Comparison of the prevalence of metabolic syndrome and its association with diabetes and cardiovascular disease in the rural population of Bangladesh using the modified National Cholesterol Education Program Expert Panel Adult Treatment Panel III and International Diabetes Federation definitions

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ABSTRACT
Aims/Introduction: To compare the prevalence of metabolic syndrome (MS) using the modified National Cholesterol Education Program Adult Treatment Plan III (NCEP) and the International Diabetes Federation (IDF) definitions and, using both definitions, determine and compare the association of MS, prediabetes, type 2 diabetes, hypertension (HTN) and cardiovascular disease risk (CVD).

Materials and Methods: A total of 2,293 randomly selected participants (aged ≥20 years) in a rural community in Bangladesh were investigated in a population-based cross-sectional study. Sociodemographic and anthropometric characteristics, blood pressure, blood glucose, and lipid profiles were studied. Age-adjusted data for MS and cardiometabolic risk factors were assessed, and their relationships were examined.

Results: The age-adjusted prevalence of MS was 30.7% (males 30.5%; females 30.5%) using the NCEP definition, and 24.5% (males 19.2%, females 27.5%) using the IDF definition. The prevalence of MS using the NCEP definition was also higher in study participants with prediabetes, type 2 diabetes, HTN and CVD risk. The agreement rate between both definitions was 92% (k = 0.80). The NCEP definition had a stronger association with type 2 diabetes and HTN (odds ratio 12.4 vs 5.2; odds ratio 7.0 vs 4.7, respectively) than the IDF definition. However, the odds ratios for prediabetes and CVD risk were not significantly different.

Conclusions: The prevalence of MS was higher using the NCEP definition, and was more strongly associated with prediabetes, type 2 diabetes, HTN and CVD in this Bangladeshi population.
INTRODUCTION

Metabolic syndrome (MS) refers to a clustering of metabolic risk factors including central obesity, glucose intolerance, dyslipidemia and hypertension14. It is estimated that approximately 20–25% of the world’s adult population have MS4. An increasing trend has also been observed in Asian countries. One metaanalysis has shown that approximately 10–13% of adult Asian people had MS in 20075. People with MS are three times as likely to have a heart attack or stroke and are twice as likely to die from a heart attack or stroke compared with people without the syndrome. In addition, they have a fivefold greater risk of developing type 2 diabetes6. Each of these related cardiometabolic risk factors have been linked with obesity, physical inactivity and consumption of calorie-dense foods, all of which are modifiable lifestyle risk factors. Therefore, a population-based systematic approach to the early detection of MS, the promotion of a healthy lifestyle and the reduction of obesity is important to achieve a reduction in the prevalence of cardiometabolic risk factors.

Unfortunately, there are multiple agreed definitions of MS and, hence, estimates of MS vary substantially across populations depending on the definition used. Expert Groups from the World Health Organization (WHO)7, European Group for the Study of Insulin Resistance (EGIR)8, National Cholesterol Education Program Expert Panel (NCEP) Adult Treatment Panel III (ATP III)9, American Association of Clinical Endocrinologists (AACE)10 and the International Diabetes Federation (IDF) Consensus Group have published different definitions11. In the aforementioned definitions, only the modified NCEP ATP III12 and the IDF definitions have suggested that the cut-off points of waist circumference (WC) should be ethnic-specific, and individuals of Asian origin should use the cut-off values of 90 cm in men and 80 cm in women.

Epidemiological studies have shown an increased rate of MS both in urban and rural areas in Bangladesh13,14, and this might be an important contributory factor for the increased prevalence of type 2 diabetes and cardiovascular disease (CVD) in the Bangladeshi population. The IDF estimated that 5.1 million people living in Bangladesh had diabetes in 201315. WHO data published in 2011 reported deaths as a result of coronary heart disease in Bangladesh were 17.1% of all deaths. The age-adjusted death rate reported was 204 per 100,000 of the population, ranking Bangladesh 25th in the world16. Hence, the identification of the population at risk of these diseases is extremely important.

