ORIGINAL ARTICLE

Prevalence of metabolic syndrome and its correlation with lifestyle-related risk factors among medical students: A study from a medical college in North India

Pradeep Kumar[1], Nikhil Govil[2], Himanshu Madaan[3], Savita Chahal[4], Anuradha Nadda[5]*

[1]MBBS Intern, [2]Department of General Medicine, [3]Department of Biochemistry, [4]Department of Psychiatry, Kalpana Chawla Government Medical College, Karnal-132001 (Haryana) India,

[5]Department of Community Medicine, Dr. B. R. Ambedkar State Institute of Medical Sciences, Mohali-160055 (Punjab) India

Abstract

Background: Health professionals despite having a fair knowledge of staying fit and healthy lose their productive hours and lives to lifestyle diseases. An early identification of Metabolic Syndrome (MetS) and understanding of its lifestyle correlates can play a pivotal role in its prevention. *Aim and Objectives:* The objective of this study was to estimate the prevalence and associated lifestyle-related risk factors of MetS in medical students. *Material and Methods:* The study was an institution-based, cross-sectional, and non-interventional study. A total of 300 MBBS students of all three professional years constituted the study population. Sociodemographic variables and lifestyle-related risk factors were recorded, followed by anthropometric assessment, blood pressure measurement, and required laboratory investigations. International Diabetes Federation (IDF) criteria were used for MetS. *Results:* The prevalence of MetS in the current study was found to be 9.0%. Lower level of HDL-C emerged to be the most common parameter (57.37%) followed by abdominal obesity (25.6%) and raised triglycerides (18%). MetS increased as one progressed through the various academic years of medical training. Prevalence of MetS among male students (12.4%) was significantly higher than their female counterparts (4.1%). Frequency of eating > 7 times/week of fast food/ junk food [OR 1.75 (1.196-1.306)], habit of watching screen while eating food [OR 1.78 (0.872-0.892)], >3 drinks (30 ml alcohol per drink) per month [OR 1.73 (1.068-1.170)] were found to be significant risk factors. *Conclusion:* Considering the high prevalence of MetS among medical students and its association with various lifestyle risk factors, it is imperative that health education, screening, early detection, lifestyle interventions and framing of new health policies are given careful consideration to manage the rising trend of MetS among them.

Keywords: Metabolic syndrome, medical students, undergraduates, lifestyle factors, obesity, hypertension, dyslipidemia, diabetes mellitus

Introduction

Health professionals are one of the most knowledgeable and valuable human resources to mankind [1]. However, despite having a fair knowledge of staying fit and healthy, the doctors in India have shorter life expectancy compared to the general population with the corresponding figures for each being; 59 and 67.9 years respectively [2]. Majority of the doctors lose their lives to lifestyle diseases like diabetes mellitus, hypertension, cardiovascular disorders, etc. Academic stress, unhealthy eating habits, experimentation with substances and personal stressors like relationship problems often lead to erratic sleeping habits and the use of maladaptive coping strategies further

makes them vulnerable to MetS [3].

The prevalence of MetS among medical students in various Indian studies has been found to vary from 2.1% to 22% [3-7], compared to the mean prevalence of 13% in young adults (18-29 years) in the general population of India [7]. In the global context, the prevalence of MetS among university students including medical students ranged from 0 to 19.2% [8]. The previous studies had certain limitations such as the inclusion of medical students from one professional year or limited sample size, others had the bias of predominantly including the male population. Further, the majority of the Indian studies were concentrated in medical colleges in South India [5-7]. An early diagnosis and identification of MetS and an understanding of its lifestyle correlates can play a pivotal role in the prevention of various cardio-metabolic illnesses in medical students [4, 5, 7, 8]. This study aims to estimate the prevalence and associated lifestyle-related risk factors of MetS in medical students.

Material and Methods

The study was an institution-based and cross-sectional study conducted among the MBBS students of all three professional years in Kalpana Chawla Government Medical College (KCGMC) Karnal, Haryana from July 2021 to November 2021. The study was conducted after getting final approval from the Institutional Ethics Committee (IEC approval vide letter No: KCGMC/IEC/2020/09 dated 24.09.2020). The present study was an ICMR STS project (2020-06345).

The sample size was calculated using the formula: $n = (Z^2 \times P (1 - P))/E^2$; Z=1.96 for 95% CI, P is the expected true proportion which was taken to be 14% (prevalence in previous studies ranged from 6% to 22%, average of which came out to be 14%) [3-7], E (0.04) is desired precision. Using the formula, the sample size came out to be 290. The final sample size was taken to be 300. The sampling technique used in the current study was convenient sampling.

