

## Prevalence of Metabolic Syndrome and Identification of Cardiovascular Disease Risk Factors Among Medical Students

Swarnim Swarn<sup>1</sup>, Indu Prasad<sup>2</sup>, Satish Kumar<sup>3</sup>, Binod Shankar Singh<sup>4</sup>, Ganesh Prasad Singh<sup>5</sup>

<sup>1</sup>Tutor, Department of Biochemistry, Vardhman Institute of Medical Sciences, Pawapuri, Bihar, India

<sup>2</sup>Assistant Professor, Department of Biochemistry, Vardhman Institute of Medical Sciences, Pawapuri, Bihar, India

<sup>3</sup>Associate Professor, Department of Medicine, Nalanda Medical College, Patna, Bihar, India

<sup>4</sup>Professor and Head of the department, Department of Biochemistry, Vardhman Institute of Medical Sciences, Pawapuri, Bihar, India

<sup>5</sup>Associate Professor, Department of Medicine, Vardhman Institute of Medical Sciences, Pawapuri, Bihar, India

---

Received: 18-09-2021 / Revised: 07-10-2021 / Accepted: 22-10-2021

Corresponding author: Dr. Satish Kumar

Conflict of interest: Nil

---

### Abstract

**Introduction:** Metabolic syndrome (MS) refers to the co-occurrence of several known cardiovascular risk factors, including insulin resistance, obesity, atherogenic dyslipidemia and hypertension. Metabolic syndrome (MS) increases the risk of developing type 2 DM and cardiovascular diseases. The National cholesterol education program- adult treatment panel III (NCEP- ATP III) definition incorporates the key features of hyperglycemia/insulin resistance, visceral obesity, atherogenic dyslipidemia and hypertension.

**Objectives:** The present study was aimed to estimate the prevalence of metabolic syndrome among medical students of VIMS, Pawapuri and to identify the important risk factors for cardiovascular disease.

**Material and methods:** A cross-sectional study was conducted among medical students at Vardhman Institute of Medical Sciences (VIMS), Pawapuri, Bihar from June 2021 to August 2021 after obtaining approval from the Institutional Ethics Committee. Two hundred sixty medical students of Vardhman Institute of Medical Sciences, Pawapuri, Bihar were included in this study. Participants were interviewed using a standardised questionnaire and height, weight, hip circumference and blood pressure were measured. A venous blood sample was taken for biochemical tests like plasma glucose, HDL, LDL and TG. Obtained data were statistically analysed using SPSS.

**Results:** Out of 260 medical students included, 169(65%) were male and 91(35%) females. The mean age of the male students' group was  $20.40 \pm 3.44$  years and the female students' group was  $21.32 \pm 3.27$  years. Only 5.76% of students gave a history of smoking and 3.84% regular alcohol consumption. Family history of Diabetes, Hypertension or cardiovascular diseases was present among 44.23% of students. Mean BMI among females was  $24.71 \pm 3.68$  kg/m<sup>2</sup> and  $23.81 \pm 3.07$  kg/m<sup>2</sup> in males. 25.76% of students were overweight and 33.84% were obese. Metabolic Syndrome was diagnosed in 23.46% of students. The prevalence of metabolic syndrome in females (28.6%) was higher than in males (20.7%).

**Conclusion:** Obesity and dyslipidaemia are prevalent among medical students and must be considered as an important component of MS and potential risk factors for diabetes and CVD. Regular screening of these risk factors and awareness among medical students about these would help prevent diabetes and CVD in society.

**Keywords:** Metabolic syndrome, cardiovascular risk & metabolic syndrome.

---

This is an Open Access article that uses a fund-ing model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

---

## Introduction

Metabolic syndrome (MS) refers to the co-occurrence of several known cardiovascular risk factors, including insulin resistance, obesity, atherogenic dyslipidemia and hypertension. These conditions are interrelated and share underlying mediators, mechanisms and pathways. Physicians and scientists have long known that certain conditions increase a person's risk of developing atherosclerotic cardiovascular disease (CVD). These risk factors include a family history of premature coronary disease, hypertension, hyperlipidemia, diabetes and smoking. Age increases the risk of CVD, as do male gender and post-menopausal hormonal status. Of these risks, some can be modified – for example, cessation of smoking – whereas others, like genetic predisposition, cannot. The risk of CVD can be decreased by addressing these individual risk factors, both by lifestyle modifications and, if appropriate, pharmacologic treatment.

