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ORIGINAL ARTICLE

Prevalence of Metabolic Syndrome and Its Risk Factors among Urban Sikh Population of Amritsar

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ABSTRACT

Metabolic syndrome (MS) refers to a cluster of various interrelated cardiometabolic risk factors that promote the development of atherosclerotic cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM). South Asians also seem to have a peculiar body phenotype known as South Asian Phenotype, characterized by increased waist circumference, increased waist hip ratio, excessive body fat mass, increased plasma insulin levels and insulin resistance, as well as an atherogenic dyslipidemia, with low levels of HDL cholesterol and increased triglyceride levels. Epidemiologists in India and international agencies such as the world health organization (WHO) have been sounding an alarm on the rapidly rising burden of CVD for the past 15 years. Thus, the primary aim of this study was to identify the prevalence of MS in the Urban Sikh Population of Amritsar by means of a door-to-door survey. A secondary aim was to identify the risk factors for the development of MS. The sample size of 1089 subjects was calculated. This study focused on Urban Sikhs living in Amritsar, Punjab. The overall prevalence of MS in Urban Sikh population of Amritsar was 34.3% with a higher prevalence among women (41.4%) compared with men (28.2%). We also found that the prevalence of MS increases with age in both sexes. We infer that out of 1089 subjects there were only 84 subjects who reported with not a single abnormal component of the MS. The rest 1005 subjects had either one or more component abnormal in them.

Keywords: Metabolic syndrome, Prevalence, Cardiovascular disorders, Urban population.

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INTRODUCTION

Metabolic syndrome (MS) refers to a cluster of various interrelated cardiometabolic risk factors that promote the development of atherosclerotic cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM).[1] It is now well known that MS is a risk factor for increased cardiovascular mortality and morbidity. MS is a complex web of metabolic factors that are associated with a two-fold risk of CVD and a five-fold risk of diabetes. Individuals with MS have a 30 to 40% probability of developing diabetes and/or CVD within 20 years, depending on the number of components present.[2] Metabolic syndrome is a lifestyle disease and factors contributing to recent changing patterns in metabolic syndrome prevalence in this particular geographic region may provide interesting insights into tackling the ever-rising burden of T2DM and CVD within a wider context of South Asians.

In the United States (US), the prevalence of the MS in the adult population was estimated to be more than 25%. Similarly, the prevalence of MS in 7 European countries was approximately 23%. It was estimated that 20 to 25% of South Asians have developed MS and many more may be prone to it.[3,4]

Asian Indians have an increased prevalence of coronary heart disease (CHD) and T2DM among all ethnic groups.[5,22] This Asian Indian or South Asian Paradox refers to the fact that high prevalence of diabetes is seen in people originating from South Asian nations of Bangladesh, India, Nepal, Pakistan and Sri Lanka, despite lower rates of obesity (as defined by conventional body-mass-index criteria).[2,3] Approximately, about one-third of urban South Asians have evidence of the metabolic syndrome.[6] Moreover, insulin resistance was observed to be there in nearly 30% of Asian Indian children and adolescents and many exhibit features of metabolic syndrome.[7]

The prevalence of obesity and MS is rapidly increasing in India and other South Asian countries, leading to increased mortality and morbidity due to CVD and T2DM.[8,22] Since MS and obesity track into adulthood, these clinical entities need to be recognized early in the life-course for effective prevention of T2DM and CVD.[9]

South Asians also seem to have a peculiar body phenotype known as South Asian Phenotype, characterized by increased waist circumference, increased waist hip ratio, excessive body fat mass, increased plasma insulin levels and insulin resistance, as well as an atherogenic dyslipidemia, with low levels of HDL cholesterol and increased triglyceride levels.[8,22]

Unfortunately, representative periodic nationwide data on cardiovascular risk factors for monitoring and surveillance are lacking in India.[10,11]

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Epidemiologists in India and international agencies such as the world health organization (WHO) have been sounding an alarm on the rapidly rising burden of CVD for the past 15 years. It is estimated that by 2020, CVD will be the largest cause of disability and death in India, with 2.6 million Indians predicted to die due to CVD.[12,13]

The urban population is very prone to development of cardiovascular diseases with Sidhu et al putting the figure at 20.15%.[14] Inspite of the predilection of this population to the development of CVD, there has been no epidemiological surveys study in this population.

