Original Article

Prevalence of metabolic syndrome in adolescents aged 10-18 years in Jammu, J and K

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ABSTRACT

Objective: To estimate the prevalence of metabolic syndrome among adolescents attending school in the Jammu region, India. **Materials and Methods:** This is a cross-sectional study conducted between November 2009 and December 2010, among a total of 1160 school-going adolescents of both sexes aged 10-18 years. Relevant metabolic and anthropometric variables were analyzed and criteria suggested by National Cholesterol Education Program Adult Treatment Panel Third (NCEP-ATP III) modified for age was used to define metabolic syndrome. **Results:** The overall prevalence of metabolic syndrome was 2.6%. Prevalence of metabolic syndrome was higher in males (3.84%) than in females (1.6%) and slightly higher in urban area (2.80%) than in rural area (2.52%), whereas prevalence of metabolic syndrome among centrally obese subjects was as high as 33.33%. High density lipoprotein cholesterol was the most common and high blood pressure was the least common constituent of metabolic syndrome. Metabolic syndrome was most prevalent in 16-18 years age group (4.79%). **Conclusion**: This study demonstrates that metabolic syndrome phenotype exists in substantial number (up to 3%) of adolescent population in the Jammu region, India, and particularly 33% of obese adolescents are at risk to develop metabolic syndrome. These findings pose a serious threat to the current and future health of these young people.

Key words: Adolescents, metabolic syndrome, obesity, prevalence

INTRODUCTION

The prevalence of chronic or non-communicable disease is escalating much more rapidly in developing countries than in industrialized countries. According to World Health Organization estimates by the year 2020, non-communicable diseases will account for approximately three quarters of all deaths in the developing world.[1]

Metabolic syndrome (MS) is characterized as the clustering of dyslipidemia, hypertension, hyperinsulinemia, and central obesity and constitutes a risk factor for cardiovascular disease. Moreover, MS confers greater risk than a single factor for cardiovascular disease.[2,3]

The MS is highly prevalent in the adult population worldwide, with a suggested ethnic predisposition in Asians.[4] The MS is rapidly increasing in prevalence with rising childhood obesity and sedentary life styles worldwide. In western countries, the incidence of childhood obesity has more than doubled over the past generation, as a consequence the prevalence of MS and type 2 diabetes mellitus is rapidly increasing in the pediatric population.[5,6] It is observed that approximately 75% of Indian urban adolescents and young adults have sedentary lifestyles, and body weight among school-going children has increased progressively over the past decade.

As MS increases the future risk of type 2 diabetes and premature coronary artery disease in adults, life style modifications and therapeutic interventions if required must be targeted toward adolescents. This may likely decrease

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the incidence of associated morbidities and mortalities that accumulate with their passage into adulthood.

Too few studies have been conducted on MS to provide specific population data about children and adolescents Particularly and even on adult population in India[7,8] or about the early identification of isolated or clustered risk factors during this important period of life, when the progression of atheromatous disease potentially accelerates.[9] Therefore, the present study focused on a representative sample of an apparently healthy young population to find the prevalence of MS in adolescents attending school between 10 and 18 years of age.

MATERIAL AND METHODS

Subjects and sampling
A total of 1160 (658 boys and 502 girls) school going adolescents aged 10-18 years participated in this cross sectional study from Jammu district, India. The sample size was calculated as required to be studied in order to get an estimate of 3.75-5.25 confidence interval (CI) (assuming 5% prevalence of MS) and a confidence level of 95%. Subjects were selected by using stratified cluster sampling technique. For this, a 'cluster' was defined as a school. A list containing names of the schools in the defined area was prepared. An appropriate number of clusters were randomly selected from the list. The number of schools was based on proportional allocation to ensure the representativeness of the sample with respect to clusters, type of school (rural/urban), and sex. An appropriate representative sample size was chosen using table of random numbers from these schools for study purpose after attaining written consent of guardian/parents/school authorities. Subjects fasting for less than 8 hours and taking medications such as insulin, androgens or anabolic steroids, which might alter metabolic profile, were excluded from the study.

