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Association of Health Literacy with Components of Metabolic Syndrome Among Adults in Southwestern Districts of Bangladesh

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Abstract

Background: Metabolic syndrome (MetS) is a cluster of metabolic abnormalities that increases the risk of cardiovascular disease and type 2 diabetes. Health literacy (HL) influences health behaviors, disease prevention, and management. Despite high MetS prevalence in Bangladesh, the relationship between HL and MetS components remains underexplored. This study assessed the association between HL and MetS among adults in southwestern Bangladesh (Kushtia, Jhenaidah, Magura).

Methods: A community-based cross-sectional study was conducted among 427 adults aged ≥18 years, selected using multistage random sampling. Sociodemographic data, anthropometry, blood pressure, and fasting blood samples for glucose and lipid profiles were collected. HL was assessed using the validated Bengali HLS-EU-Q16 questionnaire. MetS was defined according to NCEP-ATP III criteria. Bivariate analyses (chi-square, ANOVA) and multivariate logistic regression were performed to examine associations between HL and MetS components, adjusting for age, sex, and education. A p-value <0.05 was considered significant.

Results: The overall prevalence of MetS was 32.5%. Adequate HL was observed in 41% of participants. Participants with inadequate HL had a higher prevalence of central obesity (68% vs 42%), elevated fasting glucose (46% vs 26%), and high triglycerides (49% vs 29%) compared to those with adequate HL (p<0.01). Multivariate logistic regression confirmed significant associations between inadequate HL and central obesity (aOR 2.1, 95% CI 1.4–3.1), elevated fasting glucose (aOR 1.8, 95% CI 1.2–2.8), and high triglycerides (aOR 1.9, 95% CI 1.3–2.9). No significant association was found with hypertension or low HDL-C.

Conclusion: Low HL is significantly associated with key components of MetS. Community-based interventions to improve HL may help reduce MetS prevalence and improve metabolic health in southwestern Bangladesh.

Keywords: Health Literacy; Metabolic Syndrome; Obesity; Triglycerides; Fasting Glucose; Bangladesh; Community-Based Study

1. Introduction

Metabolic syndrome (MetS) is a constellation of interrelated metabolic abnormalities, including central obesity, dyslipidemia, hyperglycemia, and hypertension, which substantially increase the risk of cardiovascular disease and type 2 diabetes [1,2]. The prevalence of MetS is rising globally, and South Asia is particularly affected due to rapid urbanization, lifestyle changes, and dietary transitions [2,4]. In Bangladesh, national studies report a high burden of obesity, diabetes, and cardiometabolic risk factors [1,2,10].

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Health literacy (HL), defined as the ability to access, understand, and apply health information, is recognized as a key determinant of health outcomes [5,6]. Low HL has been associated with poor dietary habits, limited physical activity, inadequate medication adherence, and increased prevalence of non-communicable diseases, including MetS [5,6,7,8]. Studies in South Asia suggest that inadequate HL contributes to central obesity, hyperglycemia, and dyslipidemia, highlighting its public health relevance [3,8,9].

Despite this, research on the relationship between HL and MetS in Bangladesh remains limited. Understanding this relationship is crucial for developing targeted interventions to mitigate cardiometabolic risks. This study aimed to assess the association between HL and components of MetS among adults in the southwestern districts of Bangladesh (Kushtia, Jhenaidah, Magura).

2. Literature Review

Previous studies have demonstrated that low HL is a predictor of adverse metabolic outcomes. Nutbeam (2008) emphasized that HL influences individual capacity to adopt healthy lifestyle behaviors, adhere to preventive care, and manage chronic conditions [5]. Berkman et al. (2011) systematically reviewed 85 studies and found that inadequate HL is strongly associated with poor diet, obesity, diabetes, and cardiovascular risk [6]. In South Asia, Saleh et al. (2020) reported that adults with low HL are more likely to have elevated fasting glucose and triglycerides [8]. Similarly, Rahman et al. (2021) observed a significant link between inadequate HL and central obesity in rural Bangladeshi populations [9]. Interventional studies indicate that community-based HL programs can improve nutrition knowledge, increase physical activity, and reduce cardiometabolic risk [7,8]. Despite this evidence, research specifically addressing HL and MetS in Bangladesh remains limited.

This study aimed to assess the association between HL and components of MetS among adults in the southwestern districts of Bangladesh (Kushtia, Jhenaidah, Magura) to inform targeted interventions.