Thus, the primary aim of this study was to identify the prevalence of metabolic syndrome in the Urban Sikh population of Amritsar by means of a door-to-door survey. A secondary aim was to identify the risk factors for the development of metabolic syndrome.

Definition of Metabolic Syndrome

The WHO 1999 criteria[15] require the presence of any one of diabetes mellitus, impaired glucose tolerance, impaired fasting glucose or insulin resistance, And two of the following:

- Blood pressure: ≥140/90 mm Hg
- Dyslipidemia: triglycerides (TG): ≥150 mg/dl and high-density lipoprotein cholesterol (HDL-C) ≥40 mg/dl
- Central obesity: waist:hip ratio >0.90 (male); >0.85 (female), or body mass index >30 kg/m^2
- Microalbuminuria: urinary albumin excretion ratio ≥20 μg/min or albumin:creatinine ratio ≥30 mg/gm.

METHODOLOGY

The sample size of 1089 subjects was calculated. The multi stage cluster randomized sampling was done using the probabilities proportional size (PPS) method. This study focused on Urban Sikhs living in the Amritsar, Punjab, India as they constitute 70% of the total population of Amritsar according to 2011 census report. The area was arbitrarily divided into five equal zones namely (Z1, Z2, Z3, Z4, Z5). Each zone constituted of 13 Censes wards. The list provided the name, age and address of those eligible for voting (>18 years). The fieldwork was completed in a period of 20 months, starting in Jan 2012. The totals of 215 subjects from each zone were randomly selected. In the selection of the family in a particular ward the WHO method of sampling was followed to prevent any nonuniformity in selection of the subjects. A model consent form was constructed to ensure compliance with ICMR guidelines regarding the use of human subjects in research. All protocols and consent documents were reviewed and approved by the Institutional Ethics Committee of Faculty of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar. The complete detailed Performa of all the family members was filled by the investigator which included number of members in the family, age, educational status, etc. From the list provided one male and one female member were randomly selected. These two family members were requested to fill in the self-designed, professionally validated questionnaire.

The fasting blood sample was taken for the analysis of biochemical variables. The blood was analyzed for serum cholesterol, (CHO), serum trigylerides (TG), (High density lipoprotein (HDL), (Low density lipoprotein (LDL), very low density lipoprotein (VLDL). The anthropometric readings were taken namely height, weight, waist (WC) and hip circumference (HC).

STATISTICAL ANALYSIS

All values given in the text, figures, and tables are represented as mean ± SE. A one-way analysis of variance (ANOVA) was used to determine significant differences between the EG and CG group. After we had pooled the two intervention groups, Scheffe's test were used to compare relative changes from before to after training between the EG group and CG group. Scheffe's tests were used to test for significant changes within groups from before to after training. The level of significance was set at $p \leq 0.05$. Data analysis was performed using SPSS (version 20.0, SPSS Inc, Chicago, Ill).

RESULTS

All the statistical analysis was done using Stata 11.2. The association of the categorical variables with outcomes was seen by the Chi-square test. p-values less than 0.05 were taken as significant. Unadjusted odd's ratio of relationship of each factor with outcomes was found using binary logistic regression test. Factors, which are significant in univariate analysis, were included in multivariate analysis using multivariable logistic regression test.