An anthropometric and general physical measurement was carried out. Height was measured in upright position with stadiometer. Weight was measured standing (without shoes) using self zeroing scale. Waist circumference (WC) was measured standing, using a nonstretchable tape at a midpoint between a lower border of the ribcage and the iliac crest during minimal respiration, and to the nearest 0.1 cm. Children were classified as having abdominal obesity when the WC was at or above the 90th percentile for age and gender charts.[10] Blood pressure was measured using a mercury sphygmomanometer of appropriately sized cuff in sitting position. First and fifth Korotkoff sounds were used to represent the systolic and diastolic blood pressure. Subjects were requested not to smoke or drink caffeine during 30 minutes prior to the measurement and rested for at least 10 minutes. It was recorded twice within an interval of 5 minutes and average value of systolic and diastolic blood pressure of two readings was taken for the study purpose. Elevated blood pressure was defined as value at or above 90th percentile for age, gender, and height based on Task Force Report (updated) on diagnosis and management of hypertension in children.

Blood samples were obtained in the morning through an antecubital vein using vacutainer tubes containing ethylenediaminetetraacetic acid (EDTA) from the subjects who had fasted over night, and transferred to central Biochemistry laboratory in the Hospital within 4 hours. High-density lipoprotein (HDL)-cholesterol and serum triglycerides were assessed by the standard enzymatic kit method using a semi auto analyzer. Fasting blood glucose was measured using a glucometer by glucose oxidase method.

The MS was defined as present when the participant had three or more than three of the following five metabolic components as per National Cholesterol Education Program Adult Treatment Panel Third -III criteria modified by Cook, *et al.* for age.[5]
- High blood pressure (>90th percentile for age, sex, and height).
- Abdominal obesity (WC > 90th percentile for age and sex).
- Hypertriglyceridemia (Triglycerides >110 mg/dl).
- High fasting glucose (>110 mg/dl).
- Low HDL cholesterol (HDL < 40 mg/dl).

Data analysis
The data was analyzed with the help of computer software MS Excel and SPSS (by IBM 233 South wacker Drive 11th floor, Chicago, IL 60606-6412)12.0 for windows. Overall age and sex specific prevalence of MS was calculated and represented along with 95% confidence intervals.

The study was approved by the institutional ethics committee of Government Medical College, Jammu, India.

RESULTS

Demographic characteristics associated with MS in bivariate analysis are shown in Table 1. In this study three schools were chosen by stratified cluster methodology from the urban and rural setup each. The overall prevalence of MS was 2.67% (95% CI = 1.75-3.89). It was more common in males (3.8%) than in females (1.62%) and the difference was statistically significant ($P = 0.01$). By area wise, rate was slightly higher in urban area (2.80%) than in rural area (2.52%), the difference, however, was statistically insignificant ($P = 0.75$).

Table 1: Demographic characteristics and prevalence of the metabolic syndrome in 1160 adolescents aged 10-18 years

Characteristics	No. of subjects	No. of subjects with MS (%, 95% CI)	*P value*
Total	1160	2.67 (CI=1.75–3.59)	
Sex			
Boys	546	3.84 (CI=2.23–5.45)	0.01
Girls	614	1.62 (CI=0.62–2.62)	
Age (years)			
10-12	384	0.26 (CI=-0.25–0.77)	
13-15	359	2.78 (CI=1.08–4.48)	0.00007
16-18	417	4.79 (CI=2.73–6.85)	
Area			
Urban	606	2.80 (CI=1.49–4.11)	
Rural	554	2.52 (CI=1.21–3.83)	0.76
Central obesity			
(On the basis of WC in percentile)			
Obese			
(WC ≥90th)	60	33.3 (CI=21.39–45.21)	
Nonobese			
(WC <90th)	1100	1 (CI=0.41–1.59)	0.0001

CI: Confidence interval

Maximum prevalence of MS was seen in 16-18 years age group (4.79%). Only 0.26% subjects in the 10-12 years had MS while as 2.78% subjects had MS between 13 and 15 years. Chi-square value of this linear trend was 15.76 ($P = 0.00007$), which was statistically highly significant. The criteria of MS was met by 33.33% of the subjects having abdominal obesity whereas only 1% nonobese adolescents had MS and this difference in prevalence was highly significant ($P = 0.0001$).

The prevalence of each component of the MS is shown in Table 2. Low HDL cholesterol was the most common (10.66%), while high blood pressure was the least common (2.75%) component observed. The proportion of subjects with one or more abnormalities of the MS is presented in Table 3. In this sample, 11.22% of subjects had at least one or the other defining components of MS present and 2.58% had only two components. In total, 2.67% subjects fulfilled at least three components, which was the overall prevalence of MS in the studied population. There was no subject who had four or five defining components of the MS.

DISCUSSION

MS has been called several other names, including syndrome X, insulin resistance syndrome, dysmetabolic syndrome X, Reaven syndrome, and metabolic cardiovascular syndrome.[11,12] Obesity, insulin resistance, dyslipidemia, and hypertension are common to all.

