Original article

Metabolic syndrome in Bangladesh using NCEP Adult Treatment Panel III criteria

Syed Muhammad Baqui Billah[1] Muna Shalima Jahan[2] Subrina Jesmine[3]
Bounelome Keobouahome[1] Yoshihisa Watanabe[1] Takaaki Kinoue[1]
Hiroyuki Furuya[1] Tetsu Watanabe[1]

1) Department of Public Health, Tokai University Graduate School of Medicine
2) Department of Obstetrics and Gynaecology, Shaheed Shuhrawardi Medical College
3) Division of Gene Therapeutics, National Center for Global Health and Medicine

Abstract

To assess the factors of metabolic syndrome (MetS) in Bangladesh, a cross-sectional study was done on 400 randomly selected and 90 purposively selected willing respondents. The socio-epidemiologic factors were studied with anthropometric examination, blood pressure recording and fasting blood for analysis of triglyceride (TG), high density lipoprotein (HDL), fasting blood sugar (FBS). Prevalence of MetS was 38.8% with male (54.2%) and rural (49.0%) prevalence being higher than female (26.6%) and urban (34.3%) respectively. Low HDL cholesterol prevailed in almost 96% respondents followed by high TG (51%), obesity (28.0%), high FBS (27.1%) and hypertension (HTN, 16.9%). On logistic regression, age (OR=1.6, 95%CI: 1.3-1.9), male sex (OR=2.5, 95%CI: 1.4-4.2) and exercise (OR=1.9, 95%CI: 1.2-2.9) produced significantly higher odds of being associated with MetS; rural area (OR=1.4, 95%CI: 1.0-2.1) and sedentary occupation (OR=1.7, 95%CI: 0.9-3.0) were associated just insignificantly. Though higher income, better education, good physical movement and knowledge of MetS produced protective odds, they were not significant. Despite several limitations the study suggests that MetS is highly prevalent in Bangladesh. Further studies are needed to identify risk factors for effective preventive measures to improve the situation.

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《**Key words**》 metabolic syndrome, epidemiology, obesity, lifestyle, Bangladesh

Ⅰ. Introduction

Metabolic Syndrome (MetS) had already been recognized a public health problem associating cardiovascular and other endocrine risks with varying degrees of morbidity and mortality. After being proposed by World Health Organization[1] (WHO) in 1993, different institutions came out with the definition but the Adult Treatment Panel III[2] (ATP III) of National Cholesterol Education Program (NCEP) Expert Panel had been used widely. Epidemiological studies[3] indicated that this syndrome had steadily increased in all populations worldwide with endocrine and cardiovas-

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Reprint Requests to Tetsu Watanabe, Department of Public Health, Tokai University Graduate School of Medicine, 143 Shimokasuya, Isehara, Kanagawa 259-1193, Japan

cular complication. The prevalence studies[4~6] in different countries yielded differing proportion ranging from as low as 2.5% to as high as 58% with a propensity towards older age for its consequences on diabetes and cardiovascular diseases (CVD). Different factors like lifestyle, diet, body mass, risky behaviour were among the factors identified behind the occurrence of MetS. The clinical epidemiology[7] revealed abnormal abdominal obesity, impaired glucose metabolism toil in the pathophysiology of the syndrome evident as diabetes mellitus (DM), dyslipidemia manifested as high triglyceride (TG) and/or low high density lipoprotein cholesterol (HDL), and increased blood pressure. Studies[8] also showed the association of MetS with non-alcoholic fatty liver, liver enzymes and gene polymorphisms.

As South Asians represented one of the largest and fastest growing populations in the world, it could be possible for this population to suffer from MetS. In India the prevalence[9] of MetS was 41.0% with male preponderance. As assumed, Bangladesh could have similar prevalence as in India[10] for cultural, lifestyle, behaviour and environmental similarity among these two neighbouring countries to face the double burden of diseases. Studies in Bangladesh[10] on hypertension (HTN), DM[11], and dyslipidemia[12] assessed rising prevalence. There had also been prevalence studies of MetS[13] in rural Bangladeshi women. Another clinic-based study[14] on HTN patients revealed association with dyslipidemia being prevalent. But all these studies were either area specific with either urban or rural population, sex specific or hospital based with patients and there had been no study addressing general population as a whole. Expecting that there would remain lifestyle differences along diverse situation, study on general population would help us assess the differences of prevalence. Bangladesh was still not having a good picture of MetS to adopt necessary measures to inform the general people and also implement intervention strategy for combating the problem. The information of general population from this study could be used to create community awareness and also could be utilized as a basis to generate further hypothetical studies including formulation of initial preventive measures.