Students from all three professional years who gave written informed consent were included in the study. Students who were on treatment with any kind of regular medication (other than those used to treat any of the components of MetS) and those who did not follow the necessary instructions required for carrying out laboratory investigations like overnight fasting were excluded from the study. After screening the students as per inclusion and exclusion criteria, a proforma for sociodemographic variables and lifestyle-related risk factors was administered to each participant. It was followed by anthropometric assessment, blood pressure measurement and required laboratory investigations for each participant as per International Diabetes Federation (IDF) criteria for MetS defined below.

IDF criteria for MetS [9]

1. Waist Circumference (WC) to define abdominal obesity in people of Asian origin should be $\geqslant$ 90 cm for men and $\geqslant$ 80 cm for women. (If BMI is > 30 Kg/m^2, central obesity can be assumed and WC does not need to be measured)
2. Any two of the following
   i. Serum Triglycerides (TG) $\geqslant$ 150 mg/dl or on specific treatment for this lipid abnormality.
   ii. Serum High-Density Level-Cholesterol (HDL-C) $\leqslant$ 40 mg/dl for men and $\leqslant$ 50 mg/dl for women or on specific treatment for this lipid abnormality.

iii. Blood Pressure (BP) ⩾ 130/ 85 mm Hg or on treatment of previously diagnosed hypertension

iv. Fasting Blood Sugar (FBS) ⩾ 100 mg/dl or previously diagnosed Type 2 Diabetes Mellitus (T2DM)

a. Anthropometric assessment: All study participants were measured for the following anthropometric parameters: height, weight, and WC. Height was measured using the height meter and weight with the standardized scale. WC was measured using measuring tape immediately above the iliac crest as defined in IDF criteria for MetS. Body Mass Index (BMI) was calculated as square of weight (in kg) / height (in meters).

b. Blood pressure measurement: Blood pressure was measured in the right arm supine position using the following protocol: first measurement was made after at least 5 minutes of rest and was repeated 3 times, keeping 1 minute of interval between consecutive measurements. The final data was the average of 3 measurements.

c. Laboratory investigations: Blood samples were collected from the antecubital vein, in the early morning, after a minimum of 12 hours of fasting period, in a sitting position. The biochemical investigations (TG, HDL-C, and FBS) were carried out in the Department of Biochemistry, Kalpana Chawla Government Medical College, Karnal as per the standardized testing methods available.

Statistical analysis

The statistical analysis was carried out using IBM, Statistical Package for Social Sciences (SPSS) statistical version 20. The frequency, mean, median and standard deviation were calculated. Mean was compared by independent t-test (for two groups) and one-way ANOVA (for more than two groups) while for qualitative data Chi-square test was used. All statistical tests were seen at a two-tailed level of significance ($p \leqslant 0.01$ and $p \leqslant 0.05$).

Results

A total of 300 medical students from three different professional years participated in the study. The mean age of the students was 21.8 ± 1.2 years (range 17 to 26 years). Analysis of the socio-demographic data (Table 1) depicted that there was almost comparable representation of all the academic years in the study sample except the first professional which had the least number of participants (16.7%). There was a slight male preponderance of the study subjects with a male-to-female ratio of 1.4:1. The majority of the students (96.7%) were currently residing in a hostel away from their homes. About three-fourths of the students (75.3%) hailed from nuclear families. Out of all the participants, only one reported himself to be a known case of cardiovascular disease. None of the subjects reported themselves to be a diagnosed case of hypertension or diabetes mellitus. Parental history of diabetes mellitus, hypertension, and coronary artery disease was present in 65 (21.7%), 93 (29.6%), and 32 (10.6%) participants respectively.

Using the IDF criteria for diagnosing MetS, the prevalence of MetS in the current study was found to be 9.0% with a total of 27 students fulfilling the said criteria. Among the individual components of MetS, Lower level of HDL cholesterol emerged to be the most common parameter with a prevalence

of 57.37% followed by abdominal obesity (25.6%), raised triglycerides (18%), and hypertension (9.7%) in that order. The raised FBS level (1%) was the least prevalent among all components of MetS. Among the individuals with MetS, 3% had at least one of the components of MetS. The majority of individuals (13.7%) presented with at least 2 components while the subjects presenting with three and four components were observed with fewer frequencies at 7.7% and 1.3% respectively. None of the participants had all the four components together.