Objectives:

- To assess HL levels among adults in southwestern Bangladesh.
- To determine the prevalence of MetS and its components.
- To evaluate the association between HL and MetS components, adjusting for sociodemographic factors.

3. Methods

3.1. Study Design and Setting

A community-based cross-sectional study was conducted between November -February 2025 and in Kushtia, Jhenaidah, and Magura districts, southwestern Bangladesh.

3.2. Sample Size and Sampling

Sample size was calculated using the formula for cross-sectional studies:

$$n=Z^2\times p\times(1-p)/d2$$

Assuming MetS prevalence of 30%, 95% confidence, 5% margin of error, and 10% non-response, total sample size was 427. Participants were selected via multistage random sampling from urban and rural communities.

3.3. Inclusion and Exclusion Criteria

Inclusion Criteria: Adults aged 18 years and above, residing in Kushtia, Jhenaidah, and Magura districts for at least six months, willing to provide informed consent.

Exclusion Criteria**:** Pregnant women, individuals with chronic illnesses under treatment (e.g., cancer, chronic kidney disease), and those unable to provide informed consent were excluded to ensure accurate metabolic and health literacy assessments.

3.4. Data Collection

Data were collected through structured interviews and physical examinations. Sociodemographic information included age, sex, education level, occupation, and income. Anthropometric measurements such as weight, height, BMI, and waist circumference were obtained using standard protocols. Blood pressure was measured using a calibrated sphygmomanometer. Fasting blood samples were collected after a minimum of 8 hours of fasting for glucose, triglycerides, and HDL-C measurements.

3.5. Health Literacy Assessment

Health literacy (HL) was evaluated using the validated Bengali version of the HLS-EU-Q16 questionnaire. Scores were categorized as inadequate (0–8), problematic (9–12), and adequate (13–16). This assessment determined participants' ability to access, understand, and apply health information for decision-making.

3.6. Metabolic Syndrome Assessment

Metabolic syndrome (MetS) was defined according to the NCEP-ATP III criteria [1]. Participants were classified as having MetS if they met ≥3 of the following five components:

1. Central obesity: Waist circumference ≥90 cm for men and ≥80 cm for women, measured at the midpoint between the lower margin of the last palpable rib and the iliac crest using a non-stretchable tape.
2. Elevated triglycerides: Fasting serum triglycerides ≥150 mg/dL, measured enzymatically.
3. Low HDL cholesterol: Fasting HDL-C <40 mg/dL for men and <50 mg/dL for women, measured enzymatically.
4. Hypertension: Systolic BP ≥130 mmHg and/or diastolic BP ≥85 mmHg, measured twice with a calibrated sphygmomanometer and averaged.
5. Elevated fasting glucose: Fasting plasma glucose ≥100 mg/dL, measured using the glucose oxidase method.

3.7. Data Analysis

Data were analyzed using SPSS version 26. Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequency and percentage. Bivariate associations between HL and MetS components were assessed using chi-square tests for categorical variables and one-way ANOVA for continuous variables. Multivariate logistic regression was performed to evaluate the independent association between HL (inadequate vs adequate) and each MetS component, adjusting for age, sex, and education. Odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Model diagnostics included checking for multicollinearity (variance inflation factor <2) and goodness-of-fit using the Hosmer-Lemeshow test. A p-value <0.05 was considered statistically significant.

4. Results

Table 1 Sociodemographic Characteristics of Participants by Health Literacy Level

Characteristic	Inadequate HL (n=107)	Problematic HL (n=146)	Adequate HL (n=174)	p-value
Age (years, mean ± SD)	44.2 ± 12.8	42.8 ± 12.0	41.3 ± 11.5	0.03*
Female, n (%)	57 (53%)	79 (54%)	77 (44%)	0.08
Illiterate, n (%)	56 (52%)	39 (27%)	26 (15%)	<0.001*
Primary education, n (%)	37 (35%)	66 (45%)	64 (37%)	0.04*
Secondary+ education, n (%)	14 (13%)	41 (28%)	84 (48%)	<0.001*

*Note: HL = Health Literacy; p-values derived from chi-square or ANOVA. *p<0.05 significant.

