Prevalence of Factors of Metabolic Syndrome in Adolescents and Adults in Urban and Rural Population around Jaipur.

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ABSTRACT

Background: Metabolic syndrome (MetS) is a multiplex of metabolic risk factors including abdominal obesity, hypertension, atherogenic dyslipidemia and insulin resistance.The study is aimed to find causes and aetiological factors responsible for metabolic syndrome prevailing in and around Jaipur, both in rural and urban areas.**Methods:** It involves measurement of height, weight, blood pressure, fasting blood glucose, triglycerides and HDL levels. **Results:** In our study, overall prevalent rates of MetS in adolescents is 6.8% and in adults, it is 50.4%. According to present study, TGs, high blood pressure and low HDL were found to be major contributing factors for MetS in adolescents whereas in adults abdominal obesity contributed the most. **Conclusion:** These findings prove to be important tools to screen out MetS positive subjects because it is one of the leading risk factors of CVD, DM and stroke posing an emerging health problem to old and the new stressed out younger generation.

Keywords: Hypertension, Metabolic syndrome, Obesity.

INTRODUCTION

Now-a-days, there is the rapid rise of obese population in developing countries like India[1] due to the migration of rural population to urban areas and adopting a sedentary life style due probably to increase in per capita income.

In 1999, WHO formed, diagnostic standards of Metabolic Syndrome (MetS) also called syndrome X, which was later revised by National cholesterol Education Program's adult treatment panel III (NCEP) -ATP III)[2] and later by the American Association of Clinical Endocrinologists (AACE). MetS is labeled as a multiplex of metabolic risk factors including abdominal obesity (W.C.), elevated blood pressure (> 130/85 mm Hg), atherogenic dyslipidemia and insulin resistance using hyperglycemia (FBS > 110 mg/ml), hyper-triglyceridemia (GS > 150 in adults and > 110 in adolescents) and low HDL levels (< 40 mg/ml) as cutoff values for normal.

The metabolic syndrome is a constellation of severe insulin resistance and dyslipidemia that leads to future diabetes mellitus, coronary artery disease or cerebrovascular thrombotic / embolic complications.[3]

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MATERIALS AND METHODS

The study involved randomly selected 500 cases, out of which 250 were adolescents between ages of (12 to 19) yrs. having 125 males and 125 females each, and 250 adults between 20 to 80 yrs. of age (125 each of male and female genders) respectively [Table 1]. The study period included one year from Dec. 2014 till Nov. 2015, and written consent was obtained from persons involved in the study. Clearance was taken both from ethical and scientific committee of the institute. Patients fasting < 8 hrs, taking drugs like insulin, oral hypoglycemic, androgens, antihypertensive, statins or other steroidal drugs were excluded. Also patients suffering from DM and polycystic ovarian disease, hypothyroidism, Cushing's syndrome, acromegaly and pheochromocytoma were excluded.

Table 1: No. of candidates under study

Variables	Male	Female	Total	% Male	% Female
Adolescents (age 12-19 yrs)	125	125	250	25%	25%
Adults (age 20-80 yrs)	125	125	250	25%	25%

Fasting plasma sugar > 6.1 mmol/lit (110 mg/dl)

Recording age, sex, body height, body weight, waist circumference, and blood pressure readings (taken at 3 intervals after proper rest and in supine position were done. Measurement of serum triglycerides, HDL levels and FBS by autoanalyser (MILES) India Ltd. model (H 100) was done.

The parameters for the study followed are as under:

WC measured at the highest level of iliac rests taking > 102 cms in males and > 88 cms in females as markers of obesity upto 90 percentile of age and gender specific growth chart. The limiting values for BP was ≤ 130/85 as normal for adults, triglycerides levels ≤ 6.7 mmol/lit (150 mg/dl) as normal for adults and ≤ 6.1 mmol (110 mg/dl) for adolescents, fasting blood glucose 110 mg/ml (≤ 6.1 mmol) for both age groups (Modified NCEP ATP III Criteria for South Asian Indian adults)[4][Table 2].

Elevated BP in adolescents was defined as value at or above the 90 percentile for age, gender, height[3] and in adults ≥ 130/85 mm Hg. Subjects who met at least 3 out of the following criteria are labeled as having Met Syndrome (Abdominal obesity, elevated BP, high TGS, High FB glucose and Low HDL). The data were also re-analyzed using revised ADA criteria i.e. blood glucose cut off > 5.5 mmol/dl.

