A comprehensive analysis of behavioral patterns, socio-economic conditions, and the prevalence of diabetes-associated comorbidities among diabetic patients in Bangladesh

Arafat Hassan Razon[1], Sabyasachi Biswas[2], Sazzad Hossain[2], Asma Khatun[2], Jannatul Ferdousi Sagufta[2], Tabassum Sultana Barsha[2], Fatema-Tuj Zohra[2]

AFFILIATION
1 Food Science and Nutrition, School of Science and Technology, Bangladesh Open University, Gazipur, Bangladesh
2 Department of Nutrition and Food Technology, Jashore University of Science and Technology, Jashore, Bangladesh

CORRESPONDENCE TO
Fatema-Tuj Zohra. Department of Nutrition and Food Technology, Jashore University of Science and Technology, 64MG+JGQ, 7408, Jashore, Bangladesh.
E-mail: fatematj@just.edu.bd

KEYWORDS
diabetes mellitus, socioeconomic status, body mass index, outpatient department, lifestyle patterns, Bangladesh

Received: 6 February 2024, **Revised:** 31 July 2024, **Accepted:** 3 June 2025
Public Health Toxicol 2025;5(2):7
https://doi.org/10.18332/pht/205877

ABSTRACT

INTRODUCTION In Bangladesh, diabetes mellitus (DM) is a significant health concern contributing to numerous complications that enhance the mortality risk. This study aims to examine the impact of lifestyle patterns, socio-economic conditions, and comorbidities among diabetic patients to establish valid associations between variables.

METHODS A cross-sectional study was carried out among 450 patients with diabetes mellitus at the outpatient department of different hospitals in Bangladesh. Data collection was done through face-to-face interviews using a structured questionnaire.

RESULTS The study analyzed sociodemographic and lifestyle traits among diabetic patients, categorized by gender and results were based on unadjusted analysis. Men had a higher prevalence of being married (99.4%) compared to women (97.9%). Women were more common in rural areas (67.5%) and less likely to own smartphones (12.3%, vs 24.7% for men). More women were overweight (31.2%) and owned house (92.1%). Clinical symptoms showed no significant gender associations except for headaches, more prevalent in women (OR=0.65; p=0.034). Women had a higher prevalence of cardiovascular disease (48.3%, vs 35.4% for men, OR=0.59; p=0.009), while kidney dysfunction was more prevalent in men (16.5%, vs 9.6% for women, OR=1.86; p=0.032). Allergic problems (20.5%, OR=0.40; p=0.014) and asthma (5.5%, OR=0.22; p=0.029) were more common in women. No association was observed in the occurrence of ulcer with the respondents' gender. Regarding lifestyle, 50.7% of respondents consumed rice more than once daily, 71.8% did not smoke, and most (59.1%) had a normal BMI.

CONCLUSIONS Based on our study findings, men should focus on renal health by refraining from high-glycemic meals, while women should concentrate on managing their weight and cardiovascular health by utilizing modern healthcare facilities.

INTRODUCTION

Diabetes mellitus (DM) is one of the major non-communicable diseases that has become a significant global health issue[1,2]. Like other non-communicable diseases, diabetes mellitus is now one of the major concerns for human health and well-being. Each year, around eight to fourteen million people suffer from various non-communicable diseases like heart disease, diabetes mellitus, and kidney dysfunctions[3]. Briefly, in regard to the history, DM was first identified by the ancient Egyptians around 1500 BCE, who noted that the affected individual urinated frequently. The Greek physician Aretaeus later discovered

that the urine of these individuals tasted sweet. In 1776, Matthew Dobson discovered the presence of high glucose in the urine of diabetic patients and after that the term 'diabetes mellitus' was formally established in 1812[4].

The burden of type 2 diabetes mellitus (T2DM) is increasing, causing significant morbidity and mortality, particularly in developing regions. In 2013, the global prevalence of T2DM was 382 million, projected to rise to 592 million by 2035. DM affected 382 million people worldwide in 2013, with 5.3 million deaths attributed to the disease[5]. According to the International Diabetes Federation (IDF) report (2011), Bangladesh had approximately 8.4 million diabetes patients, a number expected to double by 2030[6].

Several factors are responsible for diabetic mellitus, including physical activity, dietary habits, macronutrient intake, and metabolic characteristics, and among them research has shown a correlation between physical activity and the incidence of diabetes mellitus[7]. The primary cause of diabetes is the lack of insulin production by the pancreas or the body's inadequate utilization of insulin[8]. Insulin resistance, a condition in which the body's insulin does not exert its proper effect relative to its concentration in the blood, is a common characteristic of T2DM[9]. Diabetes can be categorized into two types: Type 1 diabetes, caused by the destruction of pancreatic beta cells, and Type 2 diabetes, resulting from impaired insulin production and utilization[10].

