

A Cross Sectional Study to know the Prevalence of Metabolic Syndrome and its Association with Obesity Parameters (BMI, Waist Circumference, Waist Hip Ratio and Waist Height Ratio) and Other Lifestyle Factors

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ABSTRACT

Introduction: One-fourth of the world's adult population were having Metabolic Syndrome. Prevalence in urban India population was 25% and increasing due to westernized lifestyles. Objectives - Prevalence of metabolic syndrome and its association with obesity parameters and lifestyle factors.

Material and methods: study design-cross sectional study, sample size-3785, cluster sampling method, Study area- Urban health Field practice area of private medical college, Sidhipet district. Ethical Clearance - Obtained from Sarpanch of each village and Institutional Ethics Committee. Data Collection tool-Pretested Prevalidated semi-structured questionnaire with 2 sections, Demographic characteristics, Socio demographic data and behavioural characteristics and measurements of Anthropometric, blood pressure, Fasting Plasma glucose and lipid profile. Data Analysis - Percentages, Proportions and odds ratio calculated.

Results: Overall Prevalence of Metabolic syndrome was 30.4%. Odds of getting metabolic syndrome was 1.46,1.66,1.68,1.23,1.93 and 2.28 among daily smokers, hazardous drinkers, binge drinkers, in low fruit/vegetable consumption, low physical activity and inappropriate sleep time participants respectively.

Conclusions: Odds of metabolic syndrome in obese according to Broca's Index was 4.75 and according to BMI, was 0.06(overweight), 2.44(class I obese), 16.82(class II obese) and 214.9(class III obese) according to waist circumference, Waist Hip ratio, waist height ratio was 30.7, 26.73 and 23.69 respectively.

Keywords: Metabolic Syndrome, Life Style Behaviour, Obesity Indicators

INTRODUCTION

The metabolic syndrome is one of a cluster of metabolic risk factors that include central obesity, hyperglycaemia /glucose intolerance, hypertension, low HDL cholesterol levels, and high triglyceride levels. World Health organization has put forward its official definition of Metabolic syndrome in the year 1998¹, since then many definitions have been proposed, and the definition most widely accepted and which is considered in this study is the criteria of the National

Cholesterol Education Program Expert Panel (NCEP) and Adult Treatment Panel III (ATP III), that was modified for Asians that includes the clinical condition meeting at least 3 or more of the 5 risk factors, i.e. central obesity (waist circumference >90 cm for males and >80 cm for females), high serum triglycerides (>150 mg/dL, or under treatment), low HDL cholesterol (males <40 and females <50 mg/dl or under treatment), increased blood pressure (>130/85 mmHg or under treatment), and fasting blood glucose (>100 mg/dL or under treatment).²

Early identification and aggressive treatment of Metabolic syndrome is important because it is associated with an increased risk of type 2 diabetes, cardiovascular disease (CVD), and premature mortality.³

Burden of Metabolic syndrome-

An estimated one-fourth of the world's adult population (i.e., approximately a billion adults globally) were having Metabolic Syndrome.⁴

Age adjusted prevalence of metabolic syndrome in urban India population was found to be 25% (approximately 31% in women and 18.5% in men)⁵.

Risk in India - Indian population is adapting to a westernized lifestyle (unhealthy eating habits, dietary changes, smoking, alcoholism, improper sleep and decreased physical activity) due to acculturation which in turn has contributed to an increase in the incidence of obesity and various lifestyle related-diseases including Metabolic syndrome.^{6,7}

Hence, the present study has been conducted so that based on the results of this study, population can be educated regarding

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adaptation of healthy lifestyle patterns and thus reducing the risk of metabolic syndrome and hence mortality.

And also, on literature search, it was found that very few research studies were found on prevalence of metabolic syndrome and its association with obesity parameters & lifestyle factors in India and in the state Telangana, no studies were found. Hence in the present study effort was made to find out the Prevalence of metabolic syndrome and its association with obesity parameters and lifestyle factors in Urban field practice area of a private medical college, Sidhipet District Telangana.