Sex wise distribution of the cases in our series showed slight female preponderance (52.93%). This is similar to that reported by two other studies in 2007 (Singh, *et al.*[7])

Table 2: Prevalence of individual risk factors of metabolic syndrome in the total group of 1160 subjects studied

Components of metabolic syndrome	Total (%)
Abdominal obesity	60 (5.66)
Elevated Blood Pressure	32 (2.75)
Hyperglycemia	70 (6.03)
Hypertriglyceridemia	40 (3.44)
Low HDL	124 (10.66)

Table 3: Prevalence of one or more risk factors of MS in 1160 adolescents in the study group

No. of components	Total number	% age
0	969	83.53
1	130	11.22
3	31	2.67
4	0	0
5	0	0

and in 2010 (Das, *et al.*[13]). However, studies by William, *et al.*[14] and Kim, *et al.*[15] had male preponderance. Analyzing and comparing the above studies with the present study, it may be inferred that female preponderance in our study is just by chance and there is no sex predilection or error in the stratified randomization of the given population.

The overall prevalence of MS in our study according to modified ATP III criteria was 2.67%. Our finding of 2.67% MS was slightly less as compared with various studies from other parts of the world, mainly from developed countries. In the data set study of National Health and Nutrition Examination Survey [1988-1992] by Cook *et al.*,[5] the prevalence was 4.2% and it increased to 6.4% in the NHANES study of 1999-2000.[16] A prevalence of 3.6% was reported by investigators from the Bogalusa Heart study in young

adolescents aged 8-17 years.[17] A similar study by Vikram, *et al.*, showed prevalence of 4.3%.[18] However, one study of Nunes, *et al.* had overall lesser prevalence (1.32%) of MS as compared with our study.[19] There is no data on prevalence of MS in adolescents from the developing world. The prevalence of MS was highest in the 16-18 years age group (4.79%). Similar trend was also noted in one of the studies in 2009.[19]

In the present study, the prevalence of MS was higher in males (3.84%) than in females (1.62%), which was similar to studies in the past.[5,20] However, in two of the studies on Indian population,[7,21] there was no sex predilection in the distribution of MS.

Considering the role of urbanization in genesis of MS, the prevalence was slightly higher in urban area (2.80%) than in the rural area (2.52%) in our study. This observation, of ours, contrasts with that of Sarkar, *et al.*,[8] who in their study inferred that MS may not necessarily be a result of urbanization and could well be attributed to certain ethnic factors. The higher prevalence in urban population can be attributed to the sedentary life style and dietary habits of the urban dwellers.

None of the subjects had four or five defining components of MS, this finding of our has similarity with the study conducted by Braga-Tavares, *et al.*,[22] in the year 2010, who also mentioned that no adolescent fulfilled all the five MS criteria.

In the present study, the prevalence of low HDL, hypertriglyceridemia, elevated blood pressure, hyperglycemia, and abdominal obesity was 10.66%, 3.44%, 2.75%, 6.03%, and 5.66%, respectively. Thus, in our subjects low HDL was most common while elevated blood pressure was the least constituent of MS. Tehran Lipid and Glucose Study, by Azizi, *et al.* also showed HDL cholesterol as the most common metabolic abnormality.[23] Low HDL was the most prevalent constituent of MS in the majority of studies, suggesting that it is the strongest predictor of MS. The lower prevalence of abdominal obesity in our study could be ascribed to the use of US standard WC percentile charts, as no data for WC are available from India for adolescent population.[10]

The prevalence of MS in our study in subjects with abdominal obesity was as high as 33.3% and only 1% of the nonobese subjects had MS. Despite the lower prevalence of abdominal obesity (5.66%) in the study group, nearly one-third (33.3%) of them had MS suggesting that abdominal obesity is a surrogate marker of MS. These findings almost match with various studies conducted in past.[5,7,8,24]

CONCLUSION

This study demonstrates that MS phenotype may exist in up to 3% (2.67%) of the adolescent population in the Jammu region of J and K state, India, with almost equal distribution among urban and rural adolescent population indicating that this syndrome was not necessary a result of modernization or urbanization. The study also highlights that adolescents having central obesity are more (33%) prone to develop MS. The high prevalence of MS in such subjects emphasizes need for effective preventive and therapeutic strategies that rely on diet, exercise, and life style modification rather than medication to maintain healthy lifestyle habits into and throughout their adulthood.

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