The National cholesterol education program- adult treatment panel III (NCEP-ATP III) definition is one of the most widely used criteria of metabolic syndrome. It incorporates the key features of hyperglycemia/insulin resistance, visceral obesity, atherogenic dyslipidemia and hypertension.[1]

Metabolic syndrome (MS) increases the risk of developing type 2 DM and cardiovascular diseases over the next 5 to 10 years by five and two-fold respectively [2]. Furthermore, the patients with MS have, an average four-fold increased risk of

developing stroke & myocardial infarction and a two-fold risk of dying from a similar event compared with those without MS, regardless of the previous history of cardiovascular events [3].

Asn estimated one-fourth of the world's adult population (i.e., approximately a billion adults globally) are likely to be having Metabolic syndrome [4]

In India, insulin resistance and Metabolic syndrome are widely prevalent. In a systematic review and meta-analysis done by Krishnamoorthy Y. et al, the prevalence of MS among the adult population in India was 30% (95%CI: 28%-33%). There was a steady increase in the burden across the age groups from 13% (18–29 years group) to 50% (50–59 years), people living in urban areas (32%; 95%CI: 29%-36%) had higher prevalence when compared to tribal (28%; 95%CI: 21%-36%) or rural adults (22%; 95%CI: 20%-25%). Gender distribution of MS showed that the females had a higher prevalence (35%; 95%CI: 31%-38%) when compared to males 26% (95%CI: 22%-29%).[5]

Medical students and doctors experience high rates of psychological morbidity due to their work and study environment [6][7]. Stress may be a contributing factor to unhealthy behaviors and co-morbidities. Other aspects of medical students' health and lifestyles, such as reduced physical activity and poor diet, increased workload and stress, fast-food consumption, alcohol consumption, smoking, and illicit drug use have been observed. [8]

Many previous studies have estimated the prevalence of metabolic syndrome among medical students [10,11,12,13] but the prevalence of metabolic syndrome varies in different geographical areas, urban and tribal/ rural areas, different races and ethnic groups, different ages groups and gender [5]. Identification of the metabolic syndrome at an early age and a follow-up intervention is the best way to deal with it at its earliest and minimize cardiovascular diseases related to morbidity and mortality.[9] No study had been done to estimate the prevalence of metabolic syndrome and the cardiovascular risk factors among medical students in Bihar. Considering these facts, this study was planned.

#### **Aims and objectives:**

1. To estimate the prevalence of metabolic syndrome among medical students of VIMS, Pawapuri
2. To identify the important risk factors for cardiovascular disease

#### **Material and methods:**

##### **Research design:**

The present study was a cross-sectional study and was conducted among medical students at the Vardhman Institute of Medical Sciences (VIMS), Pawapuri, Bihar from June 2021 to August 2021. Approval from Institutional Ethics Committee was obtained vide letter no.1036, dated 16.06.2021

##### **Sample size:**

The sample size was calculated using formula  $n = Z^2 PQ/d^2$  [14,15]. Prevalence of metabolic syndrome is 10.83,[10] with precision of 5% and confidence level of 99%; so,  $n = Z^2 PQ/d^2$ , where  $P = 10.83\%$ ,  $Q = 89.17\%$  ( $100 - 10.83$ ),  $d = 5$ ,  $Z = 2.58$  (99% CI),  $n = 257 \approx 260$ .

Informed consent was obtained from all the participants.

##### **Inclusion criteria:**

All the apparently healthy undergraduate and postgraduate students of VIMS, Pawapuri, Bihar, India of age 17 years and above, willing to participate in this study, were included in this study.