Ⅱ. Materials and Methods

1. Design

The cross sectional study was conducted among selected residential areas of Dhaka, the capital city constituting urban residents and a rural community of Rajshahi city of Bangladesh during 2009-2010. There had been a joint collaboration with the department of Gene Therapy of National Center for Global Health and Medicine (NCGM) agreed to provide the logistic support in 2009. The protocol was submitted to Bangladesh Medical Research Council (BMRC), the official body for giving the permission to conduct studies inside Bangladesh. After getting the ethical clearance, data collection was done in February-March 2010. Permission from the ethical committee of Tokai University Graduate School of Medicine was also obtained for this study.

2. Sample size calculation

Using Power and Sample Size program software[15] by assessing prior data[4,10,12] the researcher calculated to study 194 urban and 194 rural subjects to reject the null hypothesis that the prevalence for rural and urban were equal with probability (power) 0.8 given the Type I error probability of 0.05 associated with the test of this null hypothesis using an uncorrected chi-squared statistic. Assuming a 80%

response rate, the calculation of 194/0.82 gave final sample number of 243 from both settings. The researcher intended to collect 250 samples from each area. The site and the samples were selected through random sampling, and invitation was done to all the respondents of the selected areas, but the researcher could not stick to the final plan. After completion of 250 respondents from the urban area, there were more respondents waiting to enroll as they heard about the research work from the local authority. On the other hand, there was no further response from the rural area after 150 randomly selected respondents. So to fulfil the total targeted sample, the researcher had to include the respondents in a non random fashion from the urban area.

3. Site and Subject selection

Two areas in Bangladesh from Dhaka and Rajshahi district were selected by multistage sampling by selecting two divisions out of 6 administrative divisions in Bangladesh and then selecting one district from each division coming down to one urban residential area and a rural area finally. The respondents were explained of the procedures followed by general physical assessment to include the population starting from 20 years and above. Respondents suffering from acute and severe illness necessitating immediate medical intervention and patients with malignancy, recent surgical procedure within last three months or having cognitive disorder were excluded from the study even if they were willing to participate. Finally 490 participants completed the investigation procedure, 149 rural and 341 urban.

4. Data collection

Data was collected by face to face interview by trained interviewers with prior written consent. For the illiterate participants, verbal consents were taken by trained interviewer. The semi-structured questionnaire contained socio-demographic and lifestyle information after being pre-tested at a hospital outpatient setting before finalization. After necessary amendment, final instrument for data collection was prepared. Respondents' age, education, occupation, monthly income, exercise information, general physical movement other than exercise, water intake per day (liter/day), hours of sleep in 24 hours (hour/day), smoking and alcohol information were recorded. Following the interview, height was recorded in centimetre (cm) and weight in kilogram (kg) with a bathroom scale on bare foot and with light dress. The waist circumference was measured along the level midway between the lower rib margin and iliac crests with a tape all around the body in horizontal position while standing straight up. After anthropometric examination, blood pressure was recorded on sitting posture with aneroid sphygmomanometer over brachium.

Two technicians from Popular Diagnostic and Laboratory in Dhaka, a renowned diagnostic company limited in Bangladesh, were contracted for collection of blood samples of the respondents and for laboratory analysis of those collected samples. The technicians followed standard procedure to draw 5-6 ml of blood sample in fasting condition from each individual for the measurement of TG, HDL and FBS and transported to Popular Diagnostic and Laboratory with standard transportation procedure. 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.

5. Data entry and analysis

Collected data was entered in Microsoft excel sheet. 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 for final analysis. As the collected samples contained some non-random respondents, the data was collated together to assess overall MetS situation.