Significant Predictors of Metabolic Syndrome

Table 1 shows overall prevalence of MS in the Urban Sikh population of Amritsar. Table 2 specifies the gender wise mean and standard deviation values of various

Table 1: Prevalence with 95% confidence interval

Lifestyle disorder	*Total subject population*	*Frequency*	*Prevalence in percentage (95% CI)*
Metabolic syndrome	1089	374	34.3 (31.5,37.1)

CI: Confidence inteval

Table 2: Gender-wise distribution of the biochemical parameters in metabolic syndrome and nonmetabolic syndrome individuals (mean ± SD)

Age (years)	*Male*	*Female*
Nonmetabolic syndrome	50.1 ± 14.1	45.9 ± 14.4
Metabolic syndrome	55.0 ± 13.3	52.6 ± 13.8
CHO (mg/dl)		
Nonmetabolic syndrome	203.0 ± 42.5	189.1 ± 43.3
Metabolic syndrome	228.0 ± 62.0	211.4 ± 45.5
TG (mg/dl)		
Nonmetabolic syndrome	159.2 ± 59.2	137.8 ± 54.5
Metabolic syndrome	215.1 ± 82.0	185.6 ± 59.0
HDL(mg/dl)		
Nonmetabolic syndrome	45.4 ± 8.5	46.5 ± 10.3
Metabolic syndrome	38.0 ± 8.5	40.6 ± 8.7
LDL (mg/dl)		
Nonmetabolic syndrome	152.4 ± 45.4	139.4 ± 41.6
Metabolic syndrome	164.8 ± 57.3	152.6 ± 44.0
VLDL (mg/dl)		
Nonmetabolic syndrome	32.1 ± 13.1	28.2 ± 18.3
Metabolic syndrome	44.0 ± 19.8	37.0 ± 12.0
SBP (mm Hg)		
Nonmetabolic syndrome	125.0 ± 11.1	122.5 ± 11.6
Metabolic syndrome	136.2 ± 14.0	130.3 ± 14.3
DBP (mm Hg)		
Nonmetabolic syndrome	83.0 ± 7.7	81.2 ± 8.3
Metabolic syndrome	89.5 ± 10.3	86.9 ± 9.4
BMI		
Nonmetabolic syndrome	26.2 ± 5.2	25.4 ± 5.0
Metabolic syndrome	27.8 ± 5.4	27.2 ± 5.4
WC (cm)		
Nonmetabolic syndrome	84.7 ± 13.3	81.8 ± 13.5
Metabolic syndrome	89.2 ± 14.3	87.7 ± 12.7
HC (cm)		
Nonmetabolic syndrome	98.5 ± 13.0	98.0 ± 13.0
Metabolic syndrome	97.9 ± 12.3	97.8 ± 13.6
WHR		
Nonmetabolic syndrome	0.87 ± 0.2	0.85 ± 0.2
Metabolic syndrome	0.93 ± 0.2	0.91 ± 0.2

BMI: Body mass index; CHO: Cholesterol; DBP: Diastolic blood pressure; HC: Hip circumference; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; SBP: Systolic blood pressure; SD: Standard deviation; TG: Triglyceride; VLDL: Very low-density lipoprotein; WC: Waist circumferences; WHR: Waist to hip ratio

parameters. Table 3 shows the gender-wise prevalence of metabolic syndrome across different age groups. The study also shows significantly higher rates of MS in the older age groups. The T2DM rates increase from 13.3% in the age group of 20 to 29 years peaking to 42.8% in the age group of 60+ years.

Chi-square outputs of significant proportions with several clinical, demographic and biochemical parameters available to the present study comparing the subjects with and without MS are shown in Table 4. Proportionately, more subjects with MS had type 2 diabetes mellitus (49.4%). Likewise proportionately more subjects, 81.5% had hypertrigylerdemia, 81.8% had low HDL levels, 58.9% had hypercholesterolemia and 60.1% suffered from hypertension.

Detailed correlates of MS in univariate analysis and multivariate logistic regression method showing significant predictors of MS are summarized in Table 4. Advancing age, gender, BMI and hypercholesterolemia significantly contributed to the increased MS risk.

Those with low HDL levels have double the risk of developing T2DM as compared to the individuals who with advancing age, the risk of developing MS increases 4.7 times more in 60+ age group than 20 to 29 years age group. Similarly, the increased serum cholesterol levels increased the risk of developing MS two times more. The subjects falling in the obese category have two and half times more risk of developing MS.