##### **Exclusion criteria:**

- Already diagnosed cases of diabetes mellitus, hypertension, hypothyroidism, renal disorders or liver disorders.
- on medication like statins
- acutely ill
- Pregnant
- not willing to participate

##### **Procedure:**

Each participant was interviewed using a standardized questionnaire containing information on demographics like age, gender, exercise, smoking, alcohol consumption, family history of diabetes mellitus, hypertension, cardiovascular diseases.

##### **Questionnaire**

1. Name
2. Age
3. Gender
4. Do you smoke? Yes/No
5. Do you take alcohol? Yes/No
6. Do you or your family members suffer from diabetes mellitus, hypertension, or cardiovascular diseases

##### **Criteria for Metabolic Syndrome**

National cholesterol education program-adult treatment panel III (NCEP- ATP III) definition was used to estimate metabolic syndrome in the present study if three or more of the following five criteria were met:

**Central obesity:** waist circumference over 40 inches or 102 cm (men) or 35 inches or 88 cm (women), 2. Hypertension: blood pressure  $\geq 130/85$  mmHg or specific medication, 3. Hypertriglyceridemia: triglyceride (TG) level  $\geq 150$  mg/dl or specific medication, 4. Low high-density lipoprotein (HDL) cholesterol: less than 40

mg/dl (men) or 50 mg/dl (women) or specific medication and 5. fasting plasma glucose  $\geq$  100 mg/dl or specific medication or previously diagnosed type2 diabetes. [1,16]

**Underweight:** BMI <18kg/m<sup>2</sup> Normal BMI: 18.0-22.9 kg/m<sup>2</sup>, Overweight: 23.0-24.9 kg/m<sup>2</sup>, Obesity: >25 kg/m<sup>2</sup>

### Anthropometric parameters

Following anthropometric parameters were studied; Height, Weight, Waist Circumference. Height (in meter) was measured using the height meter and weight (in Kg) with the standardized scale. Waist circumference (in meters) was measured using an inch tape immediately above the iliac crest as defined by the National cholesterol education program- adult treatment panel III (NCEP- ATP III) guidelines. Body mass index (BMI) was calculated as weight (kg)/ height<sup>2</sup> (meters).

### Clinical and biochemical parameters

Blood pressure was measured in the right arm sitting posture. Using all aseptic precautions, antecubital venous blood samples were obtained in the fasting state to measure plasma glucose and lipid levels (total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein, (LDL) triglyceride (TG).

### Statistical analysis:

The obtained data were statistically analysed using SPSS, Version 27.0.1.0. Mean, standard deviation (SD), standard error (SE), 95% confidence intervals were calculated. Chi-square test was used to assess the association. Independent student

t-test was used to compare the means of two independent variables. Pearson's correlation coefficient was used to assess the correlation between the biochemical profile and anthropometric parameters. P-value <0.005 was considered statistically significant.

### Results:

In the present study, 260 medical students were included, 169(65%) being male and 91(35%) females. The mean age of the male students' group was 20.40  $\pm$  3.44 years and the female students' group was 21.32  $\pm$  3.27 years. (Table 1) Mean BMI among females was 24.71  $\pm$  3.68 kg/m<sup>2</sup> while the mean BMI among males was 23.81  $\pm$  3.07 kg/m<sup>2</sup>. (Table 2) on the further categorization of BMI, 105(40.38%) students had normal BMI, 67(25.76%) students were overweight and 88 (33.84%) were obese. (Table 3) Metabolic Syndrome was diagnosed in 23.46% of students. Females had more cases of metabolic syndrome in their group (28.6%) when compared to males. (20.7%) but this difference was not statistically significant. Only 15 students (5.76%) gave the history of smoking while a history of regular alcohol consumption was given by only 10 students 3.84%). Family history of Diabetes, Hypertension or cardiovascular diseases was present among 115(44.23%) students. (Table 4) Among the risk factors of metabolic syndrome Smoking and family history of Diabetes, Hypertension and Cardiovascular Diseases were significantly associated with metabolic syndrome. The difference in age and Body mass index was significantly associated with metabolic syndrome.