Many large-scale clinical trials and meta-analyses have reported that the presence of MS, regardless of definition, is highly predictive of new-onset type 2 diabetes and CVD in many different populations17. However, data from the Asian Indian (Bangladesh) population is scarce. The risk factors for diabetes mellitus and CVD in this population are atypical compared with Caucasians, which has been documented in previous studies. Therefore, the aim of the present population-based study was to investigate the impact of utilizing the modified NCEP ATP III and the IDF definitions to determine the prevalence of MS in a rural Bangladeshi population, and to compare their associations with prediabetes, type 2 diabetes, hypertension (HTN) and CVD risk.

MATERIALS AND METHODS

Participants

The present cross-sectional study was carried out in 2009 between March and December in a rural community, ‘Chandra’, 40 km north of Dhaka, the capital city of Bangladesh. The recruitment methods and examination procedures of this rural study have been described before18-20. A total of 10 villages were randomly selected from 25 villages in the region. The total population aged ≥20 years in these villages was approximately 20,000 persons. Those aged ≥20 years, willing to participate and able to verbally communicate were eligible to enter the study. A total of 3,000 persons were randomly selected and of these, 2,376 (79.2%) were recruited. Pregnant women and those diagnosed with acute physical illness were excluded. The study was carried out according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human participants were approved by the Regional Committee for Medical and Health Research (REC) of Norway and the Ethical Committee of the Diabetic Association of Bangladesh for Medical Research [Correction added on 6 April 2015, after first online publication: This study was approved by the Regional Committee for Medical and Health Research (REC) of Norway, not by National Committee for Medical and Health Research Ethics (NEM) of Norway]. As 52% of the adult population in Bangladesh is illiterate21, a witnessed and formally recorded verbal informed consent was obtained from each person before inclusion in the study. This method was used to avoid selection bias due to individual differences in literacy level. Study participants were also verbally informed of their right to withdraw from the study at any stage, or to omit their data from the analysis. In addition, participants received a written copy of their rights during and after the completion of the study. On recruitment, participants were requested to visit a nearby field center, after an overnight fast of 8–14 h. Sociodemographic data were collected by trained staff by interviewing each participant using a study-specific validated questionnaire.

Measurements

Anthropometric measurements including height, weight, waist circumference (WC) and hip circumference (HC) were taken with participants wearing light clothes and without shoes. Weight was recorded to the nearest 0.1 kg using electronic digital liquid-crystal display weighing machines (Best Deluxe Model; Bathroom, Dhaka, Bangladesh) placed on a flat surface. The scales were placed on a flat surface and calibrated using a standard (20 kg) each day. Height was taken with the participant standing erect against a wall looking straight ahead with
the occiput, back, hip and heels in contact with the wall. Body mass index (BMI) was calculated as the weight (kg) divided by square of the height (m²). WC was measured by placing a tape horizontally midway between the lower border of the ribs and iliac crest on the mid-axillary line. HC was measured to the nearest centimeter at the greatest protrusion of the buttocks, just below the iliac crest. Waist-to-hip ratio (WHR) was then calculated from WC (cm) and height (cm), respectively.

Blood pressure was measured twice in the right arm in both a sitting and standing position. Measurements were taken 5 min apart, and the mean of the two measurements was taken as the final blood pressure reading.

On arrival at the field center, an 8-mL fasting venous blood sample was taken from each participant for measuring the fasting plasma glucose (FPG) and other relevant laboratory tests. All participants other than those with known diabetes had a 75-g oral glucose tolerance test. Another 3 mL of venous blood was collected after 2 h to determine the 2 h plasma glucose level (2hPG). Plasma glucose was measured using a glucose oxidase method. Insulin was measured later on by a two-site chemiluminescent immunoassay system (Diagnostic Products Co., Los Angeles, CA, USA).