DM not only causes dysfunction and failure in various organs of our body but also it leads to long-term complications. It is associated with a low level of education and socio-economic status (SES)[8]. Besides, various epidemiological studies suggest that low SES is responsible for the increasing rate of mortality and infections among diabetic patients[11]. Approximately 80% of adults with diabetes live in low-income countries, where the financial and disease burden associated with non-communicable diseases, particularly diabetes, places a tremendous strain on a fragile health system[5].

Even though type 1 diabetes can be diagnosed at any age, it is considered as one of the most common illnesses in children[12]. Studies indicate an increased rate of complications in type 1 diabetes among lower socio-economic status (SES) groups or no socio-economic status (SES) effect at all[13]. Type 2 diabetes mellitus (T2DM) comprises about 90–95% of all diabetes cases in developed countries and even higher rates in developing countries[14]. In a study of 100 type 2 diabetic patients in Malaysia, 87% were knowledgeable about the disease, 98% had a positive attitude towards managing it, and 99% practiced lifestyle adjustments[15].

According to a recent meta-analysis on T2DM in Bangladesh, the prevalence of diabetes mellitus was reported as 6.7% (4.9–8.6%) where the urban population had a higher prevalence (8.1%) of diabetes compared to their rural (2.3%) counterparts[16,17]. In addition, another study in the capital of Bangladesh on diabetic patients reported a 5% prevalence of T2DM in its middle-income neighborhood[18]. So, from the analysis of previous reports on diabetic patients in Bangladesh we could not find any up-to-date research data which combine both the socio-economic and lifestyle factors to assess their impact on Bangladeshi diabetic patients.

From that perspective, our study aimed to examine the impact of lifestyle patterns and socio-economic conditions on diabetic patients, with a particular focus on gender-specific differences in clinical symptoms and morbidity status.

METHODS

Study design

This was a cross-sectional observational study of behavioral patterns and socio-economic conditions of diabetic patients in Bangladesh. Data collection was carried out October to November 2022. The design aimed to provide a snapshot of the current status of diabetic patients in the selected regions. Primary data collection was ensured through structured face-to-face interviews conducted by trained interviewers using a standard questionnaire. This cross-sectional study was carried out among 450 patients with diabetes mellitus at the outpatient department of the below mentioned hospitals.

Study area

The study was carried out in three different cities of Bangladesh which include: Jashore, Gopalganj, and Kushtia. Diabetes patients were included from the outpatient department of Ahad Diabetic and Health Complex-Jashore Sadar; Kapotakkho Lions and Diabetic Hospital-Jashore; 50 Bedded Diabetes Hospital, Gopalganj; and 50 Bedded Mojibur Rahman Memorial Diabetic Hospital, Kushtia. We have selected Jashore, Gopalganj, and Kushtia to capture a diverse range of diabetic patients from both urban and rural settings. Jashore and Kushtia represent more urbanized populations, while Gopalganj is predominantly rural. This urban–rural representation not only provides a comprehensive understanding of the diabetes burden across different demographic areas in Bangladesh but also enhances the generalizability of our findings.

Study population

We only selected those patients who had been suffering from diabetic mellitus for more than five years, ensuring the focus was on individuals with long-term diabetes management experiences. Patients with gestational diabetes, newly diagnosed diabetes (less than one year), and those with severe diabetic related complications requiring hospitalization were excluded, to maintain a homogenous study population focused on stable, long-term diabetes management.

Sampling technique

In this study, the data were collected using a simple random sampling method. Patients were randomly selected from the outpatient department of the participating hospitals. Before starting each day's data collection, we used a random number generator to pick a number between 1 and 10, and

then we locate the patient according to the random number. After locating the first patient, every 10th patient was selected from the starting patient. To maintain uniformity, we tried to maintain the same sampling technique throughout the data collection period within all three cities.

Sample size

To justify the sample size of our study, we used the following equation to calculate the approximate sample size for this study and this equation has already been used in a similar study[19] to ours to calculate the sample size:

$$N=Z^2pq/d^2$$

where Z=1.96, p=0.5, q=1-p, and d=0.05. According to this equation, the sample size was 384 but we considered 450 samples for our study because of the population size of diabetic patients in the selected regions and the expected prevalence of various socio-economic and lifestyle factors. Our sample size was sufficient to detect significant differences and associations at a significance level of 0.05.

Ethical approval

The Ethics Review Committee at the Faculty of Biological Science and Technology, Jashore University of Science and Technology, Jashore, Bangladesh, reviewed the study protocol and determined that formal ethics approval was not required due to the non-interventional nature of the study. However, the committee ensured that ethical guidelines were followed, including obtaining informed consent and maintaining participant confidentiality. Before starting the survey, we obtained informed consent from all participants, ensuring confidentiality and voluntary participation. The study adhered to ethical standards for conducting research involving human subjects, including data protection and participant anonymity.