Table 1: Sociodemographic profile of study participants (n=300)

Variables	Number	Percentage
Academic year		
1st Professional	50	16.7%
2nd Professional	82	27.3%
3rd Professional (Part I)	87	29.0%
3rd Professional (Part II)	81	27.0%
Gender		
Male	178	59.3%
Female	122	40.7%
Domicile/background		
Urban	162	54.0%
Rural	138	46.0%
Current Residence		
Hostel	290	96.7%
Home	9	3.0%
Rented apartment/Paying Guest	1	0.3%
Family type		
Nuclear	226	75.3%
Joint	74	24.7%
Parental History of DM	65	21.7%
Parental History of HTN	93	29.6%
Parental History of CAD	32	10.6%

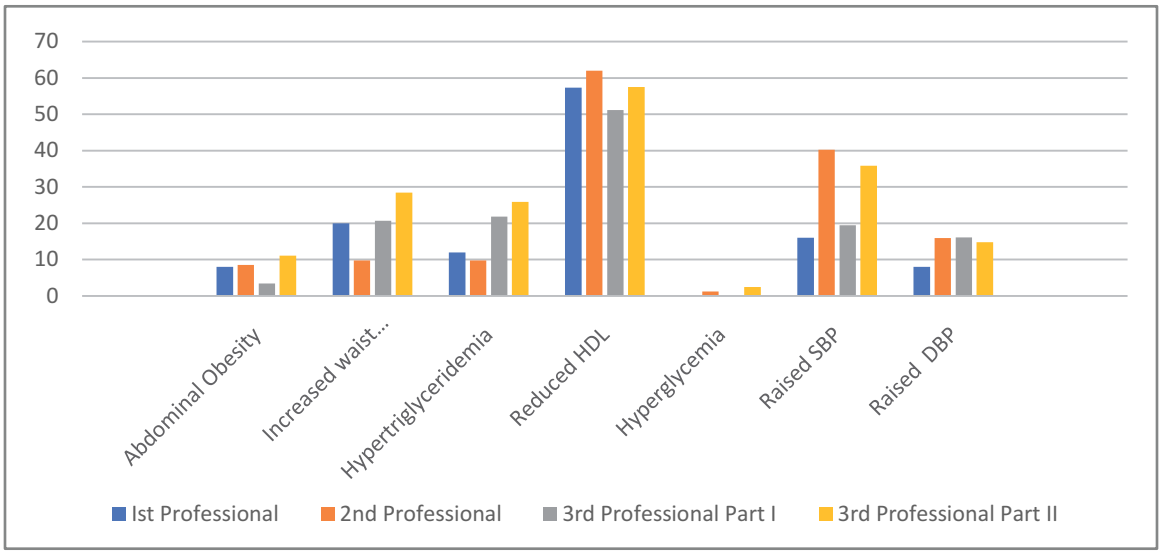

Figure 1: Academic Year wise Prevalence of Individual Components of MS

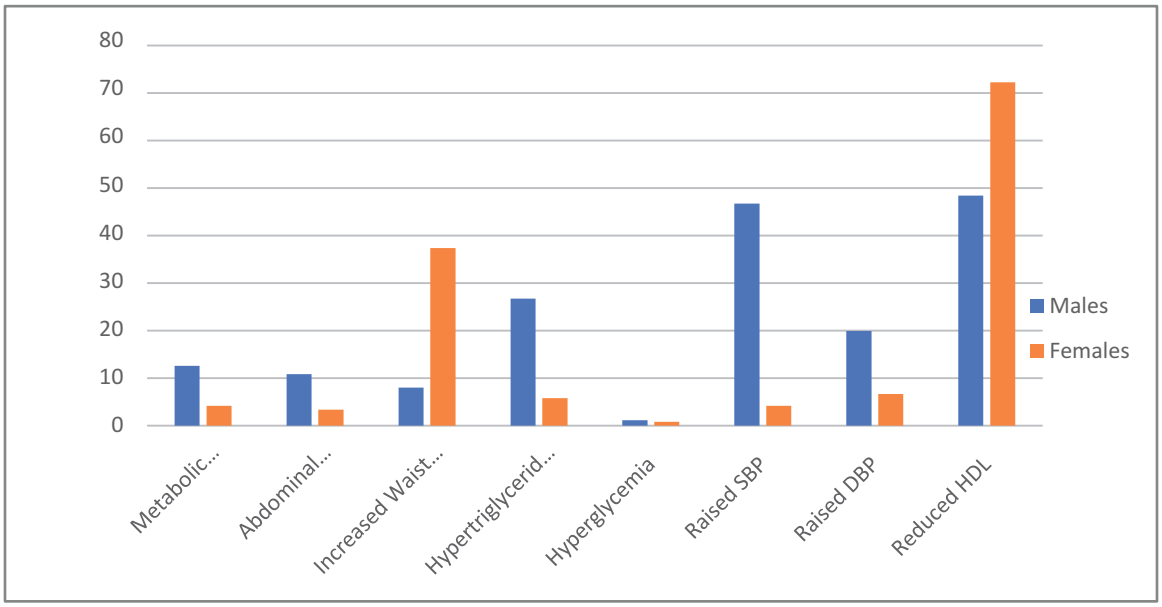

Figure 2: Gender wise prevalence of MS and its individual components

As evident from Figure 1, the prevalence of MetS increased as one progressed through the various academic years of medical training. A significantly higher number of medical students from the final year (17.3%) were found to have MetS compared to 6% among their first-year counterparts (p = 0.023). Among the individual components of MetS, abdominal obesity or increased WC was found to have greater prevalence in the final year students (11.1 and 28.4% respectively) over first year subjects (8% and 20% respectively) {p = 0.011; p = 0.028 respectively). Hypertriglyceridemia and raised systolic blood pressure were two other components that were found to have significantly increased in final-year participants (25.9% and 35.8% respectively) in comparison to first-year medical students (12% and 16% respectively) {p = 0.025; p = 0.002 respectively). However, no significant rise in the prevalence of three parameters viz. Lower level of HDL-C, increased FBS, and raised diastolic blood pressure were observed.

As can be seen in Figure 2, gender-wise comparison revealed that the prevalence of MetS among male students (12.4%) was significantly higher as compared to their female counterparts (4.1%) {p = 0.014}. Males had a significantly higher prevalence of central obesity (BMI $\geqslant$ 30 Kg/m^2), hypertriglyceridemia ($p < 0.01$), and hypertension ($p <$ 0.001). Compared to males (47.8%), significantly more females (71.3%) had reduced HDL levels (p = 0.0001). Significantly more female students (36.9%) had high WC compared to male students (7.9%) {p = 0.0001}. Gender-wise comparison of the mean scores of individual components of MetS revealed that the male students had significantly higher mean scores on almost all parameters except HDL levels (Table 2). There were significantly higher mean scores of BMI (24.98 ± 4.40), WC (83.13 ± 7.22), systolic blood pressure (127.04 ± 15.07) and serum triglycerides (115.04 ± 