Age was grouped by 10 years interval from <30 years up to >60 years. The monthly income was converted to USD from Bangladesh Taka (BDT) by dividing the sum by 70, the little modified reference value being taken from the web[16]. Also, respondents were categorized according to their monthly family income as poor (≤71.43 USD, 5000 BDT), middle income group (71.44-286 USD, 5001-20000 BDT) and rich (>286 USD), the criteria[17] modified from Asian Development Bank. Respondents with school level of education (below university level) were categorized as having little or some education and those with university education or more were considered having good education. The unemployed, government employee, private job holder, non-government organization (NGO) officials, student, teacher, retired official, lawyer and other easy going occupations with less physical effort were categorized as sedentary occupation and day labourer/farmer, NGO workers, housewives were categorized as heavy occupation. The excess daily movement or physical activity other than regular work was categorized as no/little movement if there was no or very little activity during the day and good movement if there was considerable amount of physical activity.

All the components of metabolic syndrome were categorised according to ATP III criteria and MetS was calculated with possible combination of components together. Collating all the MetS components, dichotomous variable was created as either having MetS or not.

The socio-demographic variables were assessed with χ^2 or Fisher's exact test for categorical data while Mann-Whitney U test and one way ANOVA was applied for continuous data. Median values were used for variables yielding high SD. For variable selection of independent effect measurement in logistic regression, the researcher followed the rule[18, 19] of minimum number of event or non-event divided by 15 (10-20), i.e. number of variable inclusion for adjustment of confounding factors. Dividing the minimum number (300 respondents in no MetS and 190 in MetS group, so MetS group was minimum) by 15, it was found that the researcher could include a maximum of 13 variables in the equation. The illiterate category of education was taken as reference for regression with some education and then some education was taken as reference for assessing the effect of good education. After initial regression, the non-significant variables were removed to look for best fit model. Though some variables were not significant, they were kept as the researcher assumed them to be clinically significant. Finally a forest plot figure was constructed with all significant variables and the important near significant variables in the final model from R software. All the variables were made categorical to assess the OR magnitude. Confidence Interval Analysis (CIA) software was used to calculate the 95% confidence interval (CI) for the prevalence of MetS. A p value ≤0.05 was considered statistically significant. The near significant variables with a p value ≤0.1 were also quoted with caution.

Ⅲ. Results

The prevalence of MetS was 38.8% (n=190) in the study. The socio-demographic and epidemiologic characteristics of MetS in Table 1 showed that MetS respondents tended to be

Table 1 Baseline characteristics[1] of MetS respondents

Variables[2]	Total (N=490) mean±SD	No MetS (n=300) mean±SD	MetS (n=190) mean±SD	p[3]
Age (years)	40.5±11.1	38.1±11.1	44.2±9.9	<0.001
Income (USD)	136.8±250.8	128.1±289.1	150.6±173.9	<0.001
Water intake (l/day)	3.4±1.4	3.4±1.4	3.5±1.3	0.06
Sleep (hr/day)	6.6±1.6	6.6±1.7	6.6±1.4	0.7
	n (%)	n (%)	n (%)	
Age group				<0.001
≤30	115 (23.5)	96 (32.0)	19 (10.0)	
31-40	146 (29.8)	96 (32.0)	50 (26.4)	
41-50	145 (29.8)	70 (23.3)	76 (40.0)	
51-60	62 (12.6)	26 (8.7)	36 (18.9)	
>60	21 (4.3)	12 (4.0)	9 (4.7)	
Sex				<0.001
Female	274 (55.9)	201 (67.0)	73 (38.4)	
Male	216 (44.1)	99 (33.0)	117 (61.6)	
Area				0.002
Urban	341 (69.69)	224 (74.7)	117 (61.6)	
Rural	149 (30.4)	76 (25.3)	73 (38.4)	
Income group				<0.001
≤71.43	268 (54.7)	186 (62.0)	82 (43.2)	
71.44-286	177 (36.1)	92 (30.7)	85 (44.7)	
>286	45 (9.2)	22 (7.3)	23 (12.1)	
Education				0.26
Illiterate	63 (12.9)	44 (14.7)	19 (10.0)	
Some Education	272 (55.5)	160 (53.3)	112 (59.0)	
Good Education	155 (31.6)	96 (32.0)	59 (31.0)	
Occupation				<0.001
Sedentary	244 (49.8)	122 (40.7)	122 (64.2)	
Heavy	246 (50.2)	178 (59.3)	68 (35.8)	
Physical Movement				0.34
No/Less Movement	284 (58.0)	179 (59.7)	105 (55.3)	
Good Movement	206 (42.0)	121 (40.3)	85 (44.7)	
Exercise				<0.001
No	250 (51.0)	174 (58.0)	76 (40.0)	
Yes	240 (49.0)	126 (42.0)	114 (60.0)	
Smoking				0.03
No	436 (89.0)	274 (91.3)	162 (85.3)	
Yes	54 (11.0)	26 (8.7)	28 (14.7)	
Alcohol				0.22
No	486 (99.2)	300 (100.0)	186 (97.9)	
Yes	4 (0.8)	0	4 (2.1)	
Knowledge of MetS				0.07
No	477 (97.4)	289 (96.3)	188 (99.0)	
Yes	13 (2.6)	11 (3.7)	2 (1.0)	