Methodology

A Cross sectional study was conducted on 15th January 2021- 10th May 2021 in Urban health Field practice area of RVM Institute of Medical sciences & Research Center, Laxmakkapally Village, Mulugu Mandal, Sidhipet district located in Turkapalle Village.

Sampling Frame - Catchment area of Urban health center includes 11 villages around Turkapalle village with a population of 30,902 with Male population 15,557 and Female Population 15,342 and there are about 10-12 wards in each village and total wards were 126. Total Adult population (18-75 Years) were 13020 with Male population 6516 and Female population 6504.

Sample size estimation-

Z α is equal to 1.96 at 95% confidence interval.

P – Prevalence of metabolic syndrome was 25%.⁵

1-p= 75%

e = Absolute precision taken as 5% of Prevalence (25%) that will be 1.25

N = Total number of students required were

$$\text{Sample size}(n) = \frac{\frac{z^2 X p(1-p)}{e^2}}{1 + \frac{z^2 X p(1-p)}{e^2 N}}$$

$$\text{Sample size}(n) = \frac{\frac{(1.96)^2 X 25(100 - 25)}{(1.25)^2}}{1 + \frac{(1.96)^2 X (100 - 25)}{(1.25)^2 13020}}$$

Sample size(n) required = 3419

Sampling Method - Cluster sampling method was considered. Each ward was considered as one cluster and from each cluster 32 persons (16 male and 16 female) were selected by simple random sampling method hence total adults included were 4032, but 247 participants were excluded due to incomplete information and hence 3785 participants were included in the study.

Study population

3785 (1892 males and 1893 females).

Inclusion criteria -

1. Adult population (18-75) years were included in the study.
2. Permanent residents of the village

3. Adults who gave consent to participate in the study.

Exclusion criteria

1. Bed ridden /having severe illness/Handicapped participants.
2. Who did not give consent to participate in the study.

Ethical Clearance-

The study was conducted after obtaining ethical clearance from Sarpanch of each village and also from the Institutional Ethics Committee of the Institution.

Informed consent- Before start of the study, all the adults who were included in the study were explained regarding the data collection, objectives and purpose of the study. The participants were also assured about the confidentiality and that the data will be used only for research purpose and then the written consent was taken.

Data Collection tool

Pretested Prevalidated semi-structured questionnaire was developed which was divided into two sections.

1st section- Demographic characteristics, Socio demographic data and behavioural characteristics (tobacco smoking, alcohol, fruit/vegetable consumption, and physical activity). 2nd section- Measurements of Anthropometric Indices, Blood pressure, Fasting plasma glucose and lipid profile^{8,9}.

All the Measurements were taken, on wearing light clothing, without hat and barefoot.

Weight measured to nearest 0.1 kg (using Rinto electronic thick tempered glass lcd digital display weighing scale). Height was measured using a portable, standard stadiometer (prestige height measuring scale stadiometer). Waist circumference was measured at the mid-point between inferior margin of last rib and Iliac crest and Hip Circumference at the greatest posterior protuberance of the buttocks while standing, both the circumferences were measured to nearest 1 cm using constant tension portable measuring tape.

Body Mass Index was calculated using the formula bodyweight (kg)/height²(m²). Waist hip ratio was calculated by the formula Waist Circumference (cm)/Hip Circumference (cm).

Blood pressure was measured using Sphygmomanometers (Diamond Bpmr 112 Regular Velcro Cuff Conventional Mercurial) in sitting position over the left arm for three times keeping 5 minutes gap between each measurement and average of three reading was considered.

Blood samples- 5 ml blood collected from the antecubital vein in the morning after overnight fasting (for 10 hours) in EDTA vacutainer tube to measure serum triglycerides, HDL and Fasting plasma glucose.

Fasting Plasma Glucose was estimated by GOD POD method and Serum triglycerides by GPO-DAP method.

Investigators who were collecting data, were trained about the purpose of the study, collection of information by face-to-face interview using semi structured questionnaire.

Outcome definitions-^{8,9}

- Current smokers- Daily smoking habit, Past Smokers- habit in the past for more than 6 months but no habit at present.