54.27) among final-year students compared to fresher students of medical college where the respective values were 23.05 ± 3.91, 78.01 ± 6.63, 118.08 ± 14.15 and 96.13 ± 39.76 (Table 3). Prevalence of MetS among students having a family history of diabetes mellitus, hypertension, and coronary artery disease was found to be 1 (1.5%), 8 (9%), and 1 (3.1%) respectively. The association between a family history of diabetes, hypertension, and coronary artery disease and MetS was found to be non-significant ($p < 0.05$).

Among the various lifestyle-related factors, quality of sleep emerged to be the statistically significant factor with 18.5% of those who felt tired after sleep having MetS compared to only 6.4% among those who felt rested after sleep (p = 0.003). Students eating junk food more than 7 times a week (p = 0.0001), students (14.7%) who had the habit of watching TV/laptop or phone while having food (p = 0.002), and students (11%) who exercised less than twice per week developed (p = 0.05) significant MetS. Significantly greater (32.3%) number of participants who consumed alcohol developed MetS compared to only 6.3% of those who did not (p = 0.0001) (Supplementary material; Tables 4 & 5).

Table 2: Gender-wise comparison of mean scores of individual components of MetS (n=300)

Parameters	Male (178)	Female (122)	t	*p*
BMI	24.77 ± 4.12	21.97 ± 3.54	6.114	**0.0001***
WC (cm)	82.19 ± 5.93	77.49 ± 7.36	6.103	**0.0001***
SBP (mm Hg)	130.60 ± 13.98	113.90 ± 12.69	10.546	**0.0001***
DBP (mm Hg)	78.30 ± 9.00	72.87 ± 9.96	4.912	**0.0001***
FBS (mg/dl)	82.11 ± 7.04	75.58 ± 7.94	7.487	**0.0001***
Serum TG (mg/dl)	116.93 ± 54.38	88.30 ± 36.40	5.085	**0.0001***
Serum HDL-C (mg/dl)	40.59 ± 7.03	45.44 ± 9.42	5.103	**0.0001***

Values expressed in Mean ± SD, BMI: Body mass index, WC: Waist circumference, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, FBS: Fasting blood sugar, TG: Triglycerides, HDL-C: High-density level cholesterol

Table 3: Academic year-wise comparison of mean scores of individual components of MetS (n=300)

Parameters	1st Professional	2nd Professional	3rd Professional (Part I)	3rd Professional (Part II)	F	*p*
BMI	23.05 ± 3.91	23.78 ± 4.14	22.56 ± 3.64	**24.98 ± 4.40**	5.418	**0.001**
WC (cm)	78.01 ± 6.63	80.03 ± 6.24	79.17 ± 6.71	**83.13 ± 7.22**	7.612	**0.0001**
SBP (mm Hg)	118.08 ± 14.15	127.22 ± 17.42	120.89 ± 14.28	**127.04 ± 15.07**	5.888	**0.001**
DBP (mm Hg)	74.64 ± 9.71	76.67 ± 8.80	75.80 ± 10.30	76.70 ± 10.18	0.594	0.620
FBS (mg/dl)	79.71 ± 8.25	80.05 ± 8.30	78.67 ± 7.28	79.54 ± 8.61	0.440	0.724
TG (mg/dl)	96.13 ± 39.76	94.95 ± 40.17	111.22 ± 58.16	**115.04 ± 54.27**	3.254	**0.022**
HDL-C (mg/dl)	43.76 ± 8.86	42.31 ± 8.25	43.69 ± 9.04	40.86 ± 7.38	2.006	0.113