**Definition of Variables and Outcomes**

MS was defined following the definitions provided by the modified NCEP ATP III and IDF. The modified NCEP ATP III definition requires the presence of any three of the following five factors for a diagnosis of MS: abdominal obesity, hypertriglyceridemia (triglyceride ≥1.7 mmol/L), low high-density lipoprotein cholesterol (HDL-C ≤1.03 mmol/L for men and ≤1.29 mmol/L for women), elevated blood pressure (systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥85 mmHg or current use of antihypertensive drugs) and impaired fasting glucose (FPG ≥5.6 mmol/L). The modified NCEP ATP III definition recognizes abdominal obesity is a component of MS, but does not include it as a prerequisite for the diagnosis. The IDF definition of MS places emphasis on abdominal obesity as a required factor plus any two of the other four criteria, which are essentially identical to those provided by the modified NCEP ATP III. The IDF definition uses ethnic-specific WC cut-off points as a requirement for diagnosis. Similar to the modified NCEP ATP III definition, IDF recommends cut-off levels of 90 cm in men and 80 cm in women for central obesity in Asian populations. For both definitions, we used the recommended Asian cut-off points (90 cm in men and 80 cm in women), as there are no national cut-off values specific to Bangladesh.

Cut-off points for general obesity for both sexes were a BMI of ≥25 kg/m². Cut-off points for central obesity including WC for men and women were ≥90 and ≥80 cm, respectively, and WHR for men and women were ≥0.90 and ≥0.80 cm, respectively.

Diabetes mellitus was defined as FPG ≥7.0 mmol/L and/or 2hPG ≥11.1 mmol/L. Participants with either impaired glucose tolerance (2hPG ≥7.8 mmol/L, but <11.1 mmol/L) and/or impaired fasting glycemia (FPG ≥6.1 mmol/L, but <7.0 mmol/L) were classified as prediabetes. We calculated homeostasis model assessment of insulin resistance using the method of Matthews et al. The Framingham Risk Score for CVD risk over 10 years was calculated for each man and woman. Individuals with a Framingham risk score of 10% or above define CVD risk at 10 years.

**Statistical Analysis**

Means and 95% confidence intervals (CIs) adjusted for age were given for normally distributed continuous variables. Skewed data were logarithm transformed before analysis, and the results were transformed back to the original scale. Percentages and 95% CIs were given for categorical variables. Differences between the groups of means and proportions adjusted for age were tested by analysis of covariance (ANCOVA) and logistic regression. Kappa statistics were used to measure agreement between the two definitions. Measures of test performances including sensitivity, specificity and accuracy of the two definitions were calculated from 2 × 2 contingency tables. In addition, we calculated adjusted odds ratios (ORs) based on the modified NCEP ATP III and IDF-MS definitions for prediabetes, type 2 diabetes, HTN and CVD risk. Adjusted ORs were obtained by applying logistic regression analysis with adjustments for age, sex and BMI. Statistical inference is based on 95% confidence intervals (CIs), and the significance level was set at 0.05. Both Stata 13 (StataCorp LP, College Station, TX, USA) and PASW statistics 21 for Windows (SPSS, Chicago, IL, USA) were used.

**RESULTS**

Cardiometabolic characteristics of the study population are shown in Table 1. There were 842 men and 1,451 women in the study. Men had significantly greater means for WC, WHR and systolic blood pressure than women. BMI and total energy intake was similar in men and women. Metabolic profiles also differed; men had significantly higher means for FPG and triglyceride values, but lower HDL-C values than women. Men also had a higher rate of HTN, dyslipidemia, cigarette smoking and physical inactivity. Men had a lower rate of central obesity (defined by WC and WHR), 10-year CVD risk (defined by Framingham risk score for CVD) and tobacco leaf consumption than women. General obesity (defined by BMI) was similar in men and women.

Table 2 shows the prevalence rates of MS, and MS in association with prediabetes, type 2 diabetes, HTN and CVD risk using the modified NCEP ATP III and IDF definitions. The age-adjusted prevalence rate of MS was significantly higher (P < 0.001) using the modified NCEP ATP III definition. MS was present in 24.5% of the study population using the IDF definition compared with 30.7% using the modified NCEP ATP III definition. Using the IDF definition, MS was present in 45.6% of participants diagnosed with prediabetes, 57.7% of those with type 2 diabetes, 53.4% of those with HTN and...
Table 1 | Cardiometabolic characteristics of study population by sex