- Alcohol consumption- Includes five categories,
 1. lifetime abstainer
 2. Abstainer for one year
 3. Hazardous drinking (consuming 40-59.9g of pure alcohol for men, and 20-39.9g for women on average per day)
 4. Harmful drinking (consuming ≥ 60 g of pure alcohol for men, and ≥ 40 g for women per day)
 5. Binge drinking considered on drinking ≥ 5 drinks in a row for men, and ≥ 4 drinks in a row for women.
- Fruits and Vegetable consumption- less than 400gms per day considered low consumption.
- Physically active- Walking or moderate intensive activity of 150 minutes per week.
- Sleep time - Seven to eight hours of good sound sleep at night was regarded as appropriate sleep time.
- Body Mass Index (kg/m^2)- Under weight (<18.5), Normal (18.5-24.99), Over weight (25-29.99), Obesity Class I (30-34.99), Obesity Class II (35-39.99), Obesity Class III (≥ 40).
- Waist Circumference - >90 cm in men and >80 cm in women.
- Waist Hip ratio- >1 in men and >0.85 in women (obese).

Metabolic syndrome was considered when more than three risk factors were present out of 5 components according to NCEP and ATP III that was modified and adapted for Asians².

STATISTICAL ANALYSIS

Data from the study questionnaire was entered and analysed on excel sheet version 2019. Percentages and proportions were calculated and compared. Odds Ratio was used to know the odds of getting metabolic syndrome among various demographic characteristics, lifestyle factors and obesity indicators. Statistical significance was considered if $P < 0.05$.

RESULTS

As shown in Table I, a total of 3785 persons (1892 females and 1893 males) between 18-75 years participated in the study, Majority were in 18-25 years (31.6%) and 31-45 years (25.6%). Most of the participants were illiterate/studied up to 3rd class (31.2%), or up to 10th class (33.33%) and many working as skilled and semiskilled (63.8%) workers. Majority belong to class III (48.9%), class IV and V (34.3%) of B.G Prasad socio economic status.

Overall Prevalence of Metabolic syndrome was 30.4%, which was more in >75 years (68.89%), 60-75 years (64.97%) age group. Prevalence in men was higher compared to

Demographic characteristics	No. (%)	Metabolic syndrome No. (%)	Healthy Individuals	Odds Ratio (95% CI)	P Value
Age Group (years)					
18-25	1196(31.6)	110(9.2)	1086(90.8)	0.15(0.1215 to 0.1855)	<0.0001
26-30	840(22.2)	95(11.31)	745(88.69)	0.22(0.18-0.28)	<0.0001
31-45	969(25.6)	471(48.61)	498(51.39)	2.95(2.54-3.44)	<0.0001
45-60	538(14.2)	318(59.11)	220(40.89)	4.17(3.45-5.04)	<0.0001
60-75	197(5.2)	128(64.97)	69(35.03)	4.64(3.43-6.27)	<0.0001
>75	45(1.2)	31(68.89)	14(31.11)	5.16(2.7-9.7)	<0.0001
Total	3785	1153(30.46)	2632(69.54)		<0.0001
SEX					
Men	1892	662(34.99)	1230(65.01)	1.53(1.33-1.76)	<0.0001
Women	1893	491(25.93)	1402(74.06)	0.65(0.56-0.74)	<0.0001
Total	3785	1153(30.46)	2632(69.54)		<0.0001
Education					<0.0001
Illiterate and Primary school (up to 3 rd)	1181(31.2)	376 (31.83)	805(68.16)	1.09(0.94-1.27)	<0.21
Middle school(4 th ,5 th ,6 th) & High School (7 th , 8 th , 9 th , 10 th)	1261(33.3)	385(30.53)	876(69.47)	1.00(0.86-1.16)	<0.94
Intermediate	466(12.3)	353(75.75)	113(24.25)	9.83(7.84-12.33)	<0.0001
Graduate and above	877(23.2)	39(4.44)	838(95.55)	0.07(0.05-0.1)	<0.0001
Occupation					
Unskilled	768(20.3)	383(49.87)	385(50.13)	2.9(2.46-3.41)	<0.0001
Skilled and Semiskilled	2415(63.8)	562(23.27)	1853(76.73)	0.39(0.34-0.46)	<0.0001
Shop owner /small scale Business	265(7)	127(47.92)	138(52.08)	2.24(1.73-2.87)	<0.0001
Semiprofessional and Professional	337(8.9)	281(83.38)	56(16.62)	14.82(11.01-19.9)	<0.0001
Total	3785(100)	1153(30.46)	2632(69.54)		
Socio Economic status					
Class I and II	635(16.8)	312(49.13)	323(50.13)	2.65(2.22-3.15)	<0.0001
Class III	1851(48.9)	387(20.9)	1464(76.73)	0.4(0.35-0.46)	<0.0001
Class IV & V	1299(34.3)	454(34.94)	845(65.05)	1.37(1.19-1.58)	<0.0001
Total	3785(100)	1153(30.46)	2632(69.54)		