Values expressed in Mean ± SD, BMI: Body mass index, WC: Waist circumference, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, FBS: Fasting blood sugar, TG: Triglycerides, HDL-C: High-density level cholesterol

Table 4: Correlation of lifestyle-related factors with MetS (n=300)

Lifestyle factors	Subjects with MetS (n=27)	Subjects without MetS (n= 273)	Total*	Chi-Square	*p*
Sleep					
i) During routine college days, you have					
< 6 hours of sleep/day	5(6.4%)	73(93.6)	7(26)	1.032	0.597
6-10 hours of sleep/day	21(9.8%)	194(90.2%)	215(71.5)		
> 10 hours of sleep/day	1(14.3%)	6(85.7%)	7(2.3)		
ii) During exams/tests/assessments, you have					
< 4 hours of sleep/day	11(14.1%)	67(85.9%)	78(26)	5.314	0.070
4-6 hours of sleep/day	15(8.6%)	159(91.4%)	174(58)		
> 6 hours of sleep/day	1(2.1%)	47(97.9%)	48(16)		
iii) Quality of sleep					
Feel rested after sleep	15(6.4%)	220(93.6%)	235(78.3)	9.070	**0.003***
Feel tired after sleep	12(18.5%)	53(81.5%)	65(21.7)		
iv) Do you experience daytime sleepiness					
Not at all	4(12.9%)	27(87.1%)	31(10.3)	0.692	0.708
Some days	17(8.3%)	187(91.7%)	204(68)		
Most of the days	6(9.2%)	59(90.8%)	65(21.7)		
Food					
i) Dietary pattern					
Vegetarian	20(9.2%)	198(90.8%)	218(72.7)	0.030	0.863
Non-vegetarian	7(8.5%)	75(91.5%)	82(27.3)		
ii) Frequency of eating fast food/ junk food					
< 3 times/week	6(3.0%)	191(97.0%)	197(65.7)	43.620	**0.0001***
3-7 times/week	16(16.8%)	79(83.2%)	95(31.7)		
> 7 times/week	5(62.5%)	3(37.5%)	8(2.7)		

Lifestyle factors	Subjects with MetS (n=27)	Subjects without MetS (n= 273)	Total*	Chi-Square	*p*
iii) Habit of watching the screen while eating food					
Yes	20(14.7%)	116(85.3%)	136(45.3)	9.890	**0.002***
No	7(4.3%)	157(95.7%)	164(54.7)		
iv) Eating during stress					
Eating more food during stress	9(11.0%)	73(89.0%)	82(27.3)	1.510	0.470
Eating does not change during stress	11(10.2%)	97(98.8%)	108(36)		
Eating less during stress	7(6.4%)	103(93.6%)	110(36.7)		
v) Do you drink soft drinks					
Not at all	2(5.6%)	34(94.4%)	36(12)	0.867	0.648
Sometimes	22(9.9%)	201(90.1%)	223(74.3)		
Often	3(7.3%)	38(92.7%)	41(13.7)		
vi) How often do you consume fruits					
< 2 times a week	13(11.3%)1	102(88.7%)	115(38.3)	2.809	0.245
2-5 times a week	13(9.0%)	132(91.0%)	145(48.3)		
> 5 times a week	1(2.5%)	39(97.5%)	40(13.3)		
Physical activity/ exercise					
Exercise ⩽ 2times/week	24 (11%)	195(89.0%)	219(73)	3.80	**0.05**
Exercise ⩾ 3 times/week	3(3.7%)	78(96.3%)	81(27)		
Stress					
i) Academic stress					
Experience stress before every test/internal exam/ assessment	14(9.5%)	133(90.5%)	147(49)	4.246	0.120
Experience stress only during term exams (final exams)	13(11.1%)	104(88.9%)	117(39)		
Do not experience stress at all	0(0%)	36(100%)	36(12)		

