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Socioeconomic Risk factors could be the Predictors of Metabolic Syndrome – A cross-sectional study

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Abstract

Metabolic syndrome is a strong predictor of cardiovascular diseases and diabetes mellitus type 2. Its association with socioeconomic status is not well understood. This study aims to identify metabolic syndrome prevalence using International Diabetes Federation (IDF) 2005 guidelines and finds its association with socioeconomic risk factors in local population of Indore, India. A cross-sectional survey was conducted for the prevalence of metabolic syndrome among 438 participants of Indore, Madhya Pradesh India. A pre-designed questionnaire was used to collect data, including demographic information; anthropometric parameters. Biochemical parameters were collected from their recent medical reports. Using criteria of IDF, 2005. The study analysed 438 participants (mean age 49.56 ± 13.13 years), focusing on lifestyle factors and metabolic syndrome (MetS) prevalence. MetS was more common in females who had a significantly higher MetS prevalence (55.6%) than male individuals, aged 40–49(29.4%), those with lower education levels, and lower socioeconomic status. Sedentary lifestyles (77.3%), smoking, alcohol use, low fruit and vegetable intake (62.4%) and family history of diseases such as diabetes (65.3%) and hypertension (84%), were also significantly linked to MetS. In conclusion, the findings of this study provide significant insights into the associations between sociodemographic factors, lifestyle choices, and the presence of MetS.

Keywords: Socio-economic factors, Metabolic syndrome (MetS), Cardiovascular Diseases, Diabetes mellitus type 2 (T2DM), Genetic factors.

Introduction

The global burden of non-communicable diseases (NCDs) is alarming, with low-income and lower-middle-income countries experiencing a disproportionate share of mortality rates[1]. NCDs, particularly cardiovascular disorders, diabetes, and cancer, pose a significant threat to public health, with socioeconomic determinants of health playing a crucial role in shaping the risk factors for NCDs, including metabolic syndrome (MetS)[2]. MetS is a complex condition characterized by a cluster of interrelated risk factors, including abdominal obesity, glucose intolerance, dyslipidaemia, and hypertension[3]. Recently, pro-inflammatory, pro-thrombotic, and hormonal factors have been reported to be involved in MetS[4,5].

These modifications of metabolism are interconnected to each other and are found to be involved in increasing the risk of coronary heart diseases (CHDs), cardiovascular atherosclerotic diseases, and type 2 DM and causing mortality[6]. The global prevalence of MetS is estimated to be around 20-25% among adults, with a rising trend in both developed and developing countries[2]. In India, the prevalence of MetS varies widely, ranging from 11% to 56%, with a higher incidence in urban areas[7].

Research has shown that socioeconomic factors, such as education, occupation, income, and wealth status, have a significant impact on the prevalence of MetS[8]. However, the relationship between socioeconomic status and MetS is complex and influenced by various factors, including cultural and environmental contexts[9]. The increasing prevalence of MetS in India is attributed to factors such as stress, sedentary lifestyle, and central obesity[10]. This study aims to estimate the prevalence of MetS among adults in an urban area of Indore and assess its association with sociodemographic and other risk factors.

Materials and Methods

Study Participants and Data Collection: The current cross-sectional study was conducted in Indore (Madhya Pradesh, India). A total of 438 subjects (197 females and 241 males) who were above 18 years of age and those without any critical illness participated in the study. Pregnant women, and lactating women, were excluded from the study.

The information about the demographic, anthropometric profile (height, weight and waist circumference), and pathological (blood pressure, fasting blood sugar, waist circumference, TG,

and HDL) parameters were collected from the subjects on a pre-designed questionnaire. All the participants were explained the nature of the study in a language they understand easily. Ethical consideration was undertaken and informed consent was obtained from each participating patient. The clinical diagnosis was not performed by us but the information was collected from their recent medical reports.

Metabolic Syndrome Identification: For the present study, International Diabetes Federation (IDF)[11] criteria were considered to measure the presence of the metabolic syndrome. The new IDF definition for the metabolic syndrome included central obesity (ethnic-specific for South Asians, ≥ 90 cm and ≥ 80 cm for male and female, respectively) with any other two of the following four factors:

Table-1: Diagnostic Criteria of Metabolic Syndrome according to IDF(2005)[11].

Raised triglycerides	(>150 mg/dL or 1.7mmol/L)*
Reduced HDL cholesterol	<40 mg/dL (1.03mmol/L) in males* <50mg/dL (1.29mmol/L) in females*
Raised blood pressure	SBP >130 mm Hg* or DBP >85 mm Hg*

Statistical Analysis: The data were summarized as frequencies and percentages by using an online available chi-square test calculator. A *P*-value of <0.05 was considered statistically significant.