Table-1: Demographic characteristics of the participants

women.83.38% of semiprofessional& professional, 49.87% of the unskilled and 47.92% of business persons were having metabolic syndrome. Regarding socio economic status, prevalence was more in class I& II (49.13%).

Odds of chances of metabolic syndrome was increasing with age, more in men (1.53) in Intermediate studied group (9.83) but less in graduates (0.07).

Table II describes Prevalence of lifestyle behaviours of the study participants and their risk association (odds ratio) with metabolic syndrome.

56.9%,46.5% of the participants were having the habit of smoking, alcoholism. 35.6% ,28.34% and 28.33% of the adults were consuming low fruits & vegetables, practising low physical activity and having inappropriate sleep time respectively.

Prevalence of metabolic syndrome was more among daily smokers (36.48%), Non-smokers (29.98%), Hazardous drinking (35.85%), Harmful drinking (41.26%) and Binge drinking (40%), low fruit/vegetable consumption (33.4%), low physical activity (40.91%) and inappropriate sleep time (43.55%) participants respectively.

Odds of getting metabolic syndrome was 1.46,1.33,1.66 and 1.68 among daily smokers, hazardous drinkers, harmful drinkers and binge drinkers. In low fruit/vegetable consumption, low physical activity and inappropriate sleep time participants, Odds ratio was 1.23,1.93 and 2.28 respectively.

Table III describes prevalence of all the 5 components of metabolic syndrome, in association with demographic and lifestyle characteristics. Overall, the prevalence of central obesity, high blood pressure, high fasting blood glucose, high triglycerides and low HDL were 37.17%,32.31%,29.93%,25.97% and 24.41% respectively.

Among 18-25 years and 26-30 years, central obesity prevalence was high (30.6% & 36.31%) compared to other components. Majority that is 48.02% of women were obese and 46.96% of males were hypertensive. All the components of metabolic syndrome were high in Shop owner/small scale business occupants. In professional group participants, more percentage of hypertension (61.72%) and dyslipidaemia (54.3%) were noticed.

Blood pressure was more in past and current daily smokers. All the components of metabolic syndrome were higher in harmful drinking, Binge drinking, low fruit/vegetable consumption, low physical activity and low sleeping time group of participants compared to their comparison groups.

Table IV describes the association between Obesity Indicators and metabolic syndrome, according to Broca's index,44.3% were obese and among them 48.18% were having metabolic syndrome with Odds ratio of 4.75. Prevalence of obesity according to BMI, was 15.35% (class I),11.81% (class II) and 8.82% (class III) and prevalence of metabolic syndrome among them was 47.85%(odds-2.44),83.67% (16.82) and 100% (214.9) respectively.