Older age, female sex, general obesity and hypercholesterolemia significantly contributed to an increased MS risk among this urban population.

Very few subjects in this study were in the category of health BMI. From Table 5, we infer that only 32.6% (n = 355) of the subjects presented with a healthy BMI as per the WHO guidelines. 6.7% (n = 73) were reported underweight, whereas 36.7% (n = 400) were reported as preobese and 24% (n = 261) presented as obese. The subject population presented a picture of general obesity as central obesity was not significantly present in this

Table 3: Age-specific and age-standardized prevalence of metabolic syndrome gender-wise in percentage with 95% confidence interval

	Prevalence of MS in percentage with 95% CI					
	Male		*Female*		*Total*	
Age group (years)	*n*	*Prevalence in percentage with 95% CI*	*n*	*Prevalence in percentage with 95% CI*	*n*	*Prevalence in percentage with 95% CI*
20-29	30	6.7 (–2.8, 16.1)	45	17.8 (6.2, 29.4)	75	13.3 (5.4, 21.2)
30-39	96	17.8 (9.9, 25.5)	96	27.1 (18.0, 36.1)	192	22.4 (16.4, 28.3)
40-49	136	27.2 (19.6, 34.8)	127	40.1 (31.5, 48.8)	263	33.5 (27.8, 39.2)
50-59	147	30.6 (23.1, 38.1)	104	53.8 (44.1, 63.6)	251	40.2 (34.1, 46.3)
60+	178	36.5 (29.4, 43.7)	130	51.5 (42.9, 60.2)	308	42.8 (37.3, 48.4)
Total	587	28.2 (24.6, 31.9)	502	41.4 (37.1, 45.7)	1089	34.3 (31.5, 37.1)

