An epidemiological study of metabolic syndrome in a rural area of Ambala district, Haryana

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INTRODUCTION

The rapid rise of noncommunicable diseases (NCDs) is presenting a formidable challenge in 20th century, threatening economic and social development as well as the lives and health of millions around the globe. As many countries struggle to control infectious diseases, they also face an escalation of chronic diseases – a situation for which they have neither the resources, personnel nor the health service infrastructure required to respond effectively.[1]

Of the 57 million deaths that occurred around the world in 2008, 36 million–almost two-thirds–were due to NCDs, comprising mainly cardiovascular diseases (CVD), cancers, diabetes, and chronic lung diseases.[2]

Metabolic syndrome (MS) is characterized by a cluster of risk factors, which predisposes subjects to an increased risk of diabetes and CVD.[3] The main components of the syndrome are glucose intolerance, obesity, raised blood pressure (BP), and dyslipidemia. It is increasingly attracting the attention of international research institutions and scientific societies, as a major modifiable determinant of CVD and type 2 diabetes.[4,5] The criteria employed in this study are those given by International Diabetes Federation (IDF).[6]

Apart from its association with cardiovascular disorder and diabetes mellitus, MS is also linked to various other morbidities. The risk for several cancers increases in subjects affected by MS.[7] Several studies have found that there is a significant association of MS with pancreatic, colorectal, prostatic and breast cancer.[8,9] In recent years, a lot of work has been done on MS, but most have been confined to hospitals. Very few studies have been conducted at the community level. Therefore, this study was conducted to assess its prevalence in a rural adult population of Ambala district, Haryana, and determine various biochemical and sociodemographic factors associated with the syndrome.

MATERIALS AND METHODS

A community-based cross-sectional design was adopted for the study of the prevalence of MS. As the data on the
prevalence rate of MS for Haryana state is not available, the sample size was calculated by presuming its prevalence to be 26% (mean reported prevalence in India 18% [Deepa et al.] 10-34% [Kanjilal et al.]) \[10,11\]. The sample size for the study arrived at was 1138, using the formula.

The equation for calculating sample size was as follows:

\[ n = \frac{Z^2 \cdot \pi (1 - \pi)}{e^2} \]

Where,
\[ Z = \text{Level of confidence} \ (1.96) \]
\[ \pi = \text{Prevalence of the disease} \]
\[ e = \text{Margin of error} \]

To compensate for the nonresponse, a survey of 1200 individuals was conducted.

The study of a rural population of Ambala district was conducted from January 2010 to June 2011. A multi-stage cluster sampling technique was employed to draw the required sample size. Ambala district has six blocks: Namely-Ambala I, Ambala II, Saha, Naraingarh, Barara and Shahzadpur. In the first stage, one of the six blocks in the district, namely Barara was selected by simple random sampling. Further, in the second stage, a simple two-stage cluster sampling method was adopted. Villages were taken as primary sampling units. The total population of block Barara comprising 75 villages was 128,425. Of these, 15 villages (clusters) were selected. Households were selected by random sampling and taken as secondary sampling units. All the family members of the selected households satisfying the inclusion criterion were part of the study. A total of 80 respondents were interviewed in each cluster. The study included both males and females in the age group of 20 years and above, but pregnant women were excluded. A written informed consent was obtained after the objectives were explained. The clinical definition given by the IDF was used to define MS.\[6\]

Central obesity (waist circumference 90 cm in men and 80 cm in women); plus any two of the following four factors:

- Raised triglycerides level: ≥150 mg/dl or specific treatment for this lipid abnormality
- Reduced high-density lipoprotein cholesterol: <40 mg/dl in males and <50 mg/dl or specific treatment for this lipid abnormality
- Raised BP: systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg or treatment for previously diagnosed hypertension
- Raised fasting plasma glucose ≥ 100 mg/dl (5.6 mmol/L) or previously diagnosed type 2 diabetes.

To study the risk factors of MS, the World Health Organization's STEPwise approach to surveillance (STEPS) proforma was adopted. Anthropometric measurements such as height, weight, and waist circumference were measured using standard guidelines.\[12\] BP was measured using calibrated BP monitor (Omron). After 5 min rest, three readings of BP were taken with an interval of 2 min between readings and a mean of the three was taken as the final reading.

**Laboratory analysis**

An overnight fasting blood sample (10 ml) was collected. The fasting blood sugar was analyzed by glucose oxidase peroxidase-peroxidase antiperoxidase method.\[13\] ERBA kits supplied by Transia Biochemicals Ltd., Mumbai, India were used.