37.17% were obese according to waist circumference, among whom 70.1% were suffering from metabolic syndrome (Odds-30.7). 27.2% were obese according to Waist Hip ratio,

		Comparison of prevalence of present study with other studies									
	Present Study	Rajput, et al study ¹⁰	Bansal et al ¹¹	Prasad et al ¹²	Hari Krishnan et al ¹³	VenuGopal et al ¹⁴	Khan et al ¹⁵	Ajjuan Ma et al ¹⁶			
Prevalence Overall	30.46%		16.57	33.5	24	39.7	40.9	25.59			
Male	34.97	23.8%	12.5	24.9	20		26.2	30.53			
Female	25.93	42.6%	20.33	42.5	28		59	20.44			
Area where the study was conducted	Sidhipet District, Telangana	Haryana	Western Utter Pradesh	Odissa, Urban	Kerala, Urban & Rural	Pudu-cherry	Central UP, Urban	Beijing, China			
Type of study	Population based	Population based	Population based	Population based	Population based	Population based	Hospital based	Population based			
Year of the study	2021	May-june, 2014	2017	2012	2018	2019	2018	2017			
Age group studied	18-75 years	Mean - 47.8(males) -45.7(female)	30-70 years	>20 years	Adults	>30 years both sex	Adults, both sex	18-79			

Lifestyle behavior	No. (%)	Metabolic syndrome No. (%)	Healthy Individuals	Odds Ratio (95% CI)	P Value
Smoking					
Non smoker	1631(43.1)	489(29.98)	1142(70.02)	0.96(0.83-1.1)	0.57
Past Smoker	541(14.3)	144(26.6)	397(73.38)	0.8(0.65-0.98)	0.036
Current smoker (daily)	1033(27.3)	377(36.48)	656(63.50)	1.46(1.25-1.7)	<0.001
Current Smoker(occasionally)	579(15.3)	143(24.69)	436(75.3)	0.71(0.58-0.87)	0.001
Total	3785(100)	1153(30.46)	2632(69.54)		
Alcohol					
Life time Abstainer	2025(53.5)	506(25)	1519(75.01)	0.57(0.49-0.66)	<0.001
Abstainer for one year	276(7.3)	72(26)	204(73.91)	0.79(0.6-1.04)	0.1
Hazardous drinking	530(14)	190(35.85)	340(64.15)	1.33(1.09-1.61)	0.003
Harmful drinking	269(7.1)	111(41.26)	158(58.74)	1.66(1.29-2.14)	<0.001
Binge Drinking	685(18.1)	274(40)	411(60)	1.68(1.41-2)	<0.001
Total	3785(100)	1153(30.46)	2632(69.54)		
Low Fruits and Vegetable consumption					
Yes	1347(35.6)	450 (33.4)	897(59.09)	1.23(1.07-1.43)	0.003
NO	2438(64.4)	703(28.83)	1735(71.16)	0.81(0.69-0.93)	0.004
Total	3785(100)	1153(30.46)	2632(69.54)		
Physical Inactivity					
Yes	1073(28.34)	439(40.91)	634(59.09)	1.93(1.67-2.25)	<0.001
No	2712(71.66)	714(26.33)	1998(73.67)	0.52(0.44-0.59)	<0.001
Total	3785(100)	1153(30.46)	2632(69.54)		
Inappropriate sleep time					
Yes	1072(28.33)	467(43.55)	605(56.44)	2.28(1.97-2.64)	<0.001
No	2713(71.67)	686(25.29)	2027(74.71)	0.44(0.38-0.5)	<0.001
Total	3785(100)	1153(30.46)	2632(69.54)		

Table-2: Life style behavior of the participants

among whom 78.95%, were having metabolic syndrome with Odds 26.73. According to waist height ratio, 26.34% were identified as obese and among them 78.44% were diagnosed as metabolic syndrome(odds-23.69).

DISCUSSION

Present study has identified, prevalence of metabolic syndrome and its risk (Odds Risk) association with various Demographic characteristics and lifestyle behaviors of adults (18-75 years).

In the present study, prevalence of metabolic syndrome was more in men (34.97%) compared to women (25.93%) unlike Bansal et al study¹¹, Prasad et al study¹², Khan et al study¹⁵ and Rajesh Rajput¹⁰ et al study where prevalence was higher in females than males.

In the present study, risk of metabolic syndrome was more with increasing age (Odds ratio from 2.95 to 5.16) from 31 to 75 years, in men (1.53), lesser education like in Intermediate (9.83) our results are similar to Aijuan Ma et al⁹ study in Beijing and Bhalwar R et al¹⁶ study (Increasing age, especially >45 years).