Results and Discussion

The study sample consisted of 438 participants, with a mean age of 49.56±13.13 years. The study population consisted of individuals aged 20-79 years with the highest prevalence of MetS in 40-49 age group (29.4%). The gender distribution was 55% males and 44.9% females. Educational attainment varied, with the largest proportion of participants having completed graduate-level education or higher (46.5%), while 11.41% were illiterate. Socioeconomic status was diverse, with the majority of participants falling into the upper middle (30.1%) and upper lower (30.6%) classes. A small proportion (5.7%) belonged to the upper class. Physical activity levels indicated that 48.6% of participants led a sedentary lifestyle, 40% engaged in moderate physical activity, and 11.4% participated in heavy physical activity. Regarding BMI, 37.6% of participants were of normal weight, while 31% were overweight, and 31.2% were classified as obese. Cigarette smoking was reported by 10% of participants, while 11.6% consumed alcohol at least once per week. Chewing tobacco was a habit for 26.2% of the population. A significant proportion of participants reported a family history of various diseases. T2DM was present in 12% of families, hypertension in 27%, cardiovascular diseases in 21.6%, and thyroid disease in 22% (Table-2).

Results of the study indicate that MetS prevalence increases with age, with a peak prevalence observed in the 40-49 age group. Females have a significantly higher prevalence of MetS compared to males. The prevalence of MetS decreases with increasing levels of education, with illiterate individuals having the highest prevalence. Additionally, the prevalence of MetS decreases with increasing socioeconomic status, with upper socioeconomic status individuals having the lowest prevalence. The analysis of the study population revealed significant associations between several lifestyle risk factors and the presence of MetS. Individuals with a sedentary lifestyle (58.7%) were significantly more likely to have MetS, while those engaging in moderate (24.6%) or heavy physical activity (44%) had a lower prevalence. A lower intake of fruits and vegetables (62.4%) was also strongly associated with MetS (p value 0.00001). Smoking and alcohol consumption were linked to higher rates of MetS, with smokers (22.5%) and alcohol consumers (32.7%) showing a greater likelihood of having the condition. Family history of diseases, including diabetes (65.3%), hypertension (84%), cardiovascular diseases (64%), and thyroid disorders (67%), was significantly associated with the presence of MetS (Table-3).

Our study found significant gender differences in the prevalence of MetS among the study participants. Females were more susceptible to MetS, with a higher prevalence of MetS observed among females (64.3%) as compared to males (35.7%) ($p<0.001$). Lifestyle factors, such as physical activity and dietary habits also play a significant role in the development of MetS. Females were more likely to engage in sedentary behaviour (92.64.3%) and have a less healthy diet (77%) compared to males (51.35.7% and 23%, respectively) ($p <0.001$). Sociodemographic factors, such as education and socioeconomic status, also contributed to the higher prevalence of MetS among females. Females with lower levels of education and socioeconomic status got engaged in unhealthy behaviours and had limited access to healthcare resources. Tobacco use was also significantly associated with MetS ($p < 0.001$), with 32 (91%) males and 3 (9%) females reporting tobacco use. Alcohol consumption was significantly associated with MetS ($p<0.001$), with 47 (92%) males and 4 (8%) females reporting alcohol consumption. We found no significant association between family history of diabetes and MetS ($p = 0.6511$). However, 25 (39%) males and 39 (61%) females reported a family history of diabetes. Hypertension was significantly associated with MetS ($p=0.002$), with 52 (46%) males and 62 (54%) females reporting hypertension. In contrast, 27 (35.5%) males and 49 (64.5%) females did not have hypertension. Cardiovascular disease was significantly associated with MetS ($p<0.001$), with 43 (57.3%) males and 32 (43.7%) females reporting cardiovascular disease. Thyroid disease was significantly associated with MetS ($p<0.001$), with 11 (17%) males and 54 (83%) females reporting thyroid disease. In contrast, 59 (47%) males and 66 (53%) females did not have thyroid disease (Table-4).

Table-2: General Characteristics of Studied Population.