**Strategy**

The eligible population was contacted twice for data collection. In the first visit, information about risk factors was taken by the interview technique (as specified in STEPS questionnaire) followed by anthropometry. If the central obesity was found to be more than the prescribed cut-off guideline given by the IDF, the participants were asked for their fasting blood samples. Informed, written consent was taken from participants before the interview, general physical examination and the collection of blood samples. Ethical clearance was obtained from the Ethics Review Committee of Maharishi Markandeshwar University, Mullana, before the conduct of the study. Data were analyzed using SPSS 17.0 (SPSS Inc., Chicago, IL, USA).

**RESULTS**

A total of 110 (9.2%) subjects out of 1200 were found to have MS. It was found more in females (11.64%) than males (6.45%).

The highest number of MS cases were found in the age group of >65 year olds (43.6%), while the lowest was in those aged 20-34 (6.4%). MS was found to be highest in graduates (15.5%), while it was lowest in illiterates (5.3%). The level of education was found to be significantly associated with the prevalence of MS (\(P = 0.012\)) [Table 1].

Prehypertensive participants constituted 27.9% of the study population. More than half (53.63%) of the MS cases had concomitant hypertension. About 27.74% of the study population had Stages 1 and 2 hypertension. The association of MS and hypertension was found to be statistically significant (\(P < 0.01\)) [Table 2]. The mean waist circumference in participants with MS was 89.37 ± 8.9. The majority (50.90%) of the participants who had MS had a waist circumference of 100 cm or above. The prevalence of MS increased with a higher waist circumference [Table 3]. Most cases (88.8%) of MS had fasting blood sugar levels between 150 and 200 mg/dl. About 6.36% cases of MS had
fasting blood glucose (FBG) levels below 100 mg/dl. The mean FBG was 100.71 ± 45.80 in the MS group as compared to 78.04 ± 24.66 in the non-MS group and this difference was found to be statistically significant (P < 0.01) [Table 4].

**DISCUSSION**

In this study, the overall prevalence of MS was 9.2% among individuals aged 20 years and above, in the rural part of Ambala district of Haryana state. Of the total of 1200 participants, 110 were found to have MS. Several studies in India have shown different rates of prevalence in different parts of the country. Deepa et al.[14] found the prevalence of MS in a south Indian population to be 25.8% by IDF when compared to 18.3% by Adult Treatment Panel-III (ATP-III). Another study from Bangalore by Kanjilal et al.[15] concluded that the prevalence of MS (by ATP-III) was 40.3% when compared to 34.9% by the IDF definition. Gupta et al.[14] estimated the prevalence in Bhatia community in Rajasthan by the ATP-III definition to be 36.2% in males and 47.8% in females. The Indian Council of Medical Research (ICMR) task force collaborative study reported the prevalence of MS as 30% in the urban areas of Delhi and 11% in rural Haryana using ATP-III criteria.[15] Similar results were found in another study conducted by Kamble et al.[16] in a rural area of Wardha district of Maharashtra. In that study, the overall prevalence of MS was 9.3%. The prevalence rates of MS reported by Mangat et al.[17], Pemminati et al.[18] and Kaur et al.[19] were much higher at 47.5%, 29.7%, and 41.3% respectively. The observed difference could be explained by the fact that all these studies were conducted in urban areas of India while the present study was in rural India.

Various studies done in other countries have shown different prevalence rates of MS. Cabré et al.[20] estimated the prevalence by various definitions in Spain and reported

| Table 1: Prevalence of MS according to sociodemographic variables |
|-----------------------------------------------|
| **MS (n (%))** | Present | Absent | Total (n (%)) | 𝑥² value | 𝑃 value |
|----------------|---------|--------|---------------|----------|---------|
| **Sex** | | | | | |
| Male | 37 (33.63) | 536 (49.17) | 573 (47.8) | 𝑥²=9.67 | 𝑃=0.0018 |
| Female | 73 (66.36) | 554 (50.82) | 627 (52.3) | | |
| Total | 110 (9.2) | 1090 (90.8) | 1200 | | |
| **Age in years** | | | | | |
| 20-34 | 7 (6.4) | 383 (35.13) | 390 (32.5) | 𝑥²=203.70 | 𝑃<0.01 |
| 35-49 | 22 (17.3) | 450 (41.28) | 472 (39.3) | | |
| 50-64 | 33 (29.7) | 196 (17.70) | 229 (19.1) | | |
| >65 | 48 (43.6) | 61 (5.59) | 109 (9.1) | | |
| **Mean±SD** | 45.74±6.45 | 49.66±7.88 | 45.94±15.60 | | |
| **Level of education** | | | | | |
| No formal education | 5 (4.5) | 89 (98.2) | 94 (7.8) | | |
| Primary education | 5 (4.5) | 76 (7.0) | 81 (6.8) | | |
| High school education | 37 (33.6) | 341 (31.3) | 378 (31.5) | | |
| Senior secondary education | 25 (22.7) | 354 (32.5) | 379 (31.6) | | |
| Graduation | 23 (20.9) | 125 (11.5) | 148 (12.3) | | |

