Original article:

Metabolic syndrome in urban and rural communities of Bangladesh

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Abstract

Background: Metabolic syndrome (MetS) is a rising public health concern. Bangladesh profile need exploration through research. **Methods:** Socio-epidemiologic factors of 341 urban and 149 rural people were studied with anthropometric examination, blood pressure recording and fasting blood for sugar (FBS), triglyceride (TG) and high density lipoprotein (HDL) analysis. MetS was decided on the basis of National Cholesterol Education Program ATP III criteria. **Result:** Prevalence of MetS was 38.78% (95% CI: 34.56%-43.16%). Rural prevalence (48.99%; 95% CI: 41.09%-56.94%) was more ($p=0.002$) than urban (34.31%; 95% CI: 29.47%-39.50%); low HDL cholesterol prevailed around 97% urban and 93% rural respondents; high TG was found among 48% urban and 59% rural respondents ($p=0.02$), 21% urban and 44% rural respondents were obese ($p<0.001$); around 15% urban and 22% rural had hypertension (HTN, $p=0.04$); high FBS was found among 28% urban and 26% rural respondents. Age (OR=1.06, 95% CI: 1.04-1.09) and exercise (OR=2.31, 95% CI: 1.40-3.80) of urban area whereas only males of rural (OR=5.88, 95% CI: 2.52-13.73) area were significantly associated with MetS. **Conclusions:** Prevalence of MetS is higher in rural Bangladesh than urban in terms of dyslipidaemia, HTN and obesity. Health education and mass campaign regarding the risk factors including change in lifestyle can modify the condition.

Keywords: metabolic syndrome, epidemiology, rural, urban, Bangladesh

International Journal of Human and Health Sciences Vol. 02 No. 02 April'18 Page : 71-77

Introduction

Metabolic Syndrome (MetS) is already a familiar public health problem with erratic morbidity and mortality outcomes. Definition of MetS²⁻¹⁴, varying by institutions and studies¹⁵⁻¹⁸ from different countries, generated divergent prevalence from 2.5% as low to 58% as high with a propensity towards older age to increasing¹⁹ global burden. The clinical epidemiology unearthed abnormal abdominal obesity, insulin resistance glucose metabolism, dyslipidaemia and increased blood pressure, diet, risky behaviour and lifestyle to be among the key²⁰⁻²⁹ risk factors.

Though studies on MetS in Bangladesh are few and people might not be aware of it, we are not away from the risk and consequences³⁰⁻³⁴ of it had

it not been given due attention. The studies so far done in Bangladesh³²⁻³⁴ are area or gender specific hence lacking applicability. Knowing MetS from population perspective, the situation analysis would enable us formulate prevention strategy to address the problem properly. Because of rapid urbanization there is a need to identify overall community-based risk for MetS with both rural and urban focus to refute the null hypothesis that there is no difference of MetS along rural or urban area along the risk factors. The results of the study could be utilized as a baseline guide for further extensive study in the field.

Materials and Methods

Diagnosis of MetS

The researchers choose National Cholesterol

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Education Program (NCEP) Adult Treatment Panel III (ATP III) criteria to diagnose MetS. The criteria tells if there is at least three of 1) abdominal obesity, determined by waist circumference ≥ 88 cm (35 inch) in women, ≥ 102 cm (40 inch) in men, 2) TG ≥ 1.7 mmol/l (150 mg/dl), 3) HDL cholesterol <1.3 mmol/l (50 mg/dl) in women, <1.03 mmol/l (40 mg/dl) in men, 4) blood pressure $\geq 134/85$ mm Hg, 5) FBS ≥ 6.1 mmol/l (110 mg/dl).

Design

This is a re-analysis of a published³⁵ cross sectional study conducted in one urban and one rural setting during 2009-2010. The protocol was approved by Bangladesh Medical Research Council (BMRC), the official body for issuing ethical clearance for conducting studies in Bangladesh.

Sample Size calculation

Sample size was calculated by Power and Sample Size Program software³⁶ using prior data^{29, 33, 34} of Bangladesh prevalence of (3% as low to 22% as high). Assuming prevalence for this study to 10% for Bangladesh population, the calculation gave a figure to study 194 urban and 194 rural subjects to reject the null hypothesis with 80% power and 5% Type I error probability to test the hypothesis. With a 20% dropout rate, the researcher calculated $194/0.80$ to get final sample number of 243 from both settings to cover 486 samples for final data collection.