| Variable                              | Total          | Male           | Female         | P-value |
|---------------------------------------|----------------|----------------|----------------|---------|
| n                                     | 2293           | 842            | 1451           |         |
| Age (years)                           | 41.8 (41.2–42.4) | 44.3 (43.3–45.2) | 40.4 (39.7–41.1) | <0.001  |
| Cigarette smoking (%)                 | 15.9 (14.6–17.2) | 39.6 (36.6–43.3) | 1.7 (1.0–2.3)   | <0.001  |
| Tobacco leaf consumption              | 26.3 (24.6–27.9) | 16.4 (14.1–18.7) | 32.4 (30.1–34.6) | <0.001  |
| Physical inactivity (%)               | 15.1 (13.8–16.4) | 35.9 (32.6–39.1) | 3.0 (2.2–4.0)   | <0.001  |
| Energy intake (Kcal/day)              | 1597 (1584–1610) | 1587 (1565–1608) | 1608 (1591–1624) | 0.131   |
| SBP (mmHg)                            | 116.2 (115.2–117.3) | 117.2 (116.2–118.3) | 115.2 (114.4–116.1) | 0.002   |
| WHR, males ≥90 cm; females ≥80 cm (%) | 716 (698–734)   | 586 (552–619)   | 791 (770–811)   | <0.001  |
| SBP (mmHg)                            | 1162 (1156–1169) | 1172 (1162–1183) | 1152 (1144–1161) | 0.002   |
| DBP (mmHg)                            | 77.1 (76.6–77.5) | 77.6 (76.9–78.2) | 76.5 (76.0–77.1) | 0.499   |
| Hypertension (%)                      | 15.5 (14.1–17.0) | 17.5 (15.1–20.0) | 14.3 (12.5–16.1) | 0.034   |
| FPG (mmol/L)                          | 5.2 (5.1–5.3)   | 5.3 (5.2–5.5)   | 5.1 (5.0–5.2)   | 0.002   |
| 2hPG (mmol/L)                         | 6.3 (6.2–6.4)   | 6.3 (6.1–6.5)   | 6.2 (6.1–6.4)   | 0.499   |
| Diabetes (%)                          | 7.9 (6.8–9.0)   | 9.1 (7.2–11.0)  | 7.2 (5.8–8.5)   | 0.101   |
| Prediabetes                           | 8.6 (7.4–9.7)   | 10.1 (8.1–12.1) | 7.7 (6.3–9.1)   | 0.105   |
| Fasting insulin (mU/L)†               | 8.35 (8.09–8.60) | 8.10 (7.72–8.50) | 8.59 (8.28–8.92) | 0.063   |
| HOMA-IR†                             | 1.87 (1.81–1.93) | 1.85 (1.75–1.95) | 1.89 (1.82–1.97) | 0.533   |
| T-Chol (mmol/L)                       | 4.39 (4.36–4.42) | 4.41 (4.36–4.47) | 4.36 (4.32–4.40) | 0.152   |
| TG (mmol/L)†                          | 1.38 (1.35–1.40) | 1.43 (1.39–1.48) | 1.32 (1.29–1.36) | <0.001  |
| HDL-C (mmol/L)                        | 0.90 (0.89–0.91) | 0.86 (0.84–0.97) | 0.93 (0.92–0.94) | <0.001  |
| LDL-C (mmol/L)                        | 2.77 (2.74–2.80) | 2.77 (2.73–2.81) | 2.77 (2.74–2.80) | 0.950   |
| Dyslipidemia (%)                      | 28.7 (26.9–30.5) | 35.3 (32.1–38.5) | 24.8 (22.6–27.0) | <0.001  |
| CVD (10 years risk (%)                | 67.8 (66.0–69.5) | 53.9 (50.7–57.1) | 76.0 (73.9–78.1) | <0.001  |

Data are mean (95% confidence interval) or percentage (95% confidence interval) adjusted for age as indicated. † Geometric mean (95% confidence interval) for triglyceride (TG), fasting insulin and homeostasis model assessment for insulin resistance (HOMA-IR). 2hPG, 2-h plasma glucose; BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL-C, high density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; T-Chol, total cholesterol; WC, waist circumference; WHR, waist-to-hip ratio.