**Table 1: Comparison of males and females with mean age and body mass index by independent t-test**

VARIABLE	Male(n=169)		Female(n=91)		F	p
	Mean	SD	Mean	SD		
Age (years)	20.40	3.44	21.32	3.27	11.74	<0.001
Weight(kg)	61.59	8.40	57.14	7.51	1.080	0.300
Height(meter)	160.80	4.27	152.28	3.21	20.519	<0.001

BMI (kg/m <sup>2</sup> )	23.81	3.07	24.71	3.68	0.885	0.348
Waist (centimetres)	86.22	8.23	84.71	7.83	0.137	0.711
SBP (mmHg)	123.18	9.33	118.28	5.92	13.299	<0.001
DBP (mmHg)	77.85	7.10	76	3.56	42.926	<0.001
FPG (mg/dl)	96.73	7.61	97.14	7.88	0.231	0.631
TG (mg/dl)	164.71	83.91	181.71	73.24	7.716	0.006
LDL (mg/dl)	100.27	24.05	118.28	19.20	7.287	0.007
HDL (mg/dl)	48.18	8.63	49.42	7.65	3.134	0.078

Table 2: Gender wise distribution of frequency of BMI

Category	Males(n=169)	Females(n=91)	Total (n=260)		P value
Underweight	0	0	0	10.735	<0.005
Normal	66(39.1%)	39(42.9%)	105(40.38%)		
Overweight	54(32%)	13((14.3%)	67(25.76%)		
Obese	49(29%)	39(42.9%)	88(33.84%)		

Table 3: Frequency of lifestyle habit among subjects with and without Metabolic Syndrome

HABIT	Non-MS (n=199)	MS (n=61)	Total (n=260)	$\chi^2$	P Value
<b>SMOKING</b>				28.33	<0.001
Absent	196(98.5%)	49(80.3%)	245(94.23%)		
Present	3(1.5%)	12(19.7%)	15((5.76%)		
<b>ALCOHOL</b>				4.079	0.043
Absent	194(97.5%)	56(91.8%)	250(96.15%)		
Present	5(2.5%)	5(8.2%)	10(3.84%)		
<b>FAMILY HISTORY</b>				100.489	<0.001
Absent	145(72.9%)	0(00%)	145(55.76%)		
Present	54(27.1%)	61(100%)	115(44.23%)		

Table 4: Prevalence of Metabolic Syndrome categorized by Age, Gender and BMI

VARIABLE	MS	Non-MS	TOTAL	$\chi^2$	P VALUE
<b>Age(years)</b>					
17-20	18	116	134	42.801	<0.001
21-24	21	65	86		
25-28	13	18	31		
29-32	9	0	9		
<b>Sex</b>					
Male	35(20.7%)	134(79.3%)	169	2.036	0.154
Female	26(28.6%)	65(71.4%)	91		
<b>BMI</b>					
underweight	0	0	0	80.15	<0.001
normal	0	105(52.8%)	105(40.4%)		
overweight	13(21.3%)	54(27.13%)	67(25.8%)		
obese	48(54.5%)	40(45.5%)	88(33.8%)		
<b>Total</b>	61(23.5%)	199(76.5%)	260(100%)		

**Discussion:**

Indian population has a high risk of developing diabetes and CVD. WHO has shown that 65% of the world's population lives in countries where more people die of overweight and obesity. Several studies have found that medical students in India are vulnerable to metabolic syndrome and cardiovascular diseases due to the coexistence of several risk factors [10,11]. In the present study, the prevalence of metabolic syndrome among medical students was 23.46% which was a bit higher than other Indian studies [10,12] which had a prevalence of MS ranging from 6 to 11 per cent. The difference in our finding may be due to differences in the sample population, study setting and different criteria used to define MS. The prevalence of MS in female students was 28.6% and 20.7% in male students. This gender wise difference in MS was statistically not significant and matched with findings of other studies. [10,12] Obesity was significantly high among female students (42.9%) in comparison to males (29%). This may be the most important factor for MS being more common among female students. High Triglyceride and low HDL levels were also associated with MS. Obesity and dyslipidaemia are regarded most important determinant factors for MS and early prevention and intervention may prevent Diabetes mellitus and CVD in later life.[17] Smoking and alcohol intake are also important risk factors for MS and hence students must be made aware of these facts. Genetic factors are also very important in the causation of MS and it would be prudent to do routine screening for risk factors among medical students with a family history of diabetes and CVD. Inculcating a habit of regular exercise and avoidance of junk food will be of great importance. All these findings exhibit that the components of metabolic syndrome are greatly linked to one another.