[1] Continuous values presented as means and standard deviations (SD), categorical values as frequencies and proportions.
[2] Age/age group in years, monthly income in USD converted from Bangladesh Taka (BDT: 1 BDT=1/70USD), water intake in litre/day, sleep in hours of sleep/day, weight in kilogram, height and waist in cm, BMI in kg/m^2, SBP and DBP in mm of Hg, TG, HDL and FBS in mg/dl.
[3] Mann-Whitney U test for continuous variables and χ^2 or Fisher's exact test for categorical variables.

Table 2 Prevalence of components of MetS

Components (%)	Frequency (%)		p
	Male	Female	
Obese (28.0)	118 (54.6)	19 (6.9)	<0.001
High SBP (28.2)	64 (29.6)	74 (27.0)	0.52
High DBP (31.2)	86 (39.8)	67 (24.5)	<0.001
HTN (16.9)	42 (19.4)	41 (15.0)	0.19
High TG (51.0)	134 (62)	116 (42.3)	<0.001
Low HDL (95.7)	204 (94.4)	265 (96.7)	0.22
DM (27.1)	65 (30.1)	68 (24.8)	0.19
Obese + high TG + low HDL (19.8)	86 (39.8)	11 (4.0)	<0.001
Obese + high TG + DM (8.2)	33 (15.3)	7 (2.6)	<0.001
Obese + low HDL + DM (11.2)	43 (19.9)	12 (4.4)	<0.001
High TG + low HDL + HTN (10.0)	28 (13.0)	21 (7.7)	0.052
High TG + low HDL + DM (18.4)	41 (19.0)	49 (17.9)	0.76
Obese + high TG + low HDL + DM (8.2)	33 (15.3)	7 (2.6)	<0.001

significantly older than no MetS group, mostly prevalent around age 41-50 years; there were significantly more males ($p<0.001$) suffering than females came more from rural areas than urban ($p=0.002$), mainly sedentary workers ($p<0.001$) with significantly higher ($p<0.001$) income in MetS group. Though more than half (53.3%) of them had acquired some education, there was no significant difference among the three levels of education. The median income was checked to be 71.4 USD for the whole group, 28.6 USD for no MetS group and 114.3 USD for MetS group. The water intake per day or sleep per 24 hours did not differ among the two groups. Movement pattern was also not associated significantly with MetS. Interestingly it was observed that respondents who used to exercise were suffering more from MetS than those who did not exercise. More than half smokers were suffering from MetS, significantly ($p=0.03$) higher than non-smokers. There were only 4 respondents who took alcohol. All 4 of them were suffering from metabolic syndrome. A number of 13 respondents heard the term "MetS" and 11 of them were not suffering from it though the association was just ($p=0.07$) not significant. Moreover, 12 of them were doctors and the two MetS candidates were doctors as well.

The components of MetS were presented in Table 2 along with combinations of components if the prevalence of the combination was around or >10%. It was observed that low HDL prevailed nearly 96% of the respondents followed by high TG (51.0%), high diastolic blood pressure (DBP, 31.2%), high systolic blood pressure (SBP, 28.2%), high waist or obesity (28.0%) and high FBS or DM (27.1%). Overall HTN prevalence was 16.9%. The highest prevalence was found for combination of obesity, TG and HDL in 97 (19.8%) respondents. The prevalence of components was higher in males compared to females except for HDL. Obesity and hyperlipidemia were frequent among the combination per se. There was a tendency for accumulation of components with increasing age as observed in Figure 1 and the one way ANOVA analysis showed the increase was statistically significant ($F=9.4$, $p<0.001$; data not shown). The diagnostic