24.4% of those with CVD risk. Using the modified NCEP ATP III definition, the respective comparisons were 57.8, 80.2, 69.3 and 30.9%. Prevalence rates of MS were significantly (<0.001) higher in women compared with men when using the IDF definition. Differences between sexes were not significantly different when the modified NCEP ATP III definition was applied. The agreement between these two definitions as shown by the kappa statistics was 0.80, 0.71, 0.42, 0.60, and 0.54 for the overall study population, prediabetes, type 2 diabetes, HTN and CVD risk, respectively. All participants classified as having MS applying the IDF definition were also classified as having MS using the modified NCEP ATP III definition.

Cardiometabolic characteristics of the participants diagnosed with MS using the modified NCEP ATP III and IDF definitions are shown in Table 3. Participants diagnosed with MS using the IDF definition had a greater mean BMI, WC, WHR and total energy intake than participants diagnosed with MS using the modified NCEP ATP III definition. Participants diagnosed with MS using the IDF definition also had a higher rate of both general (BMI) and central obesity (WC and WHR), but a lower rate of dyslipidemia than the participants diagnosed with MS using the modified NCEP ATP III. Men had a significantly greater mean WHR and triglyceride, and lower mean HDL-C than women, and these results were unchanged using both definitions. Rates of cigarette smoking, physical inactivity and dyslipidemia were also high among men using both definitions. Men diagnosed with MS using the IDF definition had a greater mean BMI, general obesity (BMI) and WC than women.

Diagnostic performance of the modified NCEP ATP III and IDF definitions to diagnose the conditions of prediabetes, type 2 diabetes, HTN and CVD risk are shown in Table 4. The modified NCEP ATP III definition when applied identified more participants with MS than the IDF definition in each condition. In addition, the modified NCEP ATP III definition showed greater sensitivity to predict prediabetes, type 2 diabetes, HTN and CVD risk. However, the specificity and diagnostic accuracy were similar between the modified NCEP ATP III and IDF definitions.
Table 2 | Prevalence of metabolic syndrome among overall, prediabetes, type 2 diabetes, hypertensive and people with cardiovascular risk using the modified National Cholesterol Education Program Adult Treatment Panel III and International Diabetes Federation definition

| NCEP ATP III-MS vs IDF-MS | NCEP ATP III-MS | IDF-MS | NCEP ATP III-MS vs IDF-MS | NCEP ATP III-MS | IDF-MS | NCEP ATP III-MS vs IDF-MS |
|---------------------------|-----------------|-------|---------------------------|-----------------|-------|---------------------------|
| P-value                   | Agreement (%)   | Kappa |
| **Total**                 |                 |       |                           |                 |       |                           |
| Males                     | 25.5 (23.6–27.4) | 0.08  | 24.5 (22.7–26.3)          | 0.001           | 92    | 0.80                      |
| Females                   | 25.7 (23.9–27.5) | 0.08  | 24.5 (22.7–26.3)          | 0.001           | 92    | 0.80                      |
| **Females**               |                 |       |                           |                 |       |                           |

Data presented as percentage (95% confidence interval) adjusted for age. Metabolic syndrome (MS): diagnosed according to modified National Cholesterol Education Program Adult Treatment Panel III and International Diabetes Federation definition.

DISCUSSION

This is the first population-based cross-sectional study to observe the prevalence of MS, and to evaluate and compare the association of MS with the diagnosis of prediabetes, type 2 diabetes, HTN and CVD risk in a rural Asian Indian population of Bangladesh using the modified NCEP ATP III and IDF definitions. The definition of MS proposed by the modified NCEP ATP III found 30.7% of the study population, adjusted for age, were classified as having MS. This prevalence rate was higher than the 24.5% result obtained using the IDF definition of MS. One possible reason for the observed higher rate of MS in this population is the high rate of obesity identified using the recommended Asian cut-off values. In addition, applying the lower cut-off values for WC with the modified ATP III definition instead of the original cut-off in the current study might have also increased the prevalence of MS. However, the present findings are consistent with a previous study carried out in the same population in 2004. Findings are also consistent with another rural Bangladeshi study, and studies carried out in India, Pakistan, Sri Lanka, Malaysia and China.