This study had certain limitations in that this was a single centric study and

performed on a small number of students, hence the findings of this study cannot be generalised and hence requires further multicentric exploration.

**Conclusion:**

Obesity and dyslipidaemia are prevalent among medical students and must be considered as an important component of MS and potential risk factors for diabetes and CVD. Regular screening of these risk factors and awareness among medical students about these would help prevent diabetes and CVD in society.

**Acknowledgement:**

The authors would like to thank the laboratory staff of the Department of Biochemistry, Vardhman Institute of Medical Sciences, Pawapuri, Bihar, India for their extraordinary support in carrying out research work.

**Financial support and sponsorship:**

Nil

**References:**

1. Huang PL. A comprehensive definition for metabolic syndrome. *Dis Model Mech.* 2009;2(5-6):231-237. A comprehensive definition for metabolic syndrome (nih.gov)
2. A comprehensive review on metabolic syndrome. —PubMed—NCBI [Internet]. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/24711954>
3. Type 2 diabetes and cardiovascular disease: Have all risk factors the same strength? [Internet]. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC412758>
4. Saklayen M.G. The global epidemic of the metabolic syndrome. *Curr Hypertens Rep.* 2018 Feb 26; 20:12.
5. 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.
6. Stewart SM, Betson C, Marshall I, Wong CM, Lee PW and Lam TH. Stress and vulnerability in medical students. *Medical education*; 2006: 29(2), 119-127
  7. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety and other indicators of psychological stress among U.S and Canadian medical students. *Academic Medicine*: 2006;81(4), 354-373.
  8. Mamo, Jonathan & Fenech, Chantal. A survey of medical students attending an international student conference. *International Journal of Collaborative Research on Internal Medicine and Public Health*. 2012;4(6).
  9. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond - PubMed (nih.gov)
  10. Anita Teli, Vanishree Jabannavar, Isabella Adorno, G. Sai Gayatri, Fillipos Lampis, Parwati Patil Estimation of prevalence of metabolic syndrome among 1st year medical students of a medical college in North Karnataka, India, *Indian Journal of Health Sciences and Biomedical Research KLEU – May-August;2019;12(2), Issue 2.*
  11. Kandula SGNSV, Sekhar STV D, 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; 5:2331-7
  12. Prevalence of metabolic syndrome and associated risk factors in medical students of universidad central del ecuador Cesar Ruano Nieto, Melo Pérez J, Mogrovejo Freire L, De Paula Morales Kand Espinoza Romero C V Universidad Central, Quito – Ecuador
  13. Ahmed Mohammed Ahmed, Bader Eldien Hassan Elabid, Kamal Eldin Hussein Elhassan and Hisham Ali Waggiallah, Metabolic Syndrome among Undergraduate Students Attending Medical Clinics for Obligatory Medical Screening, *Tropical Journal of Pharmaceutical Research* February 2015; 14 (2): 317-321
  14. Mohamad Amin Pourhoseingholi, Mohsen Vahedi, Mitra Rahimzadeh, Sample size calculation in medical studies, *Gastroenterol Hepatol Bed Bench*. 2013 Winter; 6(1): 14–17.
  15. Sharma SK, Mudgal SK, Thakur K, Gaur R. How to calculate sample size for observational and experimental nursing research studies? *Natl J Physiol Pharm Pharmacol* 2020;10(01):1-8.
  16. Grundy S.M., Cleeman J.I., Daniels S.R., Donato K.A., Eckel R.H., Franklin B.A., Gordon D.J., Krauss R.M., Savage P.J., Smith S.C., Jr, et al. (2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung and Blood Institute scientific statement. *Circulation*; 2005;112: 2735–2752.
  17. Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, Joshi SR, Sadikot S, Gupta R, Gulati S, Munjal YP; Concensus Group. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. *J Assoc Physicians India*. 2009 Feb; 57:163-70.