CI: Confidence interval

Table 4: Risk factors for metabolic syndrome

Variables	*Metabolic syndrome nonmetabolic syndrome n (% age)*	*p-value metabolic syndrome n (% age)*	*Unadjusted Odds ratio with 95% CI*	*Adjusted Odds ratio with 95% CI*	
Age (years)					
20-29	65 (9.0)	10 (2.6)	< 0.00	1.0	1.0
30-39	149 (20.8)	43 (11.5)		1.9 (0.9, 4.0)	1.9 (0.8, 4.0)
40-49	175 (24.4)	88 (23.5)		3.3 (1.6, 6.7)	3.0 (1.4, 6.4)
50-59	150 (20.9)	101 (27.0)		4.4 (2.1, 8.9)	4.3 (2.0, 9.0)
60+	176 (24.6)	132 (35.2)		4.9 (2.4, 9.9)	4.7 (2.3, 9.8)
Gender					
Female	294 (41.1)	208 (55.6)	< 0.00	1.0	1.0
Male	421 (58.8)	166 (44.3)		0.5 (0.4, 0.7)	0.5 (0.3, 0.6)
BMI					
Underweight	262 (36.6)	93 (24.8)	< 0.00	1.1 (0.6, 2.0)	1.2 (0.6, 2.0)
Normal	52 (7.2)	21 (5.6)		1.0	1.0
Preobese	255 (35.6)	145 (38.7)		1.6 (1.2, 2.2)	1.6 (1.2, 2.3)
Obese	146 (20.4)	115 (30.7)		2.2 (1.6, 3.1)	2.6 (1.8, 3.7)
Waist circumference					
< 102 cm in males < 88 cm in females	592 (82.8)	206 (55.0)	< 0.00	1.0	—
≥ 102 cm in males ≥ 88 cm in females	123 (17.2)	168 (44.9)		3.9 (3.0, 5.2)	—
Physical activity					
Mild	28 (3.9)	17 (4.5)	0.64	1.0	—
Moderate	77 (10.7)	46 (12.3)		1.0 (0.5, 2.0)	—
Heavy	610 (85.3)	311 (83.1)		0.8 (0.4,1.5)	—
Diet					
Vegetarian	382 (53.4)	194 (51.8)	0.62	1.0	—
Nonvegetarian	333 (46.5)	180 (48.1)		1.0 (0.8, 1.4)	—
Alcohol intake					
Nonalcoholic	552 (77.2)	308 (82.3)	0.04	1.0	—
Alcoholic	163 (22.8)	66 (17.6)		0.7 (0.5, 1.0)	—
Family history					
No family history	406 (56.7)	199 (53.2)	0.40	1.0	—
Family history of T2DM	166 (23.2)	88 (23.5)		1.1 (0.8, 1.0)	—
Family history of hypertension	143 (20.0)	87 (23.2)		1.2 (0.9, 1.7)	—
Type of oil used					
Refined	507 (70.9)	254 (67.9)	0.28	1.0	—
Desi Ghee	125 (17.4)	64 (17.1)		1.0 (0.7,1.4)	—
Dalda	83 (11.6)	56 (14.9)		1.3 (0.9,1.9)	—
Triglycerides					
< 150 mg/dl	416 (58.1)	69 (18.4)	< 0.00	1.0	—
≥ 150 mg/dl	299 (41.8)	305 (81.5)		6.1 (4.5, 8.3)	—
HDL					
< 40 mg/dl for males < 50 mg/dl for females	294 (41.1)	306 (81.8)	< 0.00	1.0	—
≥ 40 mg/dl for males ≥ 50 mg/dl for females	421 (58.9)	68 (18.1)		6.4 (4.8, 8.7)	—
Cholesterol					
< 200 mg/dl	421 (58.9)	154 (41.2)	< 0.00	1.0	1.0
≥ 200 mg/dl	294 (41.1)	220 (58.9)		2.0 (1.6, 2.6)	1.9 (1.5, 2.5)
LDL					
< 130 mg/dl	244 (34.1)	115 (30.7)	0.26	1.0	—
≥ 130 mg/dl	471 (65.8)	259 (69.2)		1.2 (0.9, 1.5)	—
Diabetes					
Not present	647 (90.4)	189 (50.5)	< 0.00	1.0	—
Present	68 (9.5)	185 (49.4)		9.3 (6.8, 12.9)	—
Hypertension					
Not present	549 (76.7)	149 (39.8)	< 0.00	1.0	—
Present	166 (23.2)	225 (60.1)		5.0 (3.9, 6.5)	—

CI: Confidence interval

Table 5: BMI: WHR distribution in the sample population

BMI	WHR	N
Normal	0.79 ± 0.15	355
Underweight	0.71 ± 0.2	73
Preobese	0.91 ± 0.18	400
Obese	1.01 ± 0.2	261

BMI: Body mass index; WHR:

population. General obesity is related to the abnormal lipid profile values, i.e. increased serum cholesterol, serum triglyride, LDL and decreased HDL values.

From Tables 6 and 7, we infer that out of 1089 subjects there were only 84 subjects who reported with not a single abnormal component of the MS. The rest 1005 subjects had either one or more component abnormal in them. Table 8 indicates the age-wise distribution of MS in the Urban Sikh population of Amritsar.

DISCUSSION

The overall prevalence of MS in Urban Sikh population of Amritsar was 34.3% with a higher prevalence among women (41.4%) compared with men (28.2%). We also found that the prevalence of MS increases with age in both sexes (Fig. 1). It is noteworthy, that 13.3% of subjects in the age group of 20 to 29 years had MS. The higher prevalence of MS in younger age in Punjabi Sikhs is of particular concern, as it implies that they might have a more prolonged exposure to atherosclerotic risk factors associated with MS.