In the present study, Prevalence of metabolic syndrome was more among daily smokers (36.48%), Hazardous drinking (35.85%), Harmful drinking (41.26%) and Binge drinking (40%), low fruit/vegetable consumption(33.4%), low physical activity(40.91%) and inappropriate sleep time (43.55%) participants which was similar to Katzmarzyk et al³ study, where 40.1% & 39.1 of former smokers and 20.3% & 21.3% of current smokers, in obese & over weight category

were having metabolic syndrome and in Bhalwar et al¹⁶ study, 17.6%, 19.2% and 17% (normal, overweight and obese) of moderate drinkers were having metabolic syndrome and also lack of regular and adequate physical exercise, non-vegetarian diet, and use of tobacco were identified risk factors for Metabolic syndrome and in a study conducted in Beijing⁹ also age, living area, education level, inappropriate sleep time, and harmful use of alcohol were associated with Metabolic syndrome.

In the present study, among the five components of metabolic syndrome, Prevalence of central obesity (37.17) was highest followed by hypertension (32.31), then followed by high fasting blood glucose(29.93%), high triglycerides (25.97%) and low HDL(24.41%) sequence is similar in a study conducted in Western cape province⁷ in 4 components that is prevalence of central obesity (68.8%), elevated blood pressure (66.4%), low HDL-c levels (64.1%), high triglycerides(26.6%) but not in elevated blood sugar level(25.8%) which is last in sequence, this difference might be due to the difference in prevalence's among countries. In Aijuan et al⁹ study, sequence was hypertension (43.06), followed by Central obesity (42.02), high Triglycerides (32.87%), high Fasting blood glucose (27.96) and low HDL (27.25%). Thus central obesity and hypertension reduction strategies should be introduced to reduce the burden of metabolic syndrome. In the present study, Prevalence of metabolic syndrome among normal weight, over weight and obese according to BMI were 15.59, 5.93 and 72.4% unlike Katzmarzyk et

Demographic characteristics	NO. (%)	Central obesity NO. (%)	High BP NO. (%)	High FPG NO. (%)	High Triglyce-Rides NO.(%)	Low HDL-C NO.(%)
Age Group (years)						
18-25	1196(31.6)	366(30.6)	57(4.77)	175(14.63)	51(4.26)	51(4.26)
26-30	840(22.2)	305 (36.31)	145(17.26)	260(30.95)	71(8.45)	58(6.9)
31-45	969(25.6)	383(39.53)	555(57.28)	326(33.64)	432(44.58)	432(44.58)
45-60	538(14.2)	244 (45.35)	324(60.2)	243(45.2)	352(65.43)	321(59.67)
60-75	197(5.2)	99 (50.25)	110(55.83)	99(50.2)	50(25.38)	48(24.36)
>75	45(1.2)	10(22.22)	32(71.11)	30(66.67)	27(60.00)	14(31.11)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
SEX						
Women	1893()	909(48.02)	334(17.64)	534(28.2)	479(25.3)	479(25.3)
Men	1893()	498(26.3)	889(46.96)	599(31.64)	504(26.62)	445(23.51)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Education						
Illiterate and Primary school (up to 3 rd)	1181(31.2)	737(62.4)	370(31.33)	144(12.19)	323(27.35)	323(27.35)
Middle school &High School (7 th , 8 th , 9 th , 10 th)	1261(33.3)	503(39.89)	231(18.32)	433(57.73)	322(25.53)	322(25.53)
Intermediate	466(12.3)	158(33.9)	269(57.72)	319(68.45)	318(68.24)	259(55.58)
Graduate and above	877(23.2)	9(1.02)	353(40.25)	237(27.02)	20(2.28)	20(2.28)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Occupation						
Unskilled	768(20.3)	209(27.21)	178(23.18)	232(30.21)	258(33.59)	245(31.9)
Skilled and Semiskilled	2415(63.8)	1035(42.86)	688(28.49)	688(28.49)	415(17.18)	415(17.18)
Shop owner /small scale Business	265(7)	120(45.28)	149(56.23)	118(44.52)	127(47.92)	127(47.92)
Semiprofessional and Professional	337(8.9)	43(12.76)	208(61.72)	95(28.19)	183(54.3)	137(40.65)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Socio Economic status						
Class I and II	635(16.8)	334(52.6)	206(32.44)	220(34.64)	287(45.2)	228(35.9)
Class III	1851(48.9)	731(39.5)	542(29.28)	532(28.74)	342(18.48)	342(18.48)
Class IV &V	1299(34.3)	342(26.33)	475(36.57)	381(29.33)	354(27.25)	354(27.25)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)