Subject selection

Convenient sampling was used as willing participants were enrolled after they met inclusion and exclusion criteria. The respondents signed or gave finger print on the consent paper after listening to the study purpose, objectives and procedures. The willing respondents from 25 years and above underwent a general physical assessment after answering socio demographic and other relevant questions. Those suffering from illness like cancer or with any recent surgical procedure within last three months or with cognitive disorder were excluded from the study.

From 500 invited residents, the rural participants were less willing to participate and we could not collect more than 149 samples within the stipulated time; on the other hand, there were more urban respondents willing to participate. Therefore, to keep the planned size, we included more urban respondents which got up to 341 to record 496 willing respondents for an overall 99.6% response rate. Four residents from urban area were excluded as they did not complete the

procedure and samples from 2 participants were missing from the laboratory hence we excluded those 2 records keeping 490 for final analysis. The total number yielded a posterior power probability of 0.99 to reject the null hypothesis.

Data collection

Face to face interview by trained interviewers was done with a-pretested semi-structured questionnaire containing socio-demographic and lifestyle information. Following the interview, waist circumference was measured along the level of navel across the tip of iliac crests in upright posture. After this, blood pressure (BP) was recorded on right arm while sitting.

Two technicians, one for urban and another for rural area, were recruited for collection of blood samples who followed standard procedure to draw 5-6 ml of fasting blood sample from each individual for the measurement of TG, HDL and FBS. The collected samples were transported to a renowned laboratory in Dhaka, with standard transportation procedure where estimations were carried out by Vitros 250 (J&J)/Dade Behring Dimension RxL Random Access Multibatch Chemistry Analyser. The units of measurements were expressed as mg/dl of blood.

Data entry and analysis

The data was entered in Microsoft excel. After finishing data entry, it was cleaned for any inconsistency and to exclude any stroke error. Then the data was read in statistical software SPSS. The data check was done again for excluding mistakes and after necessary correction the data was ready for final analysis.

In SPSS, the income was grouped from the world bank definition of poverty³⁷⁻³⁹ with little modification. The components of metabolic syndrome were categorised by threshold value and possible combination of components was sorted. Assembling all the MetS components, dichotomous variable was created as either having MetS or not.

Univariate analysis of the factors was done using χ^2 test for categorical data while Mann-Whitney U test was applied for continuous data to compare urban and rural prevalence. The data was presented as proportion and mean $\pm$ SD as applied. Logistic regression was done with all the related variables using the rule^{40, 41} of minimum number of event or non-event divided by 15 to include for adjustment of confounding factors for both urban and rural areas separately. Confidence Interval (CI, 95%) was calculated using Confidence Interval Analysis

(CIA) software. A p value ≤ 0.05 was decided to be significant. Finally box and whisker's plot was constructed for checking the age with the accumulation of MetS components across urban and rural area.

Results

The demographic and epidemiologic characteristics of rural and urban respondents are given in Table 1. Males and older respondents were significantly more from rural than urban area. Monthly income of urban population was higher than rural though the difference was not significant. Daily water intake, sleeping hours, occupation, smoking or alcohol habit and knowledge of MetS did not differ between the groups. Though urban respondents were more educated than rural, the difference was not significant. Urban people used to have more movement than rural.

Table 2 deals with the MetS components with final MetS prevalence by area. Waist circumference, DBP and TG of rural respondents was significantly higher than urban. On categorizing, 43% of rural respondents were obese compared to 21% urban ($p < 0.001$); 22% rural had HTN against 14% urban ($p = 0.04$) and 59% rural had high TG ($p = 0.02$) compared to 47.5% urban. Low HDL cholesterol and FBS did not differ in two groups. While looking at the combination, the highest prevalence was found for combination of obesity, high TG and low HDL in 97 (19.8%) followed by high TG, low HDL, DM in 90 (18.4%) respondents; 55 (11.2%) respondents had obesity, low HDL, DM combined, 49 (10%) had combination of high TG, low HDL, HTN, 40 (8.2%) had obesity, high TG, low HDL and DM while combination of obesity, high TG, DM was found in 40 (8.2%) respondents. The prevalence of components was higher in rural areas than urban as it was so in males than females. The gradual addition of components of MetS from were accounted for 156 (1), 134 (2), 122 (3), 58 (4) and 10 (5) persons respectively; only 10 respondents were not suffering from any component. Lastly, all the components were collated to assess the prevalence of MetS that was 38.78% (95% CI: 34.56%-43.16%); rural prevalence (48.99%; 95% CI: 41.09%-56.94%) was more ($p = 0.002$) than urban (34.31%; 95% CI: 29.47%-39.50%).

