Original Article

Prevalence of Metabolic Syndrome (METS) using IDF 2005 Guidelines in a Semi Urban South Indian (Boloor Diabetes Study) Population of Mangalore

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Abstract

Objective : To identify metabolic syndrome (MetS) prevalence using International Diabetes Federation (IDF) 2005 guidelines in a semi urban south Indian (Boloor Diabetes Study) population of Mangalore.

Methods : Population of randomly selected adults ≥20 years living in Boloor locality who were available for the house to house survey were assessed for the following: anthropometric variables; blood pressure; fasting blood glucose and lipid profile. Among 800 responders; 300 men, 500 women, 551 were examined (68.8%). Fasting plasma glucose as well fasting lipid profile could be done for 451 (147 men, 304 women) 81.85%; Data was analysed for prevalence of MetS and its individual components. Diagnosis of MetS was based on IDF 2005 criteria for Asian men and women. Intergroup comparisons were performed using student 't' test and Chi-square test.

Results : MetS was prevalent in 134 of 451(29.7%); men 39 (26.5%) and women 95 (31.2%). Prevalence of individual components of MetS were as follows: increased waist circumference, (common component) present in all; elevated TG in 38.8%; low HDL-C in 59.7%; increased FPG in 57.4%; elevated SBP in 80.5% and DBP in 56.7%; body mass index (BMI) ≥ 25 kg/sq.m (obesity) in 58.9% Barring increased waist circumference which is the essential criteria for diagnosis of Mets, Systolic hypertension emerged as the most frequent component in the population followed by low HDL-C and elevated FPG. Elevated TG was less prevalent in this population.

Conclusion : Prevalence of MetS in this semi urban population (Boloor) of Mangalore compares with MetS prevalence identified in cross sectional studies in India. Prevention and treatment of the predictive factors: dyslipidemias, hyperglycaemia, hypertension, together with enhanced physical activity may together reduce the prevalence of MetS.

Introduction

In Asian Indians, there is an increasing pool of the Metabolic Syndrome (MetS), which converts to type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) when effective interventions are not applied.[1,2] MetS is not a new condition and was first described in the 1920s by Kylin, a Swedish physician, as the association of hypertension, hyperglycemia and gout.[3] In the 1940s, attention was drawn to upper body adiposity (android or male-type obesity) as the obesity phenotype commonly associated with T2DM and CVD.[4] In 1988, Gerald M Reaven presented the Banting Lecture[5] and he described 'a cluster of risk factors for diabetes and cardiovascular disease' and named it 'Syndrome X'. His contribution was the introduction of the concept of insulin resistance. In 1989, Kaplan[6] renamed the syndrome 'The Deadly Quartet' and in 1992 this was renamed 'The Insulin Resistance Syndrome'.[7] It is now agreed that, the established term 'metabolic syndrome' remains the most common description of a cluster of metabolic abnormalities: abdominal obesity; dyslipidemia; hyperglycaemia; hypertension; [8,9] all of which are predictive of MetS in particular intra-abdominal (visceral) fat accumulation.[10] The International Diabetes Federation (IDF) 2005 definition recognizes that visceral adiposity is common to each component of MetS. Hence now, an excessive waist circumference is a necessary requirement for the MetS.[11,12]

Based on existing estimates MetS affects nearly 1/4th of the population in developed countries[13] and the prevalence is increasing in developing countries, including India.[14]

The prevalence of the MetS has been in: Asian Indians 49.2% - 41.4% in males, 55.3% in females;[15] South Indian population - 16.1% without T2DM, 72.0% with T2DM;[16] Chennai general population - 36.4% in men, 46.5% in women;[17] Jaipur population - 22.9% in men, 39.1% in `women.[18] To date, no data is available on the prevalence of MetS in Dakshina Kannada population. Hence, this cross sectional study was conducted with the objective of identifying the prevalence of MetS in Boloor, Mangalore, Karnataka using IDF 2005 criteria.[11]

Materials and Methods

The study was approved by Institutional Ethics Committee and written informed consent was obtained from all subjects. This was a prospective cross sectional study conducted in a semi urban population of Boloor locality in Mangalore city. The rationale for choosing Boloor locality in Mangalore for this study was that its residents comprise a multireligious community that includes the major religious groups in Mangalore. There is a wide spectrum of socioeconomic groups in the area that could possibly be representative of the general population. And Boloor is one of the three field practice areas of the community medicine department of Kasturba Medical College, Mangalore. The study was done in phases with a door to door survey which included: a questionnaire on age, diabetes status with family history and

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Table 1: Prevalence of Metabolic Syndrome by age and sex (n=451)