In contrast to the present findings, the Diabetes Epidemiology: Collaborative Analysis of Diagnostic Criteria in Asia (DECODA) study, and studies carried out in the USA, Korea, Finland and Turkey reported to have a higher prevalence of MS defined by IDF as compared with the NCEP ATP III definition, which is possibly as a result of the use of original higher WC cut-off values for the study participants. Hence, the findings of the present study emphasize the impact of modifying the definition of obesity on the prevalence of MS for different ethnic groups. Furthermore, it highlights the potential importance of ethnicity-specific obesity cut-off levels.

The prevalence of MS in the present study population was higher in women when compared with men. This is especially evident in the IDF-defined prevalence rate of 24.5%, with 27.2% of women compared with 19.2% of men, (P < 0.001). This sex disparity might be partly explained by the significantly higher prevalence of abdominal obesity in women (48.7 vs 24.4%, P < 0.001). Abdominal obesity is strongly recognized as the most important correlate of insulin resistance and MS.
Approximately 23% of women in the present study were aged ≥50 years (data not shown), although the mean age was 40.4 years. Metabolic changes accompanying menopause might explain the increased prevalence of MS in women. Jesmin et al. carried out a study to determine the prevalence of MS and related risk factors in Bangladeshi postmenopausal women living in a rural setting, and found a significant association between menopausal status and each MS risk factor. These findings imply that postmenopausal women are at higher risk of having MS and CVD.

Although the prevalence of abdominal obesity in men was half of that in women, the prevalence rates of the other components of MS including dyslipidemia (35.3 vs 24.8%, \( P < 0.001 \)) and hypertension (17.5 vs 14.3%, \( P = 0.034 \)) and mean FPG (5.3 vs 5.1, \( P = 0.002 \)) were higher in men. Men also reported a higher rate of physical inactivity (35.9 vs 30.0%, \( P < 0.001 \)) and cigarette smoking (39.9 vs 17.7%, \( P < 0.001 \)). These findings might indicate that, especially among men, the currently accepted Asian-specific cut-off level of 90 cm for WC might not be adequate to describe the effects of abdominal obesity.

The current study also reported prevalence rates of MS among participants identified with prediabetes, type 2 diabetes, HTN, and CVD risk. The higher frequency of MS in those diagnosed with prediabetes, type 2 diabetes, hypertension and CVD risk factors found in the present study is a source of major concern. All of these conditions are important risk factors for atherosclerotic CVD, and MS in type 2 diabetes is associated with both micro- and macrovascular complications. Therefore all the people diagnosed with prediabetes, type 2 diabetes, HTN, and CVD risk should be screened for MS, and offered intensive medical and lifestyle management to prevent or reduce the impact of further complications.

The role of MS as an independent predictor of cardiometabolic diseases is well known. The application of the NCEP definition was found to be superior to the IDF definition in the
identification and diagnosis of prediabetes, type 2 diabetes, HTN and CVD. This difference could be attributed to the WC as the primary inclusion criterion for the diagnosis of MS using the IDF definition. Therefore, those participants with type 2 diabetes who did not have central obesity could be excluded for the diagnosis of MS using the IDF definition.

In the present study, we examined which definition of the MS might be more closely related to the risk for prediabetes, type 2 diabetes, HTN and CVDs by comparing the ORs of MS defined by IDF and NCEP. We have noted a higher association of the NCEP definition with type 2 diabetes and HTN. We have also noted a similar association of the NCEP and IDF definitions with CVD risk events using the Framingham Risk Score and with prediabetes. The present findings are consistent with a study carried out in Korea\(^5\). In contrast to our findings, a study carried out in the United Arab Emirates reported that using the IDF definition for the identification of MS, there was a greater association with a diagnosis of prediabetes and type 2 diabetes, and a lesser association with CVD events compared with the findings when the NCEP definition for MS was applied\(^4\).