Smoking						
Non smoker	1631(43.1)	603(37)	473(29)	522(32)	391(24)	359(22)
Past Smoker	541(14.3)	216(40)	184(34)	124(23)	151(28)	141(26)
Current smoker (daily)	1033(27.3)	351(34)	444(43)	331(32)	331(32)	320(31)
Current Smoker(occasionally)	579(15.3)	237(41)	122(21)	156(27)	110(19)	104(18)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Alcohol						
Life time Abstainer	2025(53.5)	680(33.58)	609(30.07)	462(22.81)	385(19.01)	333(16.44)
Abstainer for one year	276(7.3)	132(47.82)	94(34.06)	63(22.83)	47(17.03)	50(18.12)
Hazardous drinking	530(14)	214(40.38)	208(39.25)	170(32.08)	148(27.92)	138(26.04)
Harmful drinking	269(7.1)	86(31.97)	108(40.15)	116(43.13)	167(62.08)	167(62.08)
Binge Drinking	685(18.1)	295(43.07)	204(29.78)	322(47.0)	236(34.45)	236(34.45)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Low Fruits and Vegetable consumption						
Yes	1347(35.6)	779(57.83)	613(45.5)	431(31.9)	495(36.75)	436(32.37)
NO	2438(64.4)	628(25.76)	610(25.02)	702(28.79)	488(20.02)	488(20.02)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Physical Inactivity						
Yes	1073(28.34)	569(53.03)	529(49.3)	465(43.34)	626(58.34)	617(57.5)
No	2712(71.66)	838(30.9)	694(25.59)	668(24.63)	357(13.16)	307(11.32)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)
Inappropriate sleep time						
Yes	1072(28.33)	342(31.9)	568(52.98)	465(43.38)	332(30.97)	332(30.97)
No	2713(71.67)	1065(39.26)	655(24.14)	668(24.62)	651(23.99)	592(21.82)
Total	3785(100)	1407(37.17)	1223(32.31)	1133(29.93)	983(25.97)	924(24.41)

Table-3:

Obesity Indicators	Prevalence (3785) NO. (%)	Metabolic syndrome			Odds Ratio (95% CI)	P Value
		Female NO. (%)	Male NO. (%)	Total No. (%)		
Broca Index (height in cms-100)						
Underweight or Normal	2108(55.69)	152(7.21)	193(9.16)	345(16.37)	0.21(0.18-0.24)	<0.001
Overweight/obese	1677(44.3)	339(20.21)	469(27.97)	808(48.18)	4.75(4.08-5.5)	<0.001
Total	3785(100)	491(12.97)	662(17.49)	1153(30.46)		
Body Mass Index (kg/m ²)						
Under weight (<18.5)	102(2.69)	5(4.9)	1(0.98)	6(5.88)	0.13(0.06-0.31)	<0.001
Normal (18.5-24.99)	618 (16.33)	52(8.41)	8(1.29)	60(9.71)	0.2(0.15-0.26)	<0.001
Over weight (25-29.99)	1703(45)	40(2.35)	61(3.58)	101(5.93)	0.06(0.04-0.07)	<0.001
Obesity Class I (30-34.99)	581(15.35)	122(21)	156(26.85)	278(47.85)	2.44(2.04-2.92)	<0.001
Obesity Class II (35-39.99)	447(11.81)	150(33.56)	224(50.11)	374(83.67)	16.82(12.93-21.89)	<0.001
Obesity Class III (≥ 40)	334(8.82)	122(36.53)	212(63.47)	334(100)	214.9(133.98-344.69)	<0.001
Total	3785(100)	491(12.97)	662(17.49)	1153(30.46)	5.44(4.18-7.08) (over weight included) 35.42(29.09-43.14)	
Waist Circumference						
Normal	2378(62.83)	69 (2.9)	99(4.16)	168(7.06)	0.03(0.026-0.04)	<0.001
Obese (>90 cm in men and >80 in women)	1407(37.17)	422(29.99)	563(40.01)	985(70.01)	30.7(25.29-37.27)	<0.001
Total	3785(100)	491(12.97)	662(17.49)	1153(30.46)		
Waist Hip Ratio						
Normal	2754(72.76)	138(5.01)	201(7.30)	339(12.31)	0.04(0.03-0.04)	<0.001
Obese - >1 in men and >0.85 in women	1031(27.24)	353(34.24)	461(44.71)	814(78.95)	26.73(22.15-32.25)	<0.001
Total	3785(100)	491(12.97)	662(17.49)	1153(30.46)		
Waist Height Ratio						
Normal (<0.52 in Men and <0.42 in women)	1375(36.33)	36(2.62)	37(2.69)	73(5.31)	0.07(0.053-0.08)	<0.001
Over Weight (<0.62 in Men and <0.57 in women)	1413(37.33)	179(12.67)	119(8.42)	298(21.09)	4.59(3.64-5.79)	<0.001
Obese (<0.63 in Men and <0.58 in women)	997(26.34)	276(27.68)	506(50.75)	782(78.44)	23.69(19.66-28.54)	<0.001
Total	3785(100)	491(12.97)	662(17.49)	1153(30.46)		

Table-4: Association between obesity indicators and metabolic syndrome of the participants

al³ study where Prevalence's were 4.7%,19.8% and 61.1% respectively, less prevalence among overweight was noticed in the present study.

Odds of metabolic syndrome according to BMI in the present study was 0.06(over weight),2.44(class I obese) , 16.82 (class II obese) and 214.9 (class III obese) where as in NHANES III Canada¹⁷ survey odds of having Metabolic syndrome were 5.2 , 25.2 and 67.7 among overweight, moderately obese, and severely obese men and in Katzmarzyk et al³ study odds for Metabolic Syndrome was 4.7 in overweight and 30.6 in obese men, odds in overweight group in the present study was 0.06 only which was unlike other studies , indicating overweight is not a risk factor of metabolic syndrome .This may be due to better exercise, healthy lifestyles among overweight individuals and also indicating that Overweight according to BMI is not an indicator of central obesity which is the risk factor for metabolic syndrome.

Odds of metabolic syndrome among obese individuals

according to waist circumference was 30.7 which was higher compared to waist hip ratio (26.73), waist height ratio (23.69).

This study findings go along with Dutch study¹⁸, Nakamura et al¹⁹ study, Kata et al²⁰ studies and also several national and international organisations supported by studies on both Western^{21,22,23} and Asian^{24,25,26} populations.

However, in Rajput et al¹⁰ study, Parikh et al²⁷ and Heish et al²⁸ study, Waist height ratio was considered better predictor of metabolic syndrome.

LIMITATIONS

Study was a cross-sectional study; hence causal assertions require further confirmation. There can be information and recall bias on gathering information regarding exercise, alcohol, smoking, diet and sleep history but to overcome these biases proper training to investigators and periodical checks during collection of data were given to keep the results near to truth as far as possible.

CONCLUSIONS

Overall Prevalence of Metabolic syndrome was 30.4%. Odds of getting metabolic syndrome was 1.46,1.66,1.68,1.23,1.93 and 2.28 among daily smokers, hazardous drinkers, binge drinkers, in low fruit/vegetable consumption, low physical activity and inappropriate sleep time participants respectively. Odds of metabolic syndrome in obese according to Broca's Index was 4.75 and according to BMI, was 0.06(overweight), 2.44(class I obese),16.82(class II obese) and 214.9(class III obese) according to waist circumference, Waist Hip ratio, waist height ratio was 30.7,26.73 and 23.69 respectively.

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