BP reported in the study done in Bangalore, India.[22]

Significant correlation was seen between BMI and WC, TG and HDL values. Similarly WC and BP values were also significantly correlated. Abnormality with WC was associated with abnormalities in FBS values. Other studies also observed significant positive correlation between BMI, WC with BP values among participants.[9,23] Therefore BMI was found to be a useful index for the prediction of risk factors of metabolic syndrome before blood investigations are done for its diagnosis.

The most common risk factors of metabolic syndrome among males was SBP followed by low HDL and WC in comparison to WC followed by TG and low HDL reported in a study done in Pune, India.[7] Similarly in

the latter study it was WC, low HDL and TG among females compared to WC and low HDL as found in this study.[7] In a study done in Korea,[21] male subjects had a 4.70- fold increased risk of meeting at least one of the metabolic syndrome criteria which was in contrast to our observations where risk was noted almost twice more in females.

In a study done in Korea, mean HDL level was 55.2 mg/dl and 57.8 mg/dl in males and females respectively which was more than our observations.[21] Also in previous studies and in our study, HDL values were significantly lesser in males probably due to lower physical activity among them.[17,18,21] Only in few studies it was significantly lesser among females.[7,9]

In the study done in Korea,[21] the mean TC level was 171.5 mg/dl, and the mean LDL level was 97.5 mg/dl compared to 151 mg/dl and 95 mg/dl observed in this study. Elevated blood pressure was seen among greater proportion of males in this study and in other studies.[7,9,17]

In the Korean study, poor sleep quality was significantly associated with meeting one or more of the metabolic syndrome criteria which was similar to our findings.[21] They reported a 2.98- fold increased risk for metabolic syndrome in poor sleepers when compared with good sleepers.[21] Hall *et al*. showed that sleep duration was related to metabolic syndrome in midlife adults, reporting an odds ratio of 1.83 and 1.48 for those sleeping <6 and 6–7 h/day relative to adults sleeping 7–8 h/day.[24] Choi *et al*. reported a hazard ratio of 1.8 for the incidence of metabolic syndrome in middle-aged women sleeping <6 h/day relative to those sleeping 6 to 7.9 h/day.[25] This was because poor sleep quality and short sleep duration affect endocrine and metabolic functions as also supported by observations in this study.[26]

The prevalence of metabolic syndrome reported in other studies ranged from 4% to 22% among university students compared to none in this study.[7,21,27] One criteria of metabolic syndrome was noted among 21.9%[21] and 64.4%[28], two criteria among 7.3%[21] and 11.6%[28] and three or more criteria among 3.5%[28] and 4%[21] university students in previous studies which was lesser than our observations.

As much as 34.1% participants were at medium to high-risk status for cardiovascular diseases in this study. In other studies, proportion of university students with at least one risk factor for cardiovascular diseases ranged from 49% to 75%.[9,18,29]

CONCLUSION

Substantial proportion of young medical students were found to be obese in this study. Obese participants had higher levels of risk factors of metabolic syndrome namely abnormal WC, TG and HDL levels. Abnormal central obesity was found to influence FBS and BP values. BMI was found to be a useful index for prediction of risk factors of metabolic syndrome before screening these participants using blood tests.

More than three fourth of participants were positive for at least one of the diagnostic criterion of metabolic syndrome. Medium to high risk of cardiovascular diseases was observed in more than one-third of participants. The dietary habits and physical activity were reported to be poor in more than a third of the participants. Poor sleep duration at night was found to increase the risk of presence of risk factors of metabolic syndrome. Therefore, maintenance of healthy weight through proper diet, physical activity, and exercise is important for preventing metabolic syndrome. Periodic assessment of obesity and monitoring of sleep duration is essential to prevent metabolic syndrome among university students.

The results of this study clearly highlight the necessity to continue surveillance of various criteria of metabolic syndrome among young individuals. Universities that form an ideal setting for such initiatives need to have suitable health promotion and prevention programs targeting high-risk groups.

This study was done among a homogeneous population with respect to socioeconomic, educational and nutritional background. The use of probability sampling method ensured good representation of students of this institution across various academic years. However, this study has few limitations.

LIMITATIONS

The causal relationship between various risk factors assessed with disease outcomes cannot be ascertained in a cross sectional study. Also the findings of this study cannot be generalized to the general population of the same age group as these participants were of higher socio economic groups. Moreover, prevention practices against lifestyle related disorders are expected to be better among medical students than university students of other disciplines due to better awareness level.

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CONFLICT OF INTEREST

None declared

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ABBREVIATION USED

LDL: Low density lipoproteins; HDL: High density lipoproteins; VLDL: Very low density lipoproteins; TG: Triglycerides; TC: Total cholesterol; FBS: Fasting blood sugar; FBG: Fasting Blood Glucose; TFT: Thyroid function test; WC: Waist circumference; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; BMI: Body Mass Index.

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