Questionnaire development

We developed our own survey questionnaire for our study by reviewing several previous diabetic related studies and adopting validated questions from these studies[20-24]. The sources include peer-reviewed studies on similar populations, ensuring the questionnaires relevance and comprehensiveness. The questionnaire was pretested on a small sample (n=30) to refine questions for clarity and effectiveness, leading to minor adjustment (such as simplifying medical terminology and rephrasing certain lifestyle questions) based on feedback.

Data collection

Data were collected through face-to-face interviews conducted by trained research assistants and the whole study as well as the data collection process was supervised by one qualified supervisor or principal investigator. The research assistants were trained for one day regarding the study protocol, questionnaire administration, and ethical considerations, ensuring consistency and reliability in data collection. After completing their training, they were provided with the structured questionnaire by the supervisor of this study for conducting the data collection process. The structured questionnaire covered sociodemographic characteristics, diabetes care, understanding diabetes, education/advice received, family and friend support, and lifestyle patterns. We classified our respondents family income (in BDT: 1000 Bangladeshi Takas about US$8.2) as: low, <10000; middle, 10000–49999; and high, ≥50000.

Data quality management

After collecting data, the completed questionnaires were double-checked to identify any discrepancies and errors. A subset of data was cross-verified by a second researcher to ensure accuracy. Data entry was conducted using a double-entry system to minimize errors, and discrepancies were resolved through rechecking the original questionnaires.

Data analysis

After ensuring the data quality management, the data were then coded and entered into the Statistical Package for Social Sciences (SPSS) windows version 22 software. To analyze our data, appropriate parametric and non-parametric analyses were conducted based on their appropriateness. Descriptive statistics were used to summarize sociodemographic characteristics, lifestyle factors, dietary habits and clinical outcomes. Chi-squared tests were applied to examine the association between gender and categorical variables, such as clinical symptoms and morbidity status, while logistic regression analysis was employed to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for these associations. During the analysis of our research data, we considered $p<0.05$ as statistically significant.

RESULTS

Sociodemographic and lifestyle characteristics

The study included 450 diabetic patients, stratified by gender, with 158 males and 292 females (Table 1). The majority were married, with a higher proportion among males (99.4%) compared to females (97.9%). Most participants resided in rural areas, especially among females (67.5%). A significant majority identified as Muslim, with slightly lower males (89.9%) than females (91.8%). Males had higher personal smartphone ownership (24.7%) than females (12.3%). Almost all participants had access to electricity, and a significant proportion owned their houses, with a higher rate of ownership among females (92.1%). Body mass index (BMI) distribution showed diverse weight statuses, with more females in the overweight category (31.2%) compared to males (22.2%). From the analysis of research data, we also noticed a significant proportion of our diabetic patients were aged 45–59 years, with the least number of diabetic patients aged ≤29 years.

Table 1. Sociodemographic and lifestyle characteristics of diabetic patients, a cross-sectional study (N=450)

Characteristics	Male (N=158) n (%)	Female (N=292) n (%)
Marital status		
Married	157 (99.4)	286 (97.9)
Unmarried	1 (0.6)	0 (0)
Widow	0 (0)	6 (2.1)
Residence		
Urban	74 (46.8)	95 (32.5)
Rural	84 (53.2)	197 (67.5)
Religion		
Muslim	142 (89.9)	268 (91.8)
Hindu	16 (10.1)	24 (8.2)
Having personal smart phone		
Yes	39 (24.7)	36 (12.3)
No	119 (75.3)	256 (87.7)
Electricity facility		
Yes	157 (99.4)	292 (100)
No	1 (0.6)	0 (0)
Ownership of the house		
Own	140 (88.6)	269 (92.1)
Rental	18 (11.4)	23 (7.9)
BMI		
Underweight	9 (5.7)	21 (7.2)
Normal	110 (69.6)	156 (53.4)
Overweight	35 (22.2)	91 (31.2)
Obese	4 (2.5)	24 (8.2)
Age (years)		
≤29	4 (2.5)	12 (4.1)
30–44	30 (19.6)	84 (28.8)
45–59	68 (43.0)	123 (42.1)
≥60	56 (34.8)	73 (25.0)
Education level		
Illiterate	36 (22.78)	68 (23.29)
School up to class 9	66 (41.77)	119 (40.75)
SSC (secondary school)	16 (10.13)	35 (11.99)
HSC (higher secondary)	18 (11.39)	31 (10.62)
Graduate	22 (13.93)	39 (13.35)
Annual income of family (BDT)		
<10000 (low)	111 (70.25)	123 (42.12)
10000–49999 (middle)	35 (22.15)	100 (34.25)
≥50000 (high)	12 (7.60)	69 (23.63)

BDT: 1000 Bangladeshi Takas about US$8.2.