Table 2: NCEP ATP III 2001 and IDF Criteria for Metabolic Syndrome.

	NCEP Criteria		IDF Criteria for control obesity		
	Male	**Female**	**Men**	**Women**	**Ethnicity**
Abdominal obesity	> 102 cm	> 88 cm	≥ 94 cm	≥ 80 cm	Europoid, sub Saharan African, Eastern and Middle eastern
Hypertrigly-ceridemia	≥ 150 mg/ml or specific medication		≥ 90 cm	≥ 80 cm	South Asia, China, Ethnic South & Central America
Low HDL cholesterol	< 40 mg/dl (for men)	< 50 mg/dl (for women)	≥ 85 cm	≥ 90 cm	Japanese
Hypertension			Two or more of the following:		
≥ 130 mm Systolic and ≥ 85 mm Diastolic or specific medication			Fasting TG's > 150 mg/dl or sp medication HDL cholesterol < 40 mg/ml for men and < 50 mg/ml for women		
FBS ≥ 110 mg/dl or specific medication or prev. diagnosed as having DM Type II			≥ 130 mmHg Systolic &> 85 Diast. BP or previously diagnosed hypertension. FBG ≥ 110 mg/dl or prev. diagnosed c/o DM Type II		

IDF - International Diabetes Foundation
NCEP: ATP III - National Cholesterol Education Programme - Adult Treatment Panel III.

Table 3: Urban and Rural Subdivision of Population Study

	Adolescents (Total 250)		Adults (Total 250)	
	Male	Female	Male	Female
Urban	64	52	69	61
Rural	61	73	56	64

Table 4: Subjects Positive for met syndrome out of 250 cases both in adults and in adolescents

	Male		Female		Total (%)
	No.	**%**	**No.**	**%**	
Adolescents (12-19 yrs)	12	9.60	5	4.00	17 (6.8%)
Adults (20-80 yrs)	70	56.00	56	44.80	126 (50.4%)

Note: Diagnostic criteria positive for Met syndrome was based on 3 out of 5 as depicted above.

RESULTS

Adolescents

As shown in [Table 3, 4], incidence of met syndrome in adolescents was 9.6% in males, 4% in females with a net average of 6.8% in adolescents. The prevalence in males is more than twice than in females reflecting more sedentary habits and dietary impropriation in males as compared to females.

By analyzing results of [Table 5], we infer that abdominal obesity is thrice more in females as compared to males, whereas risk factors like hyperglycemia, hypertriglyceridemia, low HDL and hypertension are nearly same in both sexes with insignificant differences (with p values 0.05).

Adults

The incidence of adult metabolic syndrome in this study is 50.4% out of which male percentage is 56% and that of females is 44.8%, which depicts a sizeable difference between both sexes (p > 0.5).

[Table 6] shows risk factors seen in met syndrome in both sexes. Hyperglycemia, hypertriglyceridemia and abdominal obesity is more prevalent in females, whereas low HDL is significantly higher in males. Similarly, hypertension values are high in males as compared to females, thereby depicting that low HDL and hypertension are common predominant causes of the male metabolic syndrome.

DISCUSSION

In the year 1938, Hinsworth coined the term 'INSULIN RESISTANCE' and later in 1988, Reaven[5] was the first to describe syndrome X in Banting Lecture at the annual meeting of the ADA. The latest theory of insulin resistance is related to the reduction of adiponectin in metS, which inhibits expression of gluco-neogenic enzymes and rate of glucose production. Adult treatment panel III[4], identified[6] components of MetS that relates to CVD.

(a) Abdominal obesity (b) atherogenic dyslipidemia (c) raised BP (d) insulin resistance and glucose intolerance (e) pro-inflammatory state due to increased cytokines like interleukin I, VI, 18, resistin, TNF-α and c-reactive protein due to over production of adipose tissue mass (f) pro-thrombotic state.