The prevalence of MS is increasing exponentially in India, both in the urban and rural areas. It has escalated in different parts of India to figures now ranging from 11 to 41%.[16]

Earlier studies across Urban India documented prevalences ranging from 22.1 to 41%,[17-19] which is comparable with our observation of 34.3%. Likewise, a prevalence study of urban community in northern India reported a prevalence of 22.37% for MS.[20] On the contrary, a lower prevalence of 19.52% was reported in an Urban population in western India.[21] While these studies show high prevalence of MS in Asian Indians living in India, truly representative data from all regions of India are not available.[6,22]

Furthermore, Asian Indians are metabolically obese but physically nonobese.[23,24] In our study even with modified BMI cut-off values for South Asians, 60.6% of subjects did not have general obesity, but still had MS. For any given level of BMI, Asian Indians had been recognized to have increased prevalence of cardiometabolic abnormalities as compared to other ethnic groups.[25,26]

Asian Indians are a high risk population with respect to diabetes and CVD, and the numbers are consistently on the rise.[27] The prevalence of MS in Asian Indians varies according to the region, the extent of urbanization, lifestyle patterns, and socioeconomic/cultural factors. Recent data show that about one third of the Urban population in India's major cities have MS.[28] The prevalence of MS in our study in females was 2 times higher as compared to females, as in other studies in India, MS prevalence in women was 1.5 to 2 times higher than in males.[29,30] A higher prevalence in women might be related to their higher rates of overweight BMI, impaired blood glucose levels, high TG, and low levels of HDL-C. Chow et al[31] found a prevalence of MS of 26.9% in males and 18.4% in females in southern India.

The development of obesity, or more specifically an increase in abdominal fat, is thought to be the primary event in the progression of MS. A tendency to gain fat in the abdominal area, as opposed to the hip, buttock, and limb areas, is linked to a rise in fatty acids in the blood, which is thought to lead to insulin resistance, high blood pressure, abdominal blood lipids and eventually diabetes. Asian Indians tend to develop central obesity rather than generalized obesity. About three fourth of the subjects participated in study were overweight/obese (BMI ≥ 23 kg/m^2), being a prime determinant of MS prevalence. Of these around one third of overweight/obese subjects had impaired glucose tolerance and many exhibit features of MS.

Table 6: Age-wise and gender-wise distribution of number of individuals with abnormal findings in the various components of metabolic syndrome

Age group (years)	Components of MS									
	Waist circumference ≥ 102 cm in males ≥ 88 cm in females		Triglycerides ≥ 150 mg/dl		HDL < 40 mg/dl for males < 50 mg/dl for females		BP ≥ 135/85 mm Hg		Fasting Blood sugar > 110 mg/dl	
	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males
20-29	19	6	13	10	31	14	5	3	7	5
30-39	41	14	32	49	72	29	17	26	17	20
40-49	63	25	63	83	97	45	36	57	37	44
50-59	40	10	67	98	84	57	48	66	41	62
>60	51	22	75	114	103	68	63	107	57	72

BP: Blood pressure; HDL: High-density lipoprotein; MS: Metabolic syndrome

Table 7: Number of components of metabolic syndrome found to be positive in the subject population

Number of components positive	*Frequency*	*Percentage (%)*
0	84	7.7
1	255	23.4
>2	376	34.5
>3	238	21.8
>4	116	10.7
>5	20	1.8

Table 8: Age-wise: metabolic syndrome distribution

Total age groups	*Non-MS*	*MS*	*Total*
20-29	65	10	75
30-39	149	43	192
40-49	175	88	263
50-59	150	101	251
60+	176	132	308
Total	715	374	1089

MS: Metabolic syndrome

In our study, we observed approximately 23.5% of subjects had history of type 2 diabetes. This means that the remaining subjects with impaired blood glucose levels were on their way to risk of developing type 2 diabetes, which is an important risk factor for CAD. Enas et al[32] in Coronary Artery Disease in Indians (CADI) study report the prevalence of diabetes to be 3 to 6 times higher among South Asians than Europeans, Americans, and other Asians. In India, it is estimated that 32 million people suffer from diabetes, and the number is projected to increase to 69.8 million by 2025.[27]