Sociodemographic factor	Values	N (%)
Age	20-29	25 (5.7)
	30-39	49 (11)
	40-49	122 (28)
	50-59	108(24.6)
	60-69	98 (22)
	70-79	36 (8)
Gender	Male	241 (55)
	Female	197 (44.9)
Education	Illiterate	50 (11.41)
	Primary	85 (19.4)
	Secondary	99 (22.6)
	Graduate & above	204 (46.5)
Socioeconomic status	Upper	25 (5.7)
	Upper middle	132 (30.1)
	Lower middle	116 (26.5)
	Upper lower	134 (30.6)
	Lower	31 (7)
Physical activity	Sedentary	213 (48.6)
	Moderate	175 (40)
	Heavy	50 (11.4)
Body mass index (BMI)	Normal weight	165 (37.6)
	Over weight	136 (31)
	Obesity	137 (31.2)
Cigarette smoking	At least 100 cigarettes till date	45 (10)
Alcohol Consumption	At least once per week	51 (11.6)
Chewing		115 (26.2)
Family History of disease (T2DM)	Type 2 diabetes	52 (12)
Family History	Hypertension	118 (27)
	Cardiovascular Disease	95 (21.6)
	Thyroid disease	96 (22)

Table-3: Socio demographic profile of the population in relation to metabolic syndrome according to IDF criteria.

Socio-demographic factors	Number	Values	Metabolic syndrome present (n=190)	Metabolic syndrome absent (n=248)	Significance x^2	p
			N (%)	N (%)		
Age	25	20-29	8(32)	17(68)	23.51	.001
	49	30-39	18(36.7)	31(63.3)		
	122	40-49	63(51.6)	59(48.3)		
	108	50-59	57(52.8)	51(47.2)		
	98	60-69	25(25.5)	73(74.5)		
	36	70-79	19(52.8)	17(47.2)		
Sex	241	Male	70 (29.04)	171(71)	44.82	.001
	197	Female	120(61)	77(39)		
Education	50	Illiterate	35(70)	15(30)	51.25	.001
	85	Primary	54(63.5)	31(36.5)		
	99	Secondary	46(46.5)	53(53.5)		
	204	Graduate & above	55(27)	149(73)		
Socioeconomic status	25	Upper	23(92)	2(8)	28.77	.001
	132	Upper middle	54(41)	78(59)		
	116	Lower middle	54(46.6)	62(53.4)		
	134	Upper lower	48(36)	86(64)		
	31	Lower	11(35.5)	20(64.5)		

Table-4: Risk Factors of Metabolic Syndrome in relation to Gender.

Life style		Male	Female	Significance x^2	p
Physical Activity	Sedentary 143	51(35.7)	92(64.3)	45.53	.001
	Moderate 30	12(40)	18(60)		
	Heavy 17	07(41)	10(59)		
Healthy Diet (fruits & vegetables)	Less 143	33(23)	110(77)	47.0743	<.001
	Norma l47	37(79)	10(21)		
Smoking	Yes 25	21(84)	04(16)	27.5135	<.001
	No 165	49(29.7)	116(70.3)		
Tobacco	Yes 35	32(91)	03(9)	54.9399	<.001
	No 155	38(24.5)	117(75.5)		
Alcohol	Yes 51	47(92)	04(8)	91.6682	<.001
	No 5139	23(16.5)	116(83.5)		
Family History Diabetes	Yes 64	25(39)	39(61)	0.2045	.6511
	No 126	45(36)	81(64)		
Hypertension	Yes 114	52(46)	62(54)	9.4246	.002
	No 76	27(35.5)	49(64.5)		
Cardiovascular Disease	Yes 75	43(57.3)	32(43.7)	22.3605	<.001
	No 115	27(23.5)	88(76.5)		
Thyroid Disease	Yes 65	11(17)	54(83)	16.8469	<.001
	No 125	59(47)	66(53)		