Table 5: Risk Factors Percentage for Metabolic Syndrome in Adolescents and Adults

	Adolescents			Adults		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Abdominal obesity	2 out of 12 (16.66%)	3 out of 5 (60.00%)	5 out of 17 (29.41%)	38 out of 70 (54.28%)	40 out of 56 (71.49%)	78 out of 126 (61.90%)
Hyperglycemia	3 out of 12 (25.00%)	1 out of 5 (20.00%)	4 out of 17 (23.53%)	20 out of 70 (28.57%)	26 out of 56 (46.43%)	46 out of 126 (36.51%)
Hypertriglycemia	5 out of 12 (41.66%)	2 out of 5 (40.00%)	7 out of 17 (41.17%)	33 out of 70 (47.14%)	34 out of 56 (60.71%)	67 out of 126 (53.17%)
Low HDL	7 out of 12 (58.33%)	3 out of 5 (60.00%)	10 out of 17 (58.82%)	56 out of 70 (80.00%)	29 out of 56 (51.78%)	85 out of 126 (67.46%)
Hypertension (> 130/85 mmHg upto 90 percentile of age and sex gender)	7 out of 12 (58.33%)	3 out of 5 (60.00%)	10 out of 17 (58.82%)	56 out of 70 (80.00%)	30 out of 56 (53.57%)	86 out of 126 (34.40%)

Table 6: Risk Factors Details in Adults (Total Adults 250)

No. of Risk Factors	**Abdominal Obesity (Waist Circumference)**		**Low HDL**		**S. Triglycerides**		**Hypertension**		**Total Percentage**
	Negative	**Positive**	**Negative**	**Positive**	**Negative**	**Positive**	**Negative**	**Positive**	
0	12	-	12	-	12	-	12	-	12 (4.8%)
1	35	10	10	35	27	18	20	25	45 (18%)
2	20	47	26	41	27	40	32	35	67 (26.8%)
3	42	56	31	67	50	48	24	74	98 (39.2%)
4	6	14	10	10	-	20	5	15	20 (8%)
5	-	8	-	8	2	6	1	7	8 (3.2%)
Total	115	135	89	161	118	132	94	156	250

The great majority of Type II DM (75%) has impaired glucose tolerance and thus MetS. This predisposes to increase incidence of CVD in DM (Type II). Besides insulin resistance, leptin resistance is also basic cause for pathophysiology of MetS. When obesity develops, hyper-leptinaemia occurs with leptin resistance in the brain, resulting in inflammation, insulin resistance, hyperlipidemia and constellation of increased BP, atherosclerosis, CHD and heart failure.

Regarding dyslipidemia, increase free fatty acid released by lipolytic enzymes in liver is associated with increase production of apo-B containing triglyceride rich VLDLS. This hypertriglyceridemia is a marker of insulin resistance.

Reduction in HDL causes cholesterol ester transfer protein mediated alterations in TGS, which make the particles size small, dense and more atherogenic. This predisposes to increase incidence of CVD and CAD. Many investigators attach more importance to insulin resistance than to obesity in the pathogenesis. [6] The elevated levels of insulin to overcome its resistance is a prime factor in causing MetS which is a precursor and develop into type II DM[2].

Adult treatment panel III recommended that abdominal obesity as one of the most important risk factor for the development of metabolic syndrome. Some males can develop multiple metabolic risk factors with only a marginal increase in WC, i.e. 94 to 102 cm. Abdominal obesity is closely associated with high TGs. First-line therapy should be the weight reduction reinforced with increased physical activity. Weight loss lowers serum cholesterol and TGs, raises HDL, lowers BP and glucose and reduces insulin resistance. Routine cholesterol testing should begin in young adulthood and should be encouraged to modify life habits to minimize the risk of obesity. Elevated BP should be lowered to at least 140/90 or 130/80 mm Hg if diabetes is present. Reduced intake of saturated fat, trans-fat and cholesterol rich foods is also proposed.

Recent studies have shown that the prevalence of MetS and particularly diabetes mellitus (DM) is very high among migrant Asian Indians and is rapidly rising even within the Indian subcontinent. In a study conducted by Ramachandran in a city of Chennai, Tamil Nadu[7], India, it was noted that MetS is more common in Asian Indian adults and low HDL (65.5%) is a most prevalent risk factor. The prevalence of MetS is age related and is more common in women. Contrary to the findings of Ramachandran et al[7], male preponderance was found in the current study. Abdominal obesity,

hyperglycemia and hypertriglyceridemia were factors dominating in females having MetS and low HDL and hypertension was more common in male MetS. The prevalence of MetS in adults as 13%, high TGs 30%, hypertension 39% and elevated FBG 5% in Jaipur urban population of India[8]. In another Indian study from Chennai[9] the MetS was prevalent in 11.2% adults (95% Cl: 9.4-13.3) and higher socioeconomic status was considered as important risk factors. In the present study the prevalence is very high as compared to that given by other workers and another study conducted on Indian population (Ramachandran).[7] It appears that even with the same ethnic population group there can be significant differences in prevalence of individual factor that constitute the MetS.