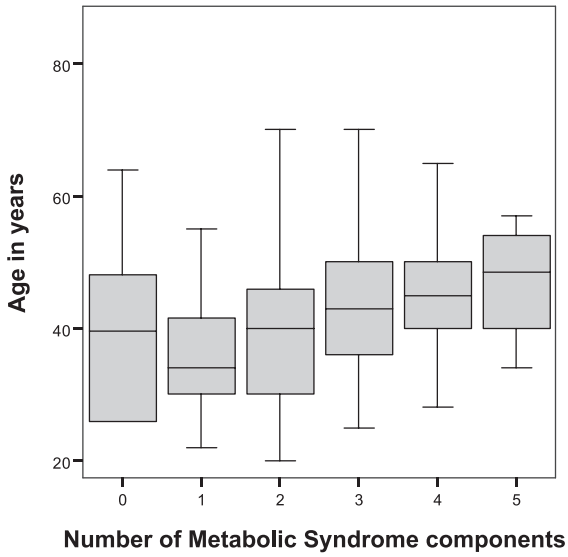

Fig. 1 Box and whisker plot showing accumulation of components of MetS by age

Figure is showing that the number of components of MetS increased with age. The box plot of all 5 component groups shows that the components mostly prevail around age 35-50 years.

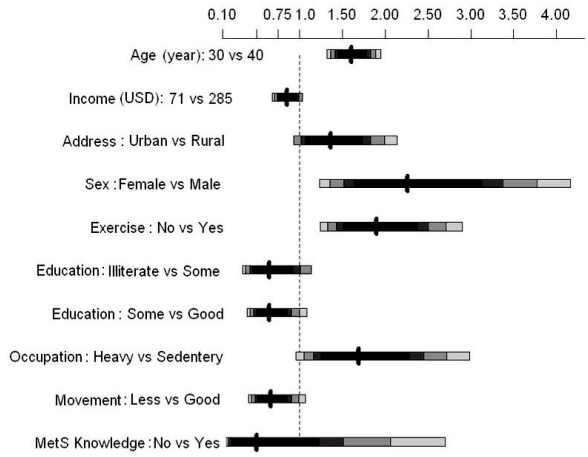

Fig. 2 Forest plot showing OR with 95% CI of the factors on MetS

The figure puts the logistic regression analysis on a plot showing the OR with 95% CI on both sides of 0. It shows that higher age, male sex and exercise are significant risk factors of MetS while the risk of some education to illiteracy and sedentary occupation were not significant. On the other hand, good movement and knowledge of MetS was protective though not significant.

components of MetS from 0 to 5 were accounted for 10, 156, 134, 122, 58 and 10 respondents, respectively.

Logistic regression through forest plot (Figure 2) analysis with the important factors showed age (OR=1.56; 95% CI: 1.28-1.89), male sex (OR=2.54, 95% CI: 1.36-4.16) and exercise (OR=1.89, 95% CI=1.24-2.90) to produce significantly higher odds of having MetS. Rural area (OR=1.36, 95% CI: 0.96-2.14), sedentary occupation (OR=1.69, 95% CI=0.98-3.02) also produced higher odds though they were not significant. Although higher income (OR=0.85, 95% CI=0.68-1.07), some education to illiterate (OR=0.65, 95% CI=0.33-1.12), good education to some education (OR=0.65, 95% CI=0.39-1.08), good physical movement (OR=0.66, 95% CI: 0.40-1.07) including knowledge of MetS (OR=0.50, 95% CI: 0.09-2.70) produced protective odds, they were not statistically significant. It was also observed that increasing age from 30-40 years produced OR of 1.56 (95% CI: 1.28-1.89), from 40-50 years the OR was 1.60 (95% CI: 1.32-1.95), from 50-60 years it was 1.60 (95% CI: 1.32-1.95), while 40-60 years the OR was 2.57 (95% CI: 1.74-3.81) to make this non-modifiable factor an important predictor.

Ⅳ. Discussion

Prevalence of MetS was more than 38% with male predominance, more in rural area, with a tendency to increase with ageing in both sexes and areas. The finding was similar to European, Latin American, US, African and Asian studies[4, 9, 20]. Though the prevalence was higher than it was found by Zaman MM et al[13], other studies[10~12] were indicative of rising prevalence of the components of MetS, so the present study finding could be representative

of the rising trend of MetS in Bangladesh. Importantly the data from India[9] showed a high prevalence of 41% which was similar to this study. As Indian culture, ethnicity and lifestyle are almost alike to Bangladesh, it is possible that the high prevalence of this study is representing the general population.