Age group	Men	Prevalence (%)	Women	Prevalence (%)	Total	Prevalence (%)
20-29	13	0	20	1 (5.0)	33	1 (3.0)
30-39	27	3(10.3)	76	21(27.6)	103	24(23.3)
40-49	46	16(34.7)	78	23(29.4)	124	39(31.4)
50-59	27	6(22.2)	60	23(38.3)	87	29(33.3)
60-69	17	5(29.4)	48	17(35.4)	65	22(33.8)
70+	17	9(52.9)	22	10(45.4)	39	19(48.7)
Total	147	39(26.5)	304	95(31.2)	451	134(29.7)

The numbers in parentheses indicate percentages.

hypertension; anthropometric measurements on body weight, waist circumference, waist to hip ratio and body mass index; fasting blood samples (after an 8- hour fast) were collected for estimations of lipid profile, fasting blood sugar (FBS), oral glucose tolerance test (OGTT). Mangalore Corporation has a population of 4, 06,565 and consists of 60 wards. Boloor comes under ward number 7 while a small portion of it lies in the ward number 1. The total population of ward 7 is 6,293 (3,152 males, 3,141 females) while that of ward 1 is 6,687 (4,136 males, 2,551 females). Hence, the total population of Boloor is around 10,000, living approximately in 1500 houses. In each house, the mean number of adults above the age of 20 is two, which gives a total adult population of approximately 3000 people. Of these 3000 people, about 1500 people live near the sea; they go fishing or sell fish in the early morning hours on all days except the rainy season and hence these were excluded from the study. Of the remaining 1500 individuals, we randomly selected 800 (300 males, 500 females) individuals and invited them to participate in this study. Of these, 551 responded to the invitation (551/800), 68.8% response rate. Fasting venous samples were collected from 451(147 men, 304 women) 81.85% and the following parameters were all determined: triglycerides (TG);total cholesterol (TC); low density lipoprotein-cholesterol (LDL-C); high density lipoprotein-cholesterol (HDL-C) levels; FBS; OGTT was performed using 75 g of glucose with fasting and 2 hour plasma glucose measurements. Heights in meters (m), weight in kilograms (kg) were measured, and body mass index (BMI) was calculated as the weight in kilograms divided by the square of the height in meters. BMI ≥25 was defined as obesity, BMI < 23 defined as normal, BMI ≥ 23-24.9 defined as overweight.[19] Waist circumference (WC) was measured in the standing position of subjects with a soft tape midway between the lowest rib and the iliac crest. Hip circumference was measured over the widest part of the gluteal region (greater trochanters) and the waist to hip ratio (WHR) was calculated. Two blood pressure recordings were obtained from the left arm of patients in a sitting position after 10 min of rest at 5 min intervals, using standard mercury manometer, the mean value was used for final analysis.

IDF-2005 guidelines for MetS were followed for diagnosis of MetS: central obesity with a WC of ≥ 90cm for men and ≥ 80 cm for women, and any two of the following four factors: 1. TG > 150mg/dl or specific treatment for this lipid abnormality; 2. HDL-C (men < 40mg/dl and women < 50mg/dl) or specific treatment for this lipid abnormality; 3. Hypertension ≥ 130/85 mmHg (systolic blood pressure SBP/diastolic blood pressure DBP) or treatment of previously diagnosed hypertension; 4. FBS ≥ 100mg/dl or previously diagnosed T2DM. Blood glucose levels were classified as following: normoglycemia <100 mg/dl, impaired fasting glucose (IFG) 100 to 125 mg/dl, T2DM ≥ 126 mg/dl and impaired glucose tolerance (IGT) was diagnosed if the 2hr post glucose was ≥ 140 and < 200 mg/dl.[11,12] Information regarding the subjects: age; diabetes status with family history; hypertension; and physical activity were collected. Physical activity was graded: heavy exercise + strenuous work= Grade I; mild exercise or light work = Grade II; no exercise and totally sedentary = Grade III.[20]

Statistical Analysis

Continuous variables are given as mean ±SD, prevalence rates are given as percentages along with the corresponding confidence intervals. The group frequencies were compared by Chi-square test and quantitative data were tested by student's 't' test (unpaired). Statistical analysis was performed with a SPSS programme version16 for windows. P value <0.05 was considered statistically significant.