Table 2. The association between various clinical symptoms and gender in diabetic patients, a cross-sectional study (N=450)

Clinical symptoms	Male (N=158) n (%)	Female (N=292) n (%)	OR (95% CI)	p*
Blurred vision				
Yes	125 (79.1)	228 (78.1)		
No	33 (20.9)	64 (21.9)	1.06 (0.66–1.71)	0.799
Dermatitis				
Yes	8 (5.1)	18 (6.2)		
No	150 (94.9)	274 (93.8)	0.81 (0.35–1.91)	0.633
Skin lesion				
Yes	23 (14.6)	52 (17.8)		
No	135 (85.4)	240 (82.2)	0.79 (0.46–1.34)	0.377
Scurvy				
Yes	18 (11.4)	31 (10.6)		
No	140 (88.6)	261 (89.4)	1.08 (0.59–2.00)	0.801
Sore mouth and tongue				
Yes	18 (11.4)	27 (9.2)		
No	140 (88.6)	265 (90.8)	1.26 (0.67–2.37)	0.469
Dry skin				
Yes	21 (13.3)	28 (9.6)		
No	137 (86.7)	264 (90.4)	1.45 (0.79–2.64)	0.229
Headache				
Yes	63 (39.9)	147 (50.3)		
No	95 (60.1)	145 (49.7)	0.65 (0.44–0.970)	0.034
Hair loss				
Yes	58 (36.7)	107 (36.6)		
No	100 (63.3)	185 (63.4)	1.00 (0.67–1.50)	0.989
Loss of appetite				
Yes	32 (20.3)	58 (19.9)		
No	126 (79.7)	234 (80.1)	1.03 (0.63–1.66)	0.921

*Based on chi-squared. Statistically significant p<0.05.

Clinical symptoms

In this study, the association between various clinical symptoms and gender was investigated (Table 2). We performed a univariate logistic regression analysis to determine the association between gender (independent variable) and the presence of clinical symptoms (dependent variables), while odd ratios (ORs) were calculated to indicate the direction and strength of the association. Additionally, chi-squared tests were used to assess the significance of the associations. No significant gender-based associations were found in the occurrence of blurred vision (OR=1.06; 95% CI: 0.66–1.71, p=0.799), dermatitis (OR=0.81; 95% CI: 0.35–1.91, p=0.633), skin lesions (OR=0.79; 95% CI: 0.46–1.34, p=0.377), scurvy (OR=1.082; 95% CI: 0.59–2.00, p=0.801), sore mouth and tongue (OR=1.26; 95% CI: 0.67–2.37, p=0.469), dry skin (OR=1.45; 95% CI: 0.79–2.64, p=0.229), hair loss (OR=1.01; 95% CI: 0.67–1.50, p=0.989), and loss of appetite (OR=1.025; 95% CI: 0.63–1.66, p=0.921). However, a significant association was found between gender and headache, with females exhibiting a higher prevalence than males (OR=0.65; 95% CI: 0.44–0.97, p=0.034).

Comorbidities

Table 3 presents the comorbidities of diabetic patients,

Table 3. Comorbidities among diabetic patients, categorized by gender, a cross-sectional study (N=450)

Comorbidities	Male (N=158) n (%)	Female (N=292) n (%)	OR (95% CI)	p*
CVD				
Yes	56 (35.4)	141 (48.3)		
No	102 (64.6)	151 (51.7)	0.59 (0.40–0.88)	0.009
Kidney dysfunction				
Yes	26 (16.5)	28 (9.6)		
No	132 (83.5)	264 (90.4)	1.86 (1.05–3.30)	0.032
Allergic problem				
Yes	18 (11.4)	60 (20.5)		
No	140 (88.6)	232 (79.5)	0.40 (0.28–0.88)	0.014
Asthma				
Yes	2 (1.3)	16 (5.5)		
No	156 (98.7)	276 (94.5)	0.22 (0.05–0.97)	0.029
Ulcer				
Yes	6 (3.8)	3 (1.0)		
No	152 (96.2)	289 (99.0)	3.80 (0.94–15.42)	0.045

*Based on chi-squared. Statistically significant p<0.05.