Discussion: The findings of this study provide significant insights into the associations between socio-demographic factors, lifestyle choices, and the presence of metabolic syndrome (MetS). The study reveals a significant association between demographic characteristics and MetS prevalence with age, sex, education, and socioeconomic status. A total of 438 individuals were selected from local population. 43.3% of them were suffering from metabolic syndrome using IDF criteria. Our results are little different than reported earlier in other cities. The prevalence of MetS has been reported to vary widely from 7.9% to 39% among various studies conducted across different developing countries in the world[12-14]. In India, it ranged from 9.2% to 43.2% as reported in the previous studies[15,16]. Researchers have found varying rates in different parts of the country. Banerjee et. al.[17] have seen that metabolic syndrome was present in 44.6% of the study subjects in urban area of West Bengal and Kaushal et. al.[18] observed that 37.1% of the study subjects living in urban area of Agra had Mets. Kamble et. al.[19] in their community-based study reported that only 5% of the adults living in rural areas of Wardha had the same condition. These variations in prevalence could be attributed to the adoption of different criteria for Mets, study settings, laboratory techniques, and risk factors. The positive association between age and MetS prevalence observed in this study is consistent with previous researches. A study[20] reported a significant increase in Mets prevalence with advancing age, with the highest prevalence observed among individuals aged 60-69 years in United States of America. Similarly, a study[21] reported a positive correlation between age and MetS prevalence, with the prevalence increasing from 12.1% among individuals aged 20-29 years to 44.1% among individuals aged 60-69 years. The sex difference in MetS prevalence observed in this study, with females having a higher prevalence than males, is also consistent with previous research. A study by Anjana et al.[7] reported a higher prevalence of MetS among females (55.6%) compared to males (41.1%) in an urban Indian population. Similarly, a study by Sundarakumar et al..[10] reported a higher prevalence of MetS among females (51.3%) compared to males (44.1%) in a rural Indian population. The inverse correlation between education and MetS prevalence observed in this study is also consistent with previous research findings. A study by Kim et. al.[22] reported a significant inverse correlation between education and MetS prevalence, with individuals with lower levels of education having a higher prevalence of Mets. Similar findings were reported earlier in different cities[8]. The inverse correlation between socioeconomic status and Mets prevalence observed in this study is also consistent with previous research[9]. Similarly, a study by Allan et al.[2] reported an inverse correlation between socioeconomic status and MetS prevalence, with individuals from higher socioeconomic backgrounds having a lower prevalence of MetS. The study also highlights the importance of lifestyle factors in the development of MetS. According to our results, a significant and inverse association was seen between physical activity and MetS. Physical activity was found to be strongly associated with MetS, with sedentary individuals having a higher prevalence of MetS[23,24]. This finding is also consistent with previous research findings[3,20,25] irrespective of age, sex, ethnicity, and current smoking in older adults with obesity. Dietary habits also emerged as a crucial factor, with lower fruit and vegetable intake being significantly associated with MetS. This finding is also consistent with previous research, which has reported a significant inverse correlation between fruit and vegetable intake and Mets prevalence[26]. Consumption of less fruits (less than one portion per day) was associated with higher prevalence of metabolic syndrome with significant association ($p<.000$). Similar results were obtained by Prasad et. al.[27] in West Bengal. Consumption of inadequate amount of vegetables (less than three portions per day) was also associated with increased chances of metabolic syndrome and the association was found to be statistically significant in our study. However, Venugopal et. al. found it to be insignificant. Smoking and alcohol consumption were also found to be significantly associated with MetS. Smoking has been reported to increase the risk of insulin resistance, hypertension, and dyslipidaemia, all of which are components of Mets[28-30]. The study also highlights the importance of genetic predispositions in the development of MetS. Family history of diseases, including diabetes, hypertension, cardiovascular diseases, and thyroid disorders, was found to be significantly associated with MetS. This finding is consistent with previous research, which has reported a significant association between family history of metabolic-related diseases and Mets prevalence[31]. The results of our study highlight significant gender differences in the prevalence of metabolic syndrome (MetS) among the study participants. Our findings suggest that females are more susceptible to MetS, with a higher prevalence of Mets observed among females as compared to males. This result is again consistent with previous studies, which have reported a higher prevalence of Mets among females[3,20]. One possible explanation for the higher prevalence of MetS among females is the role of hormonal differences. Females tend to have higher levels of estrogen, which can contribute to insulin resistance and metabolic changes[22].

Additionally, the decline in estrogen levels during menopause may further increase the risk of MetS among postmenopausal women[8]. Lifestyle factors, such as physical activity and dietary habits, also play a significant role in the development of MetS. Our study found that females were more likely to engage in sedentary behavior and have a less healthy diet, which may contribute to the higher prevalence of MetS among them. This finding is consistent with previous studies, which have reported a positive association between sedentary behavior and MetS[32].

Sociodemographic factors, such as education and socioeconomic status, may also contribute to the higher prevalence of MetS among females. Thus, females with lower levels of education and socioeconomic status may be more likely to engage in unhealthy behaviors and have limited access to healthcare resources, which can increase their risk of MetS.

Conclusion

The findings of this study provide significant insights into the associations between sociodemographic factors, lifestyle choices, and the presence of MetS. The study highlights the importance of addressing both lifestyle and genetic factors in the management and prevention of Mets. Our study highlights the importance of the gender differences in the prevalence of Mets as females are more susceptible. Therefore, targeted interventions may be necessary to reduce the risk of Mets among this population. Public health interventions targeting physical activity, diet, smoking cessation, and responsible alcohol consumption, along with early screening for individuals with a family history of metabolic-related diseases, could potentially reduce the prevalence of MetS in the population. Further research is needed to understand the underlying mechanisms of MetS among females and to develop effective interventions to reduce the risk of MetS.

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