Results

The overall response rate among the randomly selected 800 (males 300, females500) who were examined was 551 (68.8%); males 176/300(58.6%) and females 375/500 (75.0%). However, biochemical parameters which are required for the diagnosis of MetS were done in 451; 147/176 (83.5%) males and 304/375 (81.0%) females. According to the IDF-2005 criteria, MetS was present in 134 (29.7%) subjects; prevalence was 95 (31.2%) in women and 39 (26.5%) in men (P=0.358, women compared with men). Prevalence of MetS by age is given in Table 1. There is an age related increase in the prevalence of MetS, with the highest prevalence 48.7% in the age group 70+ years. Table 2 gives the mean values and the confidence intervals of anthropometric and biochemical risk factors in patients with and without controls, There is a 10 cm difference in waist circumference, 3 in body mass index, 13 mm Hg in systolic blood pressure, 7 mmHg in diastolic pressure, 27 mg/dl in fasting blood glucose, 50 mg/dl in triglycerides in MetS patients as compared to controls. These parameters have showed a statistically significant difference of P<0.0001. TC;(P=0.31), HDL-C;(P=0.09), LDL- C;(P=0.5) were not significantly different between the two groups. Table 3. gives the total and gender wise percentage alterations with confidence intervals in anthropometric and biochemical risk factors of MetS patients : Increased waist circumference was present in 60.7%, women having 16% higher prevalence (49.6% in men, 66.1% in women); Obesity was present in 38.3%, (BMI ≥ 25 kg/sq.m) men having 5% higher prevalence (41.4% in men, 36.8% in women P=0.342); elevated SBP was present in 54.9%, women having 5% higher prevalence (51.7% in men, 56.5% in women); elevated DBP was present in 33.03% , men having 4% higher prevalence (35.3% in men, 31.9% in women); elevated FBS was present in 29.4%, men having 8% higher prevalence (34.6% in men, 26.9% in women); elevated TC was present in 46.3%, men having 5% higher prevalence (49.6% in men, 44.7% in women); elevated TG was present in 18.6% of subjects, men having 6% higher prevalence (22.4% in men, 16.7% in women); Low HDL-C was present in 48.1%, women having 33% higher prevalence (25.8% in men, 58.8% in women); elevated LDL-C was present in 41.01%, with an almost similar percentage of prevalence in both genders.

T2DM was present in 10.9%, IFG in 15.4%, IGT in 10.7%. Results of the questionnaire was as follows: family history of diabetes- father 6.8%, mother 14.7%, both parents 3.3%; patients known to be hypertensive 19.05 %,(men 22.15%, women 17.6%); physical activity Grade I- 4.4%, Grade II- 29.9%, Grade III- 65.7%.

Table 2: Means of anthropometric and biochemical parameters of subjects (n=451)

Sl. No.	Variable	Patients (134) m/w(39/95)	Controls (317) m/w (108/209)	P value
1	Age (years)	52.2 ± 13.2 (50.04-54.52)	46.4± 13.7 (44.94-47.97)	<0.0001
2	WC m≥ 90cm, w ≥ 80 cm	92.3±8.1 (91.0-93.75)	82.18± 9.1 (81.17-83.19)	<0.0001
3	BMI ≥ 25 kg/sq.m	26.2±3.98 (25.61-26.96)	23.0±3.7 (22.58-23.41)	<0.0001
4	SBP ≥ 130 mm Hg	138.8±17.8 (135.86-141.92)	125.4±19.1 (123.36-127.56)	<0.0001
5	DBP ≥ 85 mm Hg	85.1±9.2 (83.63-86.7)	78.3±9.1 (77.34-79.36)	<0.0001
6	FBS ≥ 100mg/dl	122.9±54.6 (113.69-132.19)	95.5±35.2 (91.6-99.4)	<0.0001
7	TC ≥ 200 mg/dl	204.05±52.7 (195.14-212.98)	198.6±52.5 (192.85-204.42)	0.31 NS
8	TG ≥ 150 mg/dl	153.2±112.0 (134.22-172.18)	104.3±61.1 (97.61-111.07)	<0.0001
9	HDL-C m<40mg/dl,w<50mg/dl	46.64±14.02 (44.27-49.01)	49.17±14.4 (47.59-50.76)	0.09 NS
10	LDL-C ≥ 130 mg/dl	125.7±44.4 (118.22-133.29)	128.4±49.5 (123.0-133.9)	0.5 NS

Values are reported as mean± SD. The numbers in parentheses indicate the lower and upper limits of the 95% confidence intervals. Significant differences P <0.0001 of patients with MetS vs controls without MetS by the Student *'t'* test. m = men, w = women.