| Table 2: Prevalence of MS and concomitant hypertension |
|-----------------------------------------------|
| **BP** | **MS (n (%))** | Present | Absent | Total (n (%)) | 𝑥² value | 𝑃 value |
|----------------|---------|--------|--------|---------------|----------|---------|
| Normal (100-120/60-79 mm Hg) | 8 (7.27) | 524 (48.07) | 532 (44.33) | 𝑥²=172.28 | 𝑃<0.00001 |
| Prehypertension (120-139/80-89 mm Hg) | 16 (14.54) | 319 (29.26) | 335 (27.91) | | |
| Stage 1 hypertension (140-159/90-99 mm Hg) | 27 (24.54) | 118 (10.82) | 145 (12.08) | | |
| Stage 2 hypertension (>160/100 mm Hg) | 59 (53.63) | 129 (11.83) | 188 (15.66) | | |
| Total | 110 (9.2) | 1090 (90.8) | 1200 (100) | | |

| Table 3: Prevalence of MS depending on waist circumference |
|-----------------------------------------------|
| **Waist circumference in cm** | **MS (n (%))** | Present | Absent | Total (n (%)) | 𝑥² value | 𝑃 value |
|----------------|---------|--------|--------|---------------|----------|---------|
| <80 | 0 (0) | 288 (26.42) | 288 (24) | | |
| 80-90 | 19 (17.27) | 359 (32.93) | 378 (31.50) | 𝑃<0.0000001 | |
| 90-100 | 35 (31.81) | 421 (38.62) | 456 (38) | | |
| 100 above | 56 (50.90) | 22 (2.01) | 78 (6.50) | | |
| Total | 110 (9.2) | 1090 (90.8) | 1200 (100) | | |
| **Mean±SD** | 89.3±8.97 | 82.95±7.88 | 94.66±7.88 | | |

| Table 4: Prevalence of MS depending on FBG levels |
|-----------------------------------------------|
| **Fasting blood sugar in mg/dl** | **MS (n (%))** | Present | Absent | Total (n (%)) | 𝑥² value | 𝑃 value |
|----------------|---------|--------|--------|---------------|----------|---------|
| <100 | 7 (6.36) | 105 (84.11) | 112 (48.35) | 𝑃<0.01 | |
| 100-150 | 28 (25.45) | 18 (11.04) | 46 (16.84) | | |
| 150-200 | 48 (43.63) | 36 (22.08) | 84 (19.78) | | |
| >200 | 27 (24.54) | 4 (2.45) | 31 (15.01) | | |
| Total | 110 (9.2) | 163 (13.18) | 273 (100) | | |
| **Mean±SD** | 100.71±48.80 | 78.04±24.66 | 100.32±37.81 | | |
a prevalence of 35% according to IDF. The rate estimated in another study by Harzallah et al.\(^{[23]}\) in an Arab population was 45.5%. The difference in the results of various studies can be attributed to different classifications used to define MS, the composition of the study population, variation in the age groups on which these studies are conducted and differences in the study areas.

In this study, the highest number of cases (43.6%) of MS was found in the 65 years and above age group while the lowest (6.4%) was in the age group of 20-34 year olds. This finding was in accord with the study conducted by Kanjilal et al.\(^{[11]}\) in Bangalore. Similar trends were also reported in a study of the prevalence done by Taylor et al.\(^{[24]}\) in an African-American population of 21-94 year olds in which the highest prevalence was seen in the age group of 65-74 year olds and lowest in 21-34 year olds. MS was found to be comparatively higher among females than males. This finding agrees with the results of the study conducted by Mangat et al.\(^{[17]}\) who documented that using IDF, the prevalence of MS was more prevalent among females (59.6%) than males (40.4%). Similar results were reported in studies conducted by Pemminati et al.,\(^{[18]}\) Sidorenkov,\(^{[22]}\) Kamble et al.,\(^{[15]}\) Parale et al.\(^{[24]}\) and Gupta et al.\(^{[16]}\) whose results showed a higher prevalence of MS in females than males.

CONCLUSION

The prevalence of MS is on the rise even in rural areas because of the changes in their lifestyles. India has already become the diabetic capital of the world and other NCDs are also on the rise. In order to slow down this progression, we need to conduct multi-centric studies to assess the national prevalence of MS.

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