It was striking to note that low HDL prevailed in nearly 96% population followed by high TG in this study leading to high prevalence of MetS. The finding indicates that Bangladeshi population could have been suffering from dyslipidemia which was not revealed in previous studies[14]. Zaman MM[12] showed in his study 66.4% prevalence of low HDL rural Bangladesh. Study from China[21] also revealed a highly prevalent obesity and dyslipidemia. So it might be possible that the data represent true picture of the situation. The dyslipidemia could also be attributed to lifestyle, food pattern or physical activity of Bangladeshi population, which need to be assessed in further studies. Also the method of chemical analysis by the machine could be one of factors for this high prevalence of low HDL cholesterol as methodological variations adopted by different machines could yield varying result.

Prevalence of obesity was 28%, DM was 27% and HTN was lowest (17%) among the risk factors though the prevalence was higher than the previous study[14]. Rahim MA et al[11] found rising prevalence of DM from 2.3% in earlier survey to 6.8% in his survey. The study[10] on HTN showed high prevalence of 75% in urban and 53% in rural area. The low prevalence of HTN in this study could be due to sample variation.

This study revealed ageing, sex, and sedentary occupation associated with higher odds of having MetS. Including this, higher education, good physical movement and knowledge of MetS became protective. Though the associations were not significant, it could be assumed that a good knowledge of educational background and knowledge of MetS could be important protectors of MetS.

It was noticed that 60% of exercising respondents (Table 1) had MetS to produce higher odds of risk of MetS in logistic regression (Figure 2). But as this was a cross sectional study, it won't be possible to ascertain whether exercise was the cause, or the effect, of MetS. Rather it could be plausible that a cross sectional study could come up with a reverse relation of cause and effect. And this finding brings about the fact of the weakness of a cross sectional study.

The respondents who heard the term "Metabolic Syndrome" were mostly doctors, but they didn't even know the components of diagnosing MetS. The researcher assumed that the doctors and related service providers in Bangladesh still know very little about this ever growing global problem. So measures should have been taken to provide health education to service provider as well as the general people.

This study looked for the amount of water drinking and hour of sleep to find any relation with MetS but no statistically significant association was observed for these two factors. Champagne KA et al[22] established from their study that sleeping disorder could be associated with HTN, DM, MetS, obesity and other clinical conditions.

The study had several limitations. Firstly, the sampling method was not completely random as some respondents from urban areas were recruited non-randomly. So it would be hard to ascertain whether the prevalence of MetS was an underestimate or overestimate of the true prevalence. There were some other

limitations to the study too. MetS according to other criteria like WHO or IDF was not assessed so the agreement or differences of definitions could not be made. Detailed information on lifestyle and eating pattern was not done hence it was not possible to assess the type of food or lifestyle as predictive factors. But it was so far known the first community-based study in Bangladesh to assess the preliminary situation of MetS. Finally the negative association of exercise on MetS postulates the very weakness of this cross sectional design.

As this study revealed MetS a public health problem in Bangladesh, reducing the prevalence of factors especially controlling weight by reducing obesity through planning a good diet pattern could be a key preventive measure. A well documented protocol with diagnosis, management and prevention could be prepared by the health service providers or public health specialists and be used in all health facilities to educate and treat the service providers and recipients. Also mass campaign to increase awareness of the factors and healthy lifestyle should be initiated from early childhood to get rid of the growing problem in future.