Lifestyle factors	**Subjects with MetS (n=27)**	**Subjects without MetS (n= 273)**	**Total***	**Chi-Square**	***p***
Stress due to other reasons (relationship problems, family issues, financial, health etc.)					
Do not experience stress at all	3(4.5%)	64(95.5%)	67(22.3)	3.721	0.156
Sometimes	20(9.5%)	190(90.5%)	210(70)		
Most of the time	4(17.4%)	19(82.6%)	23(7.7)		
Have you ever sought treatment (medication or counselling) for stress					
Yes	2(6.3%)	30(93.8%)	32(10.7)	0.331	0.565
No	25(9.3%)	243(90.7%)	268(89.3)		
Substance use					
Do you smoke? (Smoking at least one cigarette daily)					
No	26 (8.8%)	269(92.0%)	295(98.3)	0.751	0.386
Yes	1(20.0%)	4(80.0%)	5(1.7)		
Do you take alcohol? (1 drink = 30 ml)					
No (⩽ 3 drinks per month)	17(6.3%)	252(93.7%)	269(89.7)	23.130	**0.0001***
Yes (>3 drinks per month)	10 (32.3%)	21 (67.7%)	31(10.3)		
Do you use any substance other than tobacco or alcohol					
Yes	1(14.3%)	6(85.7%)	7(2.3)	0.244	0.621
No	26(8.9%)	267(91.1%)	293(97.7)		

Table 5: Results of adjusted binary logistic regression of MetS by significant variables

Variables	OR	EXP (B)	CI	*p*
i) Quality of sleep				
Feel rested after sleep*	1	1.795	1-1	0.295
Feel tired after sleep	1.2		0.588-0.662	
ii) Frequency of eating fast food/ junk food				
< 3 times/week*	1	5.774	1-1	**<0.001**
3-7 times/week	1.52		1.164-1.292	
> 7 times/week	1.75		1.196-1.306	
iii) Habit of watching screen while eating food				
No*	1	0.167	1-1	**0.003**
Yes	1.78		0.872-0.892	
iv) Physical activity/ exercise				
Exercise ⩽ 2 times/week*	1	0.347	1-1	0.136
Exercise ⩾ 3 times/week	-1.05		1.135-1.237	
v) Do you take alcohol? (1 drink= 30 ml)				
No (⩽ 3 drinks per month)*	1	5.693	1-1	**<0.001**
Yes (> 3 drinks per month)	1.73		1.068-1.170	

Discussion

The present study was undertaken on 300 MBBS students of either gender aged 17 to 26 years studying in different professional years of a medical college in North India. The prevalence of MetS in the current study was estimated to be 9% which is close to the study conducted by Jai Prakash *et al*. (9%) and 10.83% found by Teli *et al*. [6,10].

However, there are a multitude of previous research; many of which have estimated a much lower prevalence (2.2% to 5.9%) [5, 7], while many others have found a much higher prevalence (15.5% to 22%) than ours [1, 3]. This difference in prevalence could be influenced by the population (age, gender, professional year) and geographical region being studied or the use of different criteria such as National Cholesterol Education Program – Adult Treatment Panel III, IDF, Indian consensus criteria, etc.

Lower level of HDL-C (57.37%) emerged to be the most common individual parameter in the current study followed by abdominal obesity (25.6%), hypertriglyceridemia (18%), and hypertension (9.7%) in that order. Abdominal obesity and reduced HDL-C have consistently been the two most prevalent parameters in most previous studies including those by Teli *et al*. and Vizmanos *et al*. with a prevalence of 59.17%, 38.33% and 29.7%, 27.5% respectively [1, 6].

In the present study, the prevalence of MetS among male students was significantly higher as compared to their female counterparts (12.4% versus 4.1%); with this gender difference being supported by a considerable number of previous studies [3, 11-13] Genetic, biological, dietary habits, socio-cultural behaviours are some of the factors associated with this gender-related trend in MetS [14]. A higher prevalence among males might be attributable to higher rates of obesity, high triglycerides, high blood pressure, and lifestyle habits like smoking and alcohol consumption. Subclinical hypothyroidism, common among females is often associated with a higher prevalence of MetS among them, however, this association was not studied in the current research [15].

Significantly more females than males had abnormal values of WC and HDL-cholesterol while in those with abnormal values of TG and BP, there were significantly more males. This mirrors the findings of a study conducted by Issac *et al*. [5] Even though the mean scores of HDL-C were higher among females, relatively more of them had abnormal values of HDL-C compared to males which could be due to higher cut-off for HDL-C levels for diagnosis of MetS among females. Further, lack of physical exercise is generally common among females despite them being more weight-conscious. Lower level of HDL-C scores among males (40.59 ± 7.03) in our study compared to females (45.44 ± 9.42) are in line with the findings of previous studies though the mean HDL-C scores in this study are quite lower than previous studies [16].

Male students had significantly higher mean scores of all parameters than their female counterparts except HDL-C levels. This pattern of high mean HDL-C scores among females can be explained by high levels of estrogen hormone among them, a hormone that holds a direct relationship with cardio-protective HDL-C [17]. Lower level of HDL-C was the most common component of MetS in both genders. This could be because of lesser physical activity among females while the habit of smoking is more prevalent among males.