Indeed, a report shows that India already has the largest number of diabetic subjects in the world and the majority of people with diabetes are in the age range of 45 to 64 years[10]. Our findings of 6.8% MetS in adolescents is in accordance with the various studies from other parts of the world, mainly from developing countries. In the data set, study of NHANES (1988-1992)[11] recorded the prevalence of MetS in adolescents as 4.2% and highlighted that a high percentage of overweight adolescents may have a high risk for future MetS in adulthood with a subsequent increased risk for premature CVD and type-2 diabetes. The overall prevalence of, MetS among US adolescents increased significantly from 4.2. to 6.4% in NHANES 1999-2000 ($p < 0.001$); the syndrome was more prevalent ($p < 0.01$) in male than female adolescents and was found in 32% overweight adolescents.[12]Investigators reported a prevalence of 3.6% from the Bogalusa Heart Study in Young adolescents of 8 to 17 years of age[13] and indicated that childhood obesity is a powerful predictor of development of the syndrome. In another study[14], the prevalence of the MetS in Mexican children and adolescents aged 10 to 18 years was 6.5% (9.5% CI 4.7-7.8). The incidence of prevalence of risk factors given by Moran et al[14] is very less as compared to our study.

The prevalence of MetS is highly age dependent, which is clearly demonstrated, in the present study, in which the prevalence of MetS in adolescents is 6.8% and increased to 50.4% in the adults. This agrees with the findings given in Iranian[15] and Japanese[16] population respectively. Differences in the prevalence of MetS between populations may be due to life style, genetic factors and the age and sex of population of the study. Dhingra *et al*[17] stated high prevalence of low HDL in urban adolescents and young adults which is an important observation for future development of atherosclerosis and related complications and risk factors track from early childhood to adulthood and old age.

It is also observed that the body weight among school going children, especially in urban areas has increased progressively due to physical inactivity, which is a major risk factor for the development of obesity and dislipidemia[18]. The incidence of MetS reported in the different hospital community based studies in USA is 23 to 43.6%[19]. In Indian adults, it is 36.4% in males and 46.5% in females.[7] A lower level of HDL is a more prevalent risk factor in Asian Indian than the white caucasians as the former are more insulin resistant and centrally obese than the later.[20] In the current study the contribution of obesity, low HD and high TGS were high in comparison to ↑BP and hyperglycemia as risk predictors. The least common risk factors were elevated FBG and hypertension. The pattern of individual risk factors as is seen in adults and adolescents showed a peculiar pattern. It is seen that abdominal obesity was a major predictor of MetS in adults and hence premature diabetes mellitus, CVD morbidity etc. In case of adolescents the foremost forecaster of MetS and its related premature effects were high TGs, low HDL and obesity. Because of increasing rates of obesity MetS increases the future risk of type 2 diabetic mellitus and premature coronary artery disease in adults, hence lifestyle, modifications and aggressive remedial therapy should be directed toward adolescents and young adults to reduce the related commodities that accumulate over the years.

In a country like India presents a unique demographic profile. It is listed as one of the fastest upcoming countries in terms of socioeconomic growth. But in terms of medical infrastructure it still has a long way to go. Indian population is still divided into affluent and the poor. However, it still presents a prevalence data comparable with developed countries. These countries have a definitive advantage of screening out the people at risk, counsel them and treat them if necessary. But India still is lacking in these fields of screening and counseling and then treating them.

CONCLUSION

According to the present study, TGs, high blood pressure and low HDL were found to be major contributing factors for MetS in adolescents whereas in adult abdominal obesity contributed the most. This information would be useful to screen out MetS positive subjects because it is one of the leading risk factors of CVD, DM and stroke posing an emerging health problem with old and the new stressed out younger generation.

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