focusing on cardiovascular disease (CVD), kidney dysfunction, allergic problems, asthma, and ulcers. We used chi-squared tests for independence to explore the association between gender (independent variable) and the presence of each comorbidity (dependent variable). Odd ratios (ORs) with 95% confidence intervals (CIs) were calculated to quantify the strength and direction of the associations. Females had a higher prevalence of CVD (48.3%) compared to males (35.4%), showing a significant association with gender (OR=0.59; 95% CI: 0.40–0.87, p=0.009), and males had 41.2% lower odds of having CVD than females (OR<1). Kidney dysfunction was more prevalent among males (16.5%) than females (9.6%) (OR=1.86; 95% CI: 1.05–3.30, p=0.032), and males had 85.7% higher odds having kidney dysfunction than females (OR>1). Allergic problems were more common in females (20.5%) compared to males (11.4%) (OR=0.50; 95% CI: 0.28–0.87, p=0.014) and males had 50.3% lower odds of having allergic problems than females (OR<1). Asthma was significantly more prevalent among females (5.5%) than males (1.3%) (OR=0.22; 95% CI: 0.05–0.98, p=0.029), and males had 77.9% lower odds of having asthma than females (OR<1). The occurrence of ulcers did not show a gender-based difference (OR=3.80; 95% CI: 0.94–15.42, p=0.045) and males had 280.3% higher odds of having ulcers than females (OR>1).

Carbohydrate intake and tobacco use

Supplementary file Table 1 presents the carbohydrate intake patterns and tobacco use profiles of the respondents. Approximately 50.7% of respondents reported consuming rice more than once per day, while 48.7% consumed it once daily. For roti, 47.6% reported eating it more than once per day, and 30.7% consumed it once daily. Cereal consumption was low, with 74.7% never consuming cereals. Regarding tobacco use, 71.8% did not smoke, 8.9% smoked, 17.8% used betel leaf, and 1.6% used gul.

Physical activity and working hours

Physical activity and working hours were assessed among the participants. Supplementary Figure 1 shows that among the patients the hours worked weekly were: about 3.8%, ≤18; 20.9%, 19–30; 47.8%, 31–42; 10.2%, 43–54; 12.4%, 55–66; and 4.9%, ≥67. Nearly 50.0% of patients were in the moderate weekly working hour group, reflecting a sedentary lifestyle. On the other hand, Supplementary Figure 2 illustrates that 17% of patients engaged in slow walking, 17% in fast walking, 35% in medium speed walking, and 27% did not perform any exercise. Despite the necessity of physical exercise for diabetic patients, almost 30% were not engaging in any physical activity, which is detrimental to their health.

DISCUSSION

This study provides a brief overview of sociodemographic and lifestyle characteristics, clinical symptoms, comorbidities, dietary habits, and physical activity among

diabetic patients within our study sample in Bangladesh, indicating that men should focus on renal health by refraining from high-glycemic meals, while women should concentrate on managing their weight and cardiovascular health by utilizing modern healthcare facilities.

The present study found that roughly 48% of respondents worked between 31–42 hours per week. This aligns with previous research indicating that while long working hours are not associated with DM in men, while women working more than 45 hours per week have been reported to have a significantly higher risk of DM compared to those working 35–40 hours per week[25].

In terms of physical activity, our study observed that the majority of patients engaged in medium walking (35.1%), followed by slow walking (17.1%), and fast walking (16.7%). Notably, 27.6% of patients did not exercise at all. This low engagement in physical activity is consistent with findings from another study in Bangladesh, which highlighted that people in the region are generally not health-conscious[26]. Besides, several studies have established a link between physical activity levels and DM risk, emphasizing the importance of exercise in managing diabetes[11,27]. The sedentary lifestyle noticed among our study participants can be due to numerous factors. Cultural practices, low socio-economic conditions and a lack of public consciousness regarding the importance of physical activity may all play a role. For instance, people may not get enough time to get exercise daily due to their rough working hours or there may be limited resources available in their locality to perform physical activity. To address these barriers, targeted interventions and strategies related to public health are required to promote an active lifestyle.

Age distribution in our study revealed that 42.4% of diabetic patients were aged 45–59 years, and 25.6% were aged 30–44 years, which differs from the national diabetes statistics report 2017 of the United States that showed a higher prevalence among those aged ≥65 years[28]. This discrepancy may be attributed to lifestyle patterns, with younger individuals in our study possibly adopting habits that contribute to earlier onset of DM. Specifically, 19.6% of male and 28.8% of female diabetic patients in our study were aged 30–44 years, suggesting that females in this age group are more affected. This trend could be due to less physical activity and imbalanced daily routines among women in this demographic. We noticed a slightly higher prevalence of DM among the younger age groups of our study participants which might be influenced by several lifestyle factors like dietary habits, physical activity and stress levels. Further studies are required to illustrate these underlying causes to develop targeted interventions for the management of DM.

Our study also found that 78% of patients experienced blurred vision, 10% of patients had scurvy, and approximately 17% of patients had skin lesions, with blurred vision being the most common symptom. Additionally, employment status appears to influence diabetic control, as seen in a study from Hong Kong, where employed patients had better diabetic management compared to their unemployed counterparts[29]. This aligns with the notion that physical inactivity is a significant modifiable risk factor for diabetes[30]. Globally, physical inactivity accounts for 14% of diabetes. Over the past few decades, a huge proportion of the working population has shifted from manual labor associated with the agriculture sector to less physically demanding office jobs. A study reported some similar findings to those of the present study, that individuals with a sedentary lifestyle or who undertook only mild physical activity had a higher risk for diabetes[31]. Additionally, the Chennai Urban Population Study (CUPS-14) found a significant association between light physical activity and undiagnosed diabetes[30].