Increased prevalence of low HDL-C has been reported earlier by Enas et al[32] who found that only 4% of Asian Indian men and 5% Asian Indian women had optimal HDL-C levels. Low HDL-C levels are a strong predictor of occurrence and reoccurrence of myocardial infract (MI) and stroke and are associated with premature and severe CAD. Approximately half of the population had low levels of HDL-C of which 23% were from 20 to 40 age group that is, the young adults. Similar findings were also reported by Sawant et al[33] a recent study on 9000 subjects (<40 years of age) attending the Health Check program at PD Hinduja National Hospital, it was shown that around 64.2% men and 33.8% women had abnormally

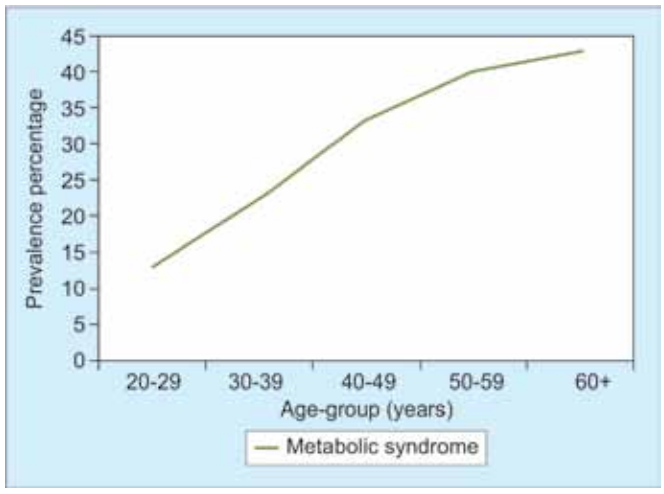

Fig. 1: Age-wise trend of metabolic syndrome

low levels of HDL-C. Obesity reduces HDL-C levels, and obese patients with MS and atherogenic dyslipidemia almost always have low HDL-C levels. Our study shows that around 35% of subjects had low HDL-C were either overweight or obese.

Our study clearly indicates that the Young Sikh adults <40 years of age have similar high BMI, WC and WHR to that of the older adults >40 years of age (Table 9).

The fact that 1005 out of 1089 subjects had one or more component abnormal clearly indicates that this particular section of the population is highly predisposed to the development of the metabolic syndrome at some stage of their lifetime. The development of these disorders is related to the increased risk of developing atherosclerotic changes in the body leading to the development of cardiovascular disorders and type-2 diabetes. Central obesity and insulin resistance are thought to represent common underlying factors of the syndrome.[34] Atherosclerosis is the underlying process of a majority of cardiovascular disease and mortality. While the clinical manifestations of atherosclerosis usually do not occur until middle age, atherosclerosis develops early in life. Several studies have shown associations between MetS and increased risk of cardiovascular disease (CVD).[35-40]

It is necessary to adopt appropriate preventive strategies and interventions in high-risk individuals to curb the growing epidemic of MS.

Table 9: Mean and standard deviation values of the anthropometric physiological and biochemical parameters accordingly to age group

Age (years)	*BMI*	*Waist*	*WHR*	*TG*	*CHO*
0-40	26.4 ± 5.3	85.7 ± 13.5	0.89 ± 0.19	150.7 ± 66.1	188.8 ± 46.2
>40	26.3 ± 5.3	84.9 ± 13.7	0.88 ± 0.20	173.3 ± 66.5	210.8 ± 47.8
Age (years)	*HDL*	*LDL*	*VLDL*	*SBP*	*DBP*
0-40	44.4 ± 10.3	135.4 ± 42.6	31.1 ± 11.5	121.3 ± 11.5	80.5 ± 8.1
>40	43.4 ± 9.3	156.8 ± 14.6	34.8 ± 14.6	129.2 ± 13.2	85.7 ± 9.0

BMI: Body mass index; CHO: Cholesterol; TG: Triglycerides; WHR: Waist to hip ratio

CONCLUSION

The study showed high prevalence of MS in the Urban Sikh population of Amritsar. It was found that there were only 84 subjects out of sample size of 1089 which were completely normal. The rest 1005 subjects had either one or more abnormal component of the MS as classified by the WHO. This fact needs serious preventive measures to curb this disease as it is the major factor leading to the cardiovascular disorders in this section of the population.

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