The prevalence of MetS increased from 6% to 17.3% as one progressed through various professional years of medical training. A six-year follow-up study conducted by Lavalle *et al*. [18] also found a rise in the prevalence of MetS from 9.8% to 14.5% though not clinically significant. This rise in the prevalence of MetS over around 4 years in the current study could be attributable to biochemical and metabolic changes accumulated due to dietary and lifestyle changes over a period as a consequence of being hostellers and having high academic stress.

The higher mean scores of BMI, waist circumference, systolic blood pressure, and serum triglycerides among final year students compared to fresher students could be attributed to cumulative effects of lack of healthy lifestyle practices, sedentary lifestyle, erratic dietary habits characterized by over consumption of junk food and preserved food items with the lesser intake of fresh fruits, skipping of meals, poor sleeping

habits, stressful environment, and increased substance use over the years. The contribution of the recent COVID-19 pandemic to increasing stress and altering the lifestyle of medical professionals cannot be denied [19].

Among the lifestyle-related factors, dietary factors found to be associated with MetS in this study were frequent (> 7 times/week) consumption of junk food and the habit of watching TV/laptop while eating food. Junk foods are usually calorie-rich with high content of saturated fats and sugars but low content of vitamins, minerals, and proteins. Increased consumption of junk food increases the risk of obesity [20]. Increased screen media exposure during mealtime leads to overeating, improper chewing, faulty signals to the brain satiety centre due to distraction, lower metabolic rate and ultimately leading to obesity and MetS [21]. In a similar study of lifestyle disease risk factors among adolescent school students in South India, there was evidence of suboptimal fruits and vegetables consumption and physical activity which further seems to worsen upon entering medical college [22].

A significant association between alcohol consumption and MetS in the current study matches closely with the findings of Kandula *et al*. [23]. Alcohol consumption contributes to the development of MetS by causing insulin resistance and dyslipidemia and by contributing to hypertension as well as increased WC [24-25].

Conclusion

There was a higher prevalence of MetS among male students and third professional students compared to the female and first professional medical students respectively. Further, various lifestyle risk factors such as junk food, screen time while eating food and alcohol were found to have significant association with MetS among them. Considering the high prevalence of MetS among medical students and its association with various lifestyle risk factors, it is imperative that health education, early detection, lifestyle interventions and framing of new health policies be given careful consideration to manage the rising trend of MetS among medical students.

Limitations and Recommendation

The causal relationship between various lifestyle-related risk factors and MetS could not be ascertained due to the cross-sectional design of the study. Since the data collection was done in the period immediately after the lifting of COVID-19 lockdown, the intricate interplay of various factors during COVID-19 lockdown might have influenced the physical health of students and ultimately the findings of this study. Regular screening of medical students for early detection of MetS is recommended. Interventions in the form of dietary, lifestyle modifications, stress management, and pharmacological treatment should be rigorously implemented for medical students, especially after COVID-19 pandemic for the prevention of risk factors for the development of the MetS and to improve the health of young budding doctors.

Acknowledgments

The authors would like to extend their gratitude to the students for their cooperation and participation in the study.

Financial support or sponsorship

The project is funded by the Indian Council of Medical Research under short-term studentship (ICMR STS Project (2020-06345).