In our study, we found that the prevalence of cardiovascular diseases (CVDs) was 44% among participants, while asthma, ulcers, and kidney dysfunction were less common at 4%, 2%, and 12%, respectively. In regard to the prevalence of comorbidities as well as DM, we think education level of our study participants might play a crucial role, as a study in South Africa reported that around 8% of their participants had DM, and of these 37% had a level of secondary education[32]. Moreover, a study in Bangladesh showed that 51% of diabetic patients had a level of secondary education, which is similar to our study, as the majority of our respondents had a level of secondary education[26]. One crucial aspect is that educated individuals may have better access to resources and information to manage their diabetic condition effectively.

Dietary habits were another focal point, with 50.7% of patients consuming rice more than once a day, 47.6% eating roti more than once a day, and 74.7% never eating cereals. A fiber-rich diet, which can help manage blood glucose levels, was notably absent among many participants, highlighting the need for dietary education and intervention.

Tobacco use was reported by 28.3% of patients, including smoking (8.9%), betel leaf, and gul (1.6%). While smoking and tobacco use may not directly cause diabetes, they are significant risk factors that necessitate behavioral modifications[33]. In our study, 71.8% of patients demonstrated good knowledge of behavioral modification recommendations as they did not smoke but exhibited poor implementation of lifestyle modification. Comparatively, a study in Nigeria reported that 57% of their participants had poor knowledge on behavioral modification and 51% had poor practices of lifestyle modification regarding the prevention of non-communicable diseases, similar to our study findings[34].

Additionally, according to the study report of the Medical Research Council of South Africa, 61% of South Africans were overweight, obese or morbid obese which was considered as the major risk factors for the prevalence of non-communicable disease in their communities[35]. While obesity is a known risk factor for DM, our study found that 59.1% of participants were of normal weight, indicating that factors

beyond obesity contribute to the prevalence of diabetes. This underscores the complexity of DM and the need for a multifaceted approach to its prevention and management.

Implications

On the basis of our study findings, some practical recommendations can be made. According to our study, public health agencies of Bangladesh should focus on promoting physical activity, improving dietary habits, and raising awareness about the risks of tobacco use. Additionally, targeted interventions to address economic, cultural and social barriers to healthy lifestyles are essential. In terms of policy implementation of our study, the policy makers of our health sectors should include the need for a comprehensive diabetes management program that incorporates behavioral modification education and support. Implementing policies that create safe and accessible spaces for physical activity, as well as promoting healthy eating through public campaigns, could have a vital impact on diabetes management and prevention in Bangladesh.

Limitations

This research has numerous limitations, which include potential biases including self-reporting bias and recall bias. Due to the cross-sectional nature of our study, we could not establish causality effect. Future studies should explore the underlying causes of the high prevalence of DM in the younger age groups and the impact of education on diabetic outcomes. Additionally, longitudinal studies are needed to establish causality between risk factors and DM and further investigate the complex interplay of factors contributing to DM. Research should also focus on developing and testing specific interventions to promote healthy lifestyles and prevent DM.

CONCLUSIONS

We provided a brief overview of sociodemographic and lifestyle characteristics, clinical symptoms, comorbidities, dietary habits, and physical activity among diabetic patients in Bangladesh. There was a higher prevalence of overweight females. With regard to morbidity status, gender differences were also noted with women showing a higher prevalence of cardiovascular diseases and allergic problems, whereas males exhibited more frequently kidney dysfunction and ulcers. Notably, a large proportion of our respondents were not engaged in adequate physical activity, and dietary intake reports indicated a high consumption of roti and rice with minimal cereal consumption. The study highlights the significance of addressing behavioral modifications, such as increasing physical activity and improving dietary habits, to manage DM effectively. Moreover, the observed differences in clinical symptoms and morbidity between genders underscore the need for tailored interventions to address these differences. Overall, the findings emphasize the complexity of diabetes management and the necessity for a holistic and individualized approach to reduce the burden of diabetes and its complications.