Table 3 shows logistic regression analysis of factors for urban and rural area. Age (OR=1.06; 95% CI: 1.04-1.09) and exercise (OR=2.31; 95% CI: 1.38-3.74) was significantly associated with MetS in urban area whereas male sex (OR=5.95;

95% CI: 2.55-13.90) was associated with the same in rural area. There was no interaction of factors along urban or rural areas.

Box and whisker's plot (Figure 1 and 2) checked the age with the components of MetS for both urban and rural areas. It were found that accumulation of components was significantly associated ($p < 0.001$) with advancing age in urban area whereas it was not so for rural area. In urban population any single component was found at median age of 34 years, two components at 38 years, 3 components at 42 years, 4 components at 44.5 years and all the components at 45 years; on the other hand, the rural population had association with first component at 37 years, 2 components at 42 years, 3 components at 44 years, 4 components at 46.5 years and all the components were found at the age of 48.5 years. From the scores we can understand that the rural people are becoming the candidates of MetS at a later age than urban.

Discussion

The rural predominance of MetS was a different finding than our assumption. Tendency of MetS to increase with ageing in urban area and in male sex for rural areas were also important features to note, albeit the prevalence was similar to European, Latin American, US, African and Asian studies^{32, 42-48}. Zaman MM et al³³ showed low female prevalence but other studies^{34, 49, 50} indicated high prevalence. So this study could be representative of the country situation giving a baseline understanding of MetS in Bangladesh. It was striking to note that low HDL prevailed in nearly 96% population in our study. The finding indicates that Bangladeshi population could have been suffering from dyslipidaemia more than any other problems which was not revealed in previous studies^{33,34} and is now becoming a revelation of hidden fact^{49, 50}. Other prevalence findings⁵¹⁻⁶⁰ are also giving similar impression that Bangladesh population might have been suffering more from lipid related problems. The possible explanation for this prevalence could be lifestyle or food pattern or physical activity of Bangladeshi population, which could be assessed in further hypothetical studies. The similarity is evident from studies⁶¹⁻⁶⁹ to reveal lifestyle, comorbidity, body biochemistry, psychological stress, genetic predisposition to be associated with MetS. Study from China⁷⁰ revealed that obesity and dyslipidaemia could attenuate the effect of MetS on chronic kidney disease in patients with coronary artery disease acquiring support from

other studies⁷¹⁻⁷³. Even the components are found to be associated with neuropathy⁷⁴ and cognitive impairment⁷⁵. And it can be predicted from the childhood had we initiate studies to assess the development⁷⁶.

It was interesting that urban exercising respondents (Table 3) had a 2 fold higher odds of being a candidate for MetS than non-exercising respondents. But as this was a cross sectional study, it wouldn't be possible to ascertain whether exercise was the cause, or the effect, of MetS. Rather it could be plausible that the urban respondents could be assuming that exercise might control their blood biochemistry hence could indulge themselves in consuming fatty diet. Studies also endorse that dietary habit and poor health behaviour^{77, 78} could be contributing for the high prevalence of obesity and MetS in the Bangladeshi immigrant population asserting that this is not related to any genetic phenomenon. The study had several limitations. The sampling

method was not random and because of low rural response we had to accept more willing urban respondents to keep up the desired sample size. Detailed information on lifestyle and eating pattern was not obtained so it was not possible to assess the type of food associated with MetS. But as the study assessed both rural and urban population, it was so far known the first community-based study in Bangladesh covering entire population with baseline information which could be used as a reference for further policy formulation and intervention plan.

Acknowledgements

The researchers acknowledge the help Tokai University Graduate School of Medicine and National Centre for Global Health and Medicine, Japan to provide financial and logistic supports for the study. Also the gratitude goes to Mr. Mistuhiro Isozaki, researcher from Tokai University, for his support in creating forest plot.

Figure 1. Box and Whisker's plot with accumulation prevalence of components of MetS by ATP III along age distribution in urban area

Figure 2. Box and Whisker's plot with accumulation prevalence of components of MetS by ATP III along age distribution in rural area.

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