References

1. Vizmanos B, Betancourt-Nuñez A, Márquez-Sandoval F, González-Zapata LI, Monsalve-Álvarez J, Bressan J, *et al*. Metabolic syndrome among young health professionals in the multicenter Latin America metabolic syndrome study. *Metab Syndr Relat Disord* 2020; 18(2):86-95.
2. Pandey SK, Sharma V. Doctor, heal thyself: Addressing the shorter life expectancy of doctors in India. *Indian J Ophthalmol* 2019; 67(7):1248-50.
3. Kanitkar SA, Kalyan M, Diggikar P, More U, Kakrani AL, Gaikwad A, Agarwal R, Makadia A. Metabolic Syndrome in Medical Students. *JIMSA* 2015; 28(1): 14-15.
4. Duperly J, Lobelo F, Segura C, Sarmiento F, Herrera D, Sarmiento OL, *et al*. The association between Colombian medical students' healthy personal habits and a positive attitude toward preventive counseling: cross-sectional analyses. *BMC Public Health* 2009; 9:218.
5. Issac R, Pengan MC, Sudhiraj PS, Paul SS, Chirukandath R. Cross sectional study on prevalence of metabolic syndrome among medical students: Time to intervene for future. *Int J Health Clin Res* 2020; 3(11):85-91.
6. Teli A, Jabannavar, Adorno I, Gayatri GS, Lampis F, Patil P. Estimation of prevalence of metabolic syndrome among 1st year medical students of a medical college in North Karnataka, India. *Indian J Health Sci Biomed Res* 2019; 12: 174-8.
7. Krishnamoorthy Y, Rajaa S, Murali S, Rehman T, Sahoo J, Kar SS. Prevalence of metabolic syndrome among adult population in India: A systematic review and meta-analysis. *PLoS One* 2020; 15(10): e0240971.
8. Campo-Arias A, González-Guerrero JL, Peñaloza-Vázquez C, Tatis-González JF. Prevalence of metabolic syndrome among university students: A systematic review. *Rev Fac Med* 2018; 66(4): 629-633.
9. Yahia N, Brown C, Rapley M, Chung M. Assessment of college students' awareness and knowledge about conditions relevant to metabolic syndrome. *Diabetol Metab Syndr* 2014; 6(1):111
10. Jai P, Venkatesh P, Rajesh SS, Krishna Iyengar. A study on prevalence of metabolic syndrome in young medicos of South Karnataka. *Indian J Public Health Res Develop* 2020; 11(7): 318-323.
11. Sawant A, Mankeshwar R, Shah S, Raghavan R, Dhongde G, Raje H, *et al*. Prevalence of metabolic syndrome in urban India. *Cholesterol* 2011; 2011:920983.
12. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988-1994. *Arch Pediatr Adolesc Med* 2003; 157(8):821-827.
13. Padmavathi P, Sailaja E, Renuka E, Gnanadesigan E, Mahendran KB. Prevalence of metabolic syndrome. *Int J Res Pharm Biomed Sci* 2013; 4(3):66-9.
14. Regitz-Zagrosek V, Lehmukhl E, Weicker MO. Gender differences in the metabolic syndrome and their role for cardiovascular disease. *Clin Res Cardiol* 2006; 95(3): 136-147.
15. Munde SM, Thorat AP, Hazari NR, Karad VS. Metabolic syndrome and insulin resistance in women with subclinical hypothyroidism. *J Krishna Inst Med Sci Univ* 2022; 11(1):55-64.
16. Mee-Kyung S, Jongsoon W, Hyeryeon Y. Prevalence of Metabolic Syndrome in University students in Korea. *Indian J Sci Technol* 2015; 8(16): 1-7.
17. Krauss RM, Lindgren FT, Wingerd J, Bradley DD, Ramcharan S. Effects of estrogens and progestins on high density lipoproteins. *Lipids* 1979; 14(1):113-118.
18. Lavalle FJ, Villarreal JZ, Montes J, Mancillas LG, Rodríguez SE, González P, *et al*. Change in the prevalence of metabolic syndrome in a population of medical students: 6-year follow-up. *J Diabetes Metab Disord* 2015; 14:85.
19. Chahal S, Govil N, Gupta N, Nadda A, Srivastava P, Gupta S, Dang P. Stress, coping and attitudinal change towards medical profession during COVID-19 pandemic among health care professionals in India: a cross sectional study. *Indian J Mental Health* 2020; 7(3):255-262.
20. Bodor JN, Rice J, Farley T, Swalm CM, Rose D. The association between obesity and urban food environments. *J Urban Health* 2010; 87(5):771-781.
21. Robinson TN, Banda JA, Hale L, Lu AS, Fleming-Milici F, Calvert SL, *et al*. Screen Media Exposure and Obesity in Children and Adolescents. *Pediatrics* 2017; 140(Suppl 2):S97-S101.

22. Mani G, Balaji SM. Profile of selected lifestyle disease risk factors among adolescent school students in an industrial area of Vellore District, Tamil Nadu. *J Krishna Inst Med Sci Univ* 2019; 8(4):76-88.
23. Kandula SGNSV, Sekhar STVD, Kongara S, Arepalli SK. A study on the prevalence of obesity and metabolic syndrome among students of a medical college. *Int J Res Med Sci* 2017; 5(6): 2331-2337.
24. Stranges S, Wu T, Dorn JM, Freudenheim JL, Muti P, Farinaro E, *et al*. Relationship of alcohol drinking pattern to risk of hypertension: a population-based study. *Hypertension* 2004; 44(6):813-819.
25. Magis DC, Jandrain BJ, Scheen AJ. Alcohol, insulin sensitivity and diabetes. *Rev Med Liege* 2003; 58(7-8): 501-507.

Author for Correspondence:
Dr. Nikhil Govil, Department of General Medicine, Kalpana Chawla Government Medical College, Karnal, Haryana, India.
E-mail: govilnikhil37@gmail.com Cell: 8950228410

How to cite this article:
Kumar P, Govil N, Madaan H, Chahal S, Nadda A. Prevalence of metabolic syndrome and its correlation with lifestyle-related risk factors among medical students: A study from a medical college in North India. *J Krishna Inst Med Sci Univ* 2024; 13(2):44-58.

Submitted: *30-Dec-2023* ***Accepted:*** *19-Feb-2024* ***Published:*** *01-Apr-2024*