REFERENCES

1. Zaman MM, Choudhury SR, Ahmed J, Talukder MdH, Rahman AHMS. Blood glucose and cholesterol levels in adult population of Bangladesh: Results from STEPS 2006 survey. Indian Heart Journal/Indian Heart Journal. 2016;68(1):52-56. doi:10.1016/j.ihj.2015.06.031
2. De Silva AP, De Silva SHP, Haniffa R, et al. A survey on socioeconomic determinants of diabetes mellitus management in a lower middle-income setting. International Journal for Equity in Health. 2016;15(1). doi:10.1186/s12939-016-0363-3.
3. Boyle JP, Honeycutt AA, Narayan KM, et al. Projection of diabetes burden through 2050: impact of changing demography and disease prevalence in the U.S. Diabetes Care. 2001;24(11):1936-1940. doi:10.2337/diacare.24.11.1936
4. Ahmed AM. History of diabetes mellitus. Saudi Med J. 2002;23(4):373-378.
5. Rahman MdS, Akter S, Abe SK, et al. Awareness, Treatment, and Control of Diabetes in Bangladesh: A Nationwide Population-Based Study. PLoS ONE. 2015;10(2): e0118365. doi:10.1371/journal.pone.0118365
6. Shawon MdSR, Hossain FB, Adhikary G, et al. Attitude towards diabetes and social and family support among type 2 diabetes patients attending a tertiary-care hospital in Bangladesh: a cross-sectional study. BMC Research Notes. 2016;9(1). doi:10.1186/s13104-016-2081-8
7. Rahati S, Shahraki M, Arjomand G, Shahraki T. Food pattern, lifestyle and diabetes mellitus. International Journal of High-Risk Behaviors and Addiction. 2014;3(1). doi:10.5812/ijhrba.8725
8. Suwannaphant K, Laohasiriwong W, Puttanapong N, Saengsuwan J, Phajan T. Association between Socioeconomic Status and Diabetes Mellitus: The National Socioeconomics Survey, 2010 and 2012. J Clin Diagn Res. 2017;11(7):LC18-LC22. doi:10.7860/JCDR/2017/28221.10286
9. Féry F, Paquot N. Etiopathogenesis and pathophysiology of type 2 diabetes. Jmaj. 2010;60(5-6):361-368. Accessed June 3, 2025. https://rmlg.uliege.be/article/1239?lang=en
10. Barrera FL, Velázquez A, Pérez LM. Explorando los determinantes del buen manejo forestal comunitario. Interciencia. 2010;35(8):560-567. doi:10.2337/dc15-S005.
11. Kim NH, Kim TJ, Kim NH, et al. Relative and combined effects of socioeconomic status and diabetes on mortality: A nationwide cohort study. Med (United States). 2016;95(30). doi:10.1097/MD.0000000000004403
12. Stenberg D. Physiological role of alpha 2-adrenoceptors in the regulation of vigilance and pain: effect of medetomidine. Acta Vet Scand Suppl. 1989;85(9911):21-28. doi:10.1016/S0140-6736(13)60591-7
13. Secrest AM, Costacou T, Gutelius B, Miller RG, Thomas J, Orchard TJ. NIH Public Access. Ann Epidemiol. 2012;21(5):374-381. doi:10.1016/j.annepidem.2011.02.007