Table 2 Anthropometric and Biochemical Parameters by Health Literacy

Parameter	Inadequate HL (n=107)	Problematic HL (n=146)	Adequate HL (n=174)	p-value
BMI (kg/m^2)	26.1 ± 3.9	25.3 ± 3.7	24.3 ± 3.4	<0.001*
Waist circumference (cm)	93.2 ± 11.2	91.0 ± 10.2	88.0 ± 9.8	<0.001*
Fasting glucose (mg/dL)	106 ± 17	103 ± 15	99 ± 12	<0.001*
Triglycerides (mg/dL)	162 ± 36	157 ± 34	148 ± 32	0.002*
HDL-C (mg/dL)	43 ± 9	44 ± 8	46 ± 9	0.01*
Systolic BP (mmHg)	130 ± 15	129 ± 14	126 ± 12	0.04*
Diastolic BP (mmHg)	84 ± 11	82 ± 10	80 ± 9	0.03*

*Note: Values are mean ± SD; HL = Health Literacy; p-values from ANOVA; *p<0.05 significant.

Table 3 Prevalence of MetS Components by Health Literacy

MetS Component	Inadequate HL (n=107)	Problematic HL (n=146)	Adequate HL (n=174)	p-value
Central obesity (%)	68	56	42	<0.001*
Elevated triglycerides (%)	49	40	29	0.002*
Hyperglycemia (%)	46	36	26	0.004*
Hypertension (%)	34	31	26	0.11
Low HDL-C (%)	34	30	21	0.08

*Note: MetS = Metabolic Syndrome; p-values from chi-square test; *p<0.05 significant.

Table 4 Multivariate Logistic Regression of HL and MetS Components

MetS Component	Inadequate HL (n=107)	Problematic HL (n=146)	Adequate HL (n=174)	p-value
Central obesity (%)	68	56	42	<0.001*
Elevated triglycerides (%)	49	40	29	0.002*
Hyperglycemia (%)	46	36	26	0.004*
Hypertension (%)	34	31	26	0.11
Low HDL-C (%)	34	30	21	0.08

*Note: OR = Odds Ratio; CI = Confidence Interval; adjusted for age, sex, education; *p<0.05 significant.

Table 5 Stratified Analysis of MetS Prevalence by Age and Sex

Variable	MetS Prevalence (%)	p-value
Age ≥45 years	40	0.01*
Age <45 years	28	
Male	31	0.45
Female	34	

*Note: MetS = Metabolic Syndrome; p-values from chi-square test; *p<0.05 significant.

5. Discussion

This study demonstrates that low health literacy (HL) is independently associated with key components of metabolic syndrome (MetS), including central obesity, elevated fasting glucose, and hypertriglyceridemia, among adults in southwestern Bangladesh. These associations remained significant after adjusting for age, sex, and education, highlighting the critical role of HL in metabolic health.

Our findings are consistent with previous studies showing that inadequate HL contributes to adverse metabolic outcomes, such as obesity, dyslipidemia, and impaired glucose regulation [5,6,8,9]. Individuals with low HL may have limited knowledge regarding healthy nutrition, portion control, and physical activity, which can increase the risk of developing MetS components [3,7].

The lack of significant association between HL and hypertension or low HDL-C observed in this study may be attributable to genetic predisposition, ongoing antihypertensive or lipid-lowering therapy, or unmeasured lifestyle factors, which could attenuate the direct influence of HL on these parameters [4,10].

Health literacy is thought to influence MetS through multiple pathways, including knowledge acquisition, behavioral engagement, and effective healthcare utilization. Our results suggest that targeted, culturally appropriate interventions—such as community-based educational programs, simplified health materials in Bengali, and structured support promoting healthy lifestyles—could reduce the burden of MetS in Bangladesh [5,6,8].

Additionally, the high prevalence of low HL in this population emphasizes the need for public health strategies that go beyond individual education, including systemic approaches to improve access to health information, reinforce preventive care, and support lifestyle modification at the community level.

6. Conclusion

In adults from southwestern Bangladesh, low health literacy is significantly associated with central obesity, elevated fasting glucose, and hypertriglyceridemia. These findings highlight the potential of community-based interventions focused on improving HL to mitigate the prevalence of MetS and enhance overall metabolic health. Implementing culturally sensitive education and support programs may offer a practical and effective approach to reduce cardiometabolic risk in this population [5,6,8,9].

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of ethical approval

The study was approved by the Institutional Ethical Committee of Faculty of Biological Sciences from Islamic University, Bangladesh.

Statement of informed consent

Written informed consent was obtained from all participants prior to data collection.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Authors' Contributions

S.A, B.S.A conceptualized and designed the study; M.H.H conducted data collection; S. A, M.H.H performed data analysis; all authors contributed to manuscript writing and approved the final version.

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