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References

1) World Health Organization. Definition, diagnosis and classification of diabetes mellitus and its complications. In: Report of a WHO consultation 1999, WHO, Geneva
2) Grundy SM, Brewer HB Jr, et al.: Americal Heart Association, National Heart, Lung, and Blood Institute. Definition of metabolic syndrome: report of the National Heart, Lung, and Blood Institute/ Americal Heart Association conference on scientific issues related to definition. Circulation 109: 433–438, 2004
3) Albarti KG, Zimmet P, et al.: The metabolic syndrome-a new worldwide definition. Lancet 366: 1059–1062, 2005
4) Ford ES, Giles WH, et al.: Prevalence of the metabolic syndrome among us adults: findings from the third national health and nutrition examination survey. JAMA 287: 356–359, 2002
5) Lee W-Y, Park J-S, et al.: Prevalence of metabolic syndrome among 40698 Korean metropolitan subjects. Diabetes Research and Clinical Practice 65: 143–149, 2004. Global Health Action 44–53, 2009
6) Nawi Ng, Hakimi M, et al.: Prevalence of physical inactivity in nine rural INDEPTH Health and Demographic Surveillance System in five Asian countries.
7) Kirk EP, Klein S: Pathogenesis and pathophysiology of the cardiometabolic syndrome. J Clin Hypertens 11: 761–765, 2009
8) Murata C, Watanabe T, et al.: Aldehyde dehydrogenase 2 and β3 adrenergic receptor gene polymorphism: their association with elevated liver enzymes and metabolic syndrome. Metabolism 52: 1096–1101, 2003
9) Ramachandran A, Snehalata C, et al.: Metabolic syndrome in urban Asian Indian adults- a population study using modified ATP III criteria. Diabetes Research and Clinical Practice 60: 199–204, 2003
10) Hypertension Study Group. Prevalence, awareness, treatment and control of hypertension among the elderly in Bangladesh and India: a multicentre study.

Bulletin of the World Health Organization 79: 490–500, 2001
11) Rahim MA, Akhtar Hussain A, et al.: Rising prevalence of type 2 diabetes in rural Bangladesh: a population based study. Diabetes Research and Clinical Practice 77: 300–305, 2007
12) Zamam MM: Plasma lipids in a rural population of Bangladesh. European Journal of Cardiovascular Prevention and Rehabilitation 13: 444–448, 2006
13) Zaman MM, Ahmed J, et al.: Prevalence of metabolic syndrome in rural Bangladeshi women. Diabetes care 29: 1456–1457, 2006
14) Siddique MA, Sultan MAU, et al.: Clustering of metabolic factors among the patients with essential hypertension. Bangladesh Med Res Counc Bull 34: 71–75, 2008
15) Dupont WD, Plummer WD: “Power and Sample Size Calculations: A Review and Computer Program”, Controlled Clinical Trials 11:116–28, 1990
16) Coinmill.com - The Currency Converter. Bangladeshi Taka (BDT) and USD currency exchange rate conversion calculator. Available from: http://coinmill.com/BDT_USD.html#USD=1
17) Asian Development Bank. Purchasing power parity. Preliminary report. In: 2005 International Comparison Program in Asia and the Pacific. Asian Development Bank. Philippines. 2005
18) Harrell Jr, Frank E: In: Harrell Jr. Frank E. Regression modeling strategies: with application to linear models, logistic regression, and survival analysis. Springer Verlag New York Inc: Springer, 2001
19) Peduzi P, et al.: A simulation study on the number of events per variable in logistic regression analysis. J Clin Epidemiol 49: 1373–1379, 1996
20) Villegas R, Perry IJ, et al.: Prevalence of the metabolic syndrome in middle-aged men and women. Diabetes Care 26: 3198–3199, 2003
21) Liu H, Yu J, et al.: Does obesity attenuate the effect of metabolic syndrome in patients with coronary artery disease? Report from China Heart Survey. Circ J 74: 462–467, 2010
22) Champagne KA, Kimoff RJ, et al.: Sleep disordered breathing in women of childbearing age & during pregnancy. Indian J Med Res 131: 285–301, 2010

バングラデシュにおけるメタボリックシンドロームの実態

要約

バングラデシュにおけるメタボリックシンドローム（MetS）の実態を明らかにするため、ダッカ市から無作為に選んだ地区の住民341人と、149人の田舎に住む住民を対象とし、ATP III の診断基準を用いた調査研究を行った。MetS の有病率は全体で38.8％であった。男性が女性と比べ（54.2％ vs 26.6％）、また田舎が都市部と比べ（49.0％ vs 34.3％）高率であった。検査項目では、HDL コレステロール低値を示す者が96％と高率であった。他の項目での異常者は、中性脂肪高値が51.0％、肥満が28.0％、高血糖が27.1％、高血圧が16.9％であった。ロジスティック回帰分析では、年齢、男性、運動、田舎が MetS と関連していた。一方、高収入、高学歴、日常の身体活動、MetS に関する知識などが予防的に働く傾向が見られた。今後の予防対策のため、さらなる調査研究の必要性が示唆された。（臨床環境20：61～70, 2011）

《キーワード》メタボリックシンドローム、疫学、肥満、生活習慣、バングラデシュ