14. Umeh AE, Nkombua L. A study of the knowledge and practice of lifestyle modification in patients with type 2 diabetes mellitus in Middelburg sub-district of Mpumalanga. South African Fam Pract. 2018;60(1):26-30. doi:10.1080/20786190.2017.1364012
15. Okonta HI, Ikombele JB, Ogunbanjo GA. Knowledge, attitude and practice regarding lifestyle modification in type 2 diabetic patients. African J Prim Heal Care Fam Med. 2014;6(1):2-7. doi:10.4102/phcfm.v6i1.655
16. Saquib N, Saquib J, Ahmed T, Khanam MA, Cullen MR. Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010. BMC Public Health. 2012;12(1):434. doi:10.1186/1471-2458-12-434
17. Hussain A, Rahim MA, Azad Khan AK, Ali SM, Vaaler S. Type 2 diabetes in rural and urban population: diverse prevalence and associated risk factors in Bangladesh Diabet Med. 2005;22(7):931-936. doi:10.1111/j.1464-5491.2005.01558.x
18. Saquib N, Khanam MA, Saquib J, et al. High prevalence of type 2 diabetes among the urban middle class in Bangladesh. BMC Public Health. 2013;13(1):1032. doi:10.1186/1471-2458-13-1032
19. Haque MM, Uddin AKMM, Abu NM, Khan MZH, Roy SK, Arafat Y. Health and Nutritional Status of Aged People. Chattagram Maa-O-Shishu Hospital Medical College Journal. 2014;13(3):30–34. doi:10.3329/cmoshmcj.v13i3.21019
20. Imam T. Diabetic prevalence in Bangladesh: the role of some associated demographic and socio-economic characteristics. Int J Adv Res Technol. 2012:95-105.
21. Nowakowska M, Zghebi SS, Ashcroft DM. et al. The comorbidity burden of type 2 diabetes mellitus: patterns, clusters and predictions from a large English primary care cohort. BMC Med. 2019;17(1):145. doi:10.1186/s12916-019-1373-y
22. Asif M. The prevention and control the type-2 diabetes by changing lifestyle and dietary pattern. J Educ Health Promot. 2014;3:1. doi:10.4103/2277-9531.127541
23. Tol A, Mohebbi B, Sadeghi R. Evaluation of dietary habits and related factors among type 2 diabetic patients: An innovative study in Iran. J Educ Health Promot. 2014;3(1):4. doi:10.4103/2277-9531.127548
24. Prajapati VB, Blake R, Acharya LD, Seshadri S. Assessment of quality of life in type II diabetic patients using the modified diabetes quality of life (MDQoL)-17 questionnaire. Brazilian Journal of Pharmaceutical Sciences. 2017;53(4). doi:10.1590/s2175-97902017000417144
25. Gilbert-Ouimet M, Ma H, Glazier R, Brisson C, Mustard C, Smith PM. Adverse effect of long work hours on incident diabetes in 7065 Ontario workers followed for 12 years. 2018;6(1):1-7. doi:10.1136/bmjdrc-2017-000496
26. Sultana Z, Ali M, Akhtar M, Uddin M. Haque M. A Study of Evaluation for the Management of Diabetes in Bangladesh. Pharmacology & Pharmacy. 2013;4(3):355-361. doi:10.4236/pp.2013.43051
27. Veghari G, Sedaghat M, Joshaghani H, et al. Association between socio-demographic factors and diabetes mellitus in the north of Iran: A population-based study. International Journal of Diabetes Mellitus. 2010;2(3):154–157. doi:10.1016/j.ijdm.2010.09.001
28. U.S. Centers for Disease Control and Prevention. Diabetes: National diabetes statistics report. U.S. Centers for Disease Control and Prevention; 2024. Accessed June 3, 2025. https://www.cdc.gov/diabetes/php/data-research/index.html
29. Tang YH, Pang MC, Chan MF, Yeung SP, Yeung TF. Health literacy, complication awareness, and diabetic control in patients with type 2 diabetes mellitus. Journal of Advanced Nursing. 2008;62(1):74-83. doi:10.1111/j.1365-2648.2007.04526.x
30. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. Indian J Med Res. 2007;125(3):217-230. Accessed June 3, 2025. https://journals.lww.com/17496352.pmid
31. Gupta A, Gupta R, Sarna M, Rastogi S, Gupta VP, Kothari K. Prevalence of diabetes, impaired fasting glucose and insulin resistance syndrome in an urban Indian population. Diabetes Res Clin Pract. 2003;61(1):69-76. doi:10.1016/s0168-8227(03)00085-8
32. Buila NB, Ntambwe ML, Mupepe DM, et al. The impact of hs-CRP on cardiovascular risk stratification in pilots and air traffic controllers. Aerosp Med Hum Perform. 2020;91(11). doi:10.3357/AMHP.5601.2020
33. Islam RM, Khan MN, Oldroyd JC, et al. Prevalence of diabetes and prediabetes among Bangladeshi adults and associated factors: Evidence from the Demographic and Health Survey, 2017-18. medRxiv. 2021. doi:10.1101/2021.01.26.21250519
34. Saidu H, Akasai AM, Yao AA, Adamu FI, Mijinyawa M. Factor analysis of knowledge, attitude and practice of life style modification measures among hypertensive patients in North – Western Nigeria. J Med Res. 2017;3(2):74-78. doi:10.31254/jmr.2017.3210
35. Joubert J, Norman R, Bradshaw D, et al. Estimating the burden of disease attributable to excess body weight in South Africa in 2000. S Afr Med J. 2007;97(8 Pt 2):683-690. Accessed June 3, 2025. https://www.google.com/url?sa=t&source=web&rct=-j&opi=89978449&url=https://www.ajol.info/index.php/samj/article/view/13898&ved=2ahUKEwiWx5_ft9eNAxUM-8LsIHYt2MaIQFnoECBkQAQ&usg=AOvVaw3wytGTdLwluIsk-r3ab5Gc3

ACKNOWLEDGMENTS
The authors would like to thank all the participants for sharing their time and necessary information for the successful completion of the study.

CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

FUNDING
There was no source of funding for this research.

ETHICAL APPROVAL AND INFORMED CONSENT
The Ethics Review Committee of the Faculty of Biological Science and Technology, Jashore University of Science and Technology reviewed the study protocol and determined that formal ethics approval was not required due to the non-interventional nature of the study. Participants provided informed consent.

DATA AVAILABILITY
The data supporting this research are available from the authors on reasonable request.

AUTHORS' CONTRIBUTIONS
FTZ: designed the research. AK, AHR, SB, JFS, TSB and SH: conducted the research and analyzed the data. AHR wrote the manuscript. All authors read and approved the final manuscript.

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer-reviewed.