Table 3 : Percentages of anthropometric and biochemical parameters by gender (n=451)

Sl. No.	Variable	Men n=147 n (%) 95% CI	Women n=304 n (%) 95% CI	Total subjects n = 451 n (%) 95%CI
1	WC m≥ 90 cm, w ≥ 80 cm	73(49.6) (41.38-57.96)	201(66.1) (60.50-71.47)	274(60.7) (56.05-65.22)
2	BMI ≥ 25 kg/ sq. m	61(41.4) (33.46-49.85)	112(36.8) (31.37-42.46)	173(38.3) (33.79-43.04)
3	SBP ≥ 130 mm Hg	76(51.7) (43.36-60.06)	172(56.5) (50.77-62.17)	248(54.9) (50.34-59.69)
4	DBP ≥ 85 mm Hg	52(35.3) (27.64-43.62)	97(31.9) (26.74-37.54)	149(33.03) (28.68-37.63)
5	FBS ≥ 100mg/ dl	51(34.6) (27.05-43.03)	82(26.9) (22.04-32.32)	133(29.4) (25.3-34.0)
6	TC ≥ 200 mg/dl	73(49.6) (41.38-57.96)	136(44.7) (39.09-50.56)	209(46.3) (41.6-51.00)
7	TG ≥ 150 mg/dl	33(22.4) (15.95-30.06)	51(16.7) (12.77-21.42)	84(18.6) (15.16-22.51)
8	HDL-C m<40mg/dl, w<50mg/dl	38(25.8) (19.0-33.66)	179(58.8) (53.12-64.50)	217(48.1) (43.34-52.77)
9	LDL-C ≥130mg/dl	61(41.4) (33.46-49.85)	124(40.7) (35.19-46.55)	185(41.01) (36.47-45.77)

Values are reported as n= number of subjects followed by percentages in parentheses. The numbers in parentheses given below the 'n' indicate the lower and upper limits of the 95% confidence intervals (CI). m = men, w = women.

Discussion

Our study shows a high prevalence of MetS, nearly 1/3rd of the study population being affected. The prevalence is similar to the prevalence studies conducted in various parts of India: 26% in Chennai, south India; [21] 27% in railway employees;[22] 31% in Jaipur, north India.[18] There is increasing prevalence of MetS with an increase in age, which is highest in both sexes, in those 70 years and above. There is also a marginally higher prevalence rate of MetS in women subjects. Studies by Ramachandran *et al*.[17] Rajeev Gupta *et al*.[18] Deepa *et al*.[21] Parale GP *et al*.[22] Pemminati *et al*.[23] have shown similar results.

Serum total cholesterol, low density lipoprotein cholesterol and high density lipoprotein cholesterol values were not statistically different between MetS patients as compared to controls. This indicates poor control in the general population of lipid profile including HDL-C (one of the four diagnostic criteria for MetS according to IDF 2005). It is observed from the present study that the MetS group has significantly higher cardiometabolic risk factors predisposing this population to coronary artery disease of which the population at risk may be unaware. Among the individual components of MetS that were altered in this study, the largest differences by gender were seen in female patients of MetS who had increased WC (w = 66.1% versus m= 49.6%) and low HDL-C (w = 58.8% versus. m=25.8%). Similar findings in female subjects of MetS and low HDL-C have been reported in the studies of Ramachandran *et al*.[17] Rajeev Gupta *et al*.[18] Pemminati *et al*.[23] Reddy *et al*.[24] Krishnaswami *et al*.[25] The loss of the protective effect of estrogens on the lipid profile in the postmenopausal women may account for this finding.[26] The higher prevalence of low HDL-C and central obesity seen in women of the present study has also been reported among Indian and other south Asian women.[17,18,27] This is perhaps an indication of: similar ethnic background; lifestyle factors such as food habits :- diet rich in carbohydrate, overcooking (known to destroy nutrients), deep frying and refrying in the same oil; decreased physical activity, which may have influenced these outcomes in female subjects of the Indian subcontinent.

Overall this study suggests, that the increase in prevalence of MetS and its components could be attributed to: urbanisation(lifestyle changes), physical inactivity (64.5% of study population were found to be sedentary, grade III physical inactivity);and to genetic components[28] where the genetic polymorphisms of FTO (fat mass and obesity associated)[29] gene may be associated with conversion of unspent calories to abdominal fat in populations traditionally exposed to heavy exercise and strenuous activity in former agro economies which have now rapidly changed their life to urban technologies with sedentary living. There is a need to developing therapeutic strategies: weight control, increased physical activity, decreased intake of LDL- raising nutrients that can modify the MetS as a whole and its individual risk factors. Larger prospective studies in other parts of India are required to identify the prevalence of this syndrome in cross sectional population and in specific groups of high-risk patients.

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