The strengths of the present study are that it was a population-based study, a relatively large sample size with availability of extensive information of confounders and carried out in a representative rural population of Bangladesh. One limitation was the cross-sectional design of the study, as this did not allow us to draw any causal interference. Therefore, future large prospective studies should be used to confirm the association between the aforementioned factors and MS.

In conclusion, applying both the NCEP ATP III and IDF definitions, the prevalence of the MS was shown to be common in the Bangladesh, Asian Indian rural population under study. The prevalence of MS was higher using the NCEP ATP III definition compared with the identification of MS using the IDF definition. In addition, more of the participants diagnosed with MS using the NCEP ATP III definition were also diagnosed with prediabetes, type 2 diabetes, HTN and CVD risk than the participants identified using the IDF definition.

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**Table 4** | Diagnostic performance of modified National Cholesterol Education Program Expert Panel Adult Treatment Panel III and International Diabetes Federation definition to diagnose prediabetes, type 2 diabetes, hypertension and people with cardiovascular disease risk in a rural Bangladeshi population

| Method      | Prediabetes | DM         | HTN         | CVD risk |
|-------------|-------------|------------|-------------|----------|
| NCEP ATP III-MS | 16.48 (116) | 20.88 (147) | 35.65 (251) | 14.64 (101) |
| IDF-MS      | 16.22 (91)  | 18.89 (106) | 34.05 (191) | 11.35 (63)  |

| Method      | Sensitivity | Specificity | Accuracy | Sensitivity | Specificity | Accuracy | Sensitivity | Specificity | Accuracy | Sensitivity | Specificity | Accuracy | Sensitivity | Specificity | Accuracy | Sensitivity | Specificity | Accuracy |
|-------------|-------------|-------------|----------|-------------|-------------|----------|-------------|-------------|----------|-------------|-------------|----------|-------------|-------------|----------|-------------|-------------|----------|
| NCEP ATP III-MS | 59 (52–65) | 72 (70–74)  | 70        | 59 (52–65) | 72 (70–74)  | 70        | 59 (52–65) | 72 (70–74)  | 70        | 59 (52–65) | 72 (70–74)  | 70        | 59 (52–65) | 72 (70–74)  | 70        |
| IDF-MS      | 46 (39–53)  | 77 (75–79)  | 74        | 46 (39–53) | 77 (75–79)  | 74        | 46 (39–53) | 77 (75–79)  | 74        | 46 (39–53) | 77 (75–79)  | 74        | 46 (39–53) | 77 (75–79)  | 74        |

CI, confidence interval; CVD, cardiovascular disease; DM, type 2 diabetes; HTN, hypertension; IDF, International Diabetes Federation; MS, metabolic syndrome; NCEP ATP III, National Cholesterol Education Program Adult Treatment Panel III criteria; OR, odds ratio.

**Table 5** | Association of metabolic syndrome with prediabetes, type 2 diabetes, hypertensive and people with cardiovascular risk using the modified National Cholesterol Education Program Expert Panel Adult Treatment Panel III and International Diabetes Federation definition

| Method      | Prediabetes  | P-value  | DM          | P-value  | HTN         | P-value  | CVD risk   | P-value |
|-------------|--------------|----------|-------------|----------|-------------|----------|------------|---------|
| NCEP ATP III-MS | 2.9 (2.1–4.1) | <0.001   | 12.4 (8.1–19.0) | <0.001   | 7.0 (5.3–9.4) | <0.001   | 2.6 (1.6–4.4) | <0.001   |
| IDF-MS      | 2.3 (1.6–3.3) | <0.001   | 5.2 (3.5–7.8)  | <0.001   | 4.7 (3.4–6.3) | <0.001   | 2.3 (1.2–4.2) | 0.008   |

Age, sex and body mass index adjusted. CI, confidence interval; CVD, cardiovascular disease; DM, type 2 diabetes; HTN, hypertension; IDF, International Diabetes Federation; MS, metabolic syndrome; NCEP ATP III, National Cholesterol Education Program Adult Treatment Panel III criteria; OR, odds ratio.
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