Diabetes and It's Associated Risk Factors in Bangladesh: A Logistic Regression Approach

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ABSTRACT

Diabetes is an escalating public health issue in Bangladesh, with its prevalence increasing due to demographic transformations, urbanization, and alterations in lifestyle. This study examines the occurrence of diabetes and its correlating factors among adults utilizing data from the Bangladesh Demographic and Health Survey (BDHS) 2022. A cross-sectional analysis was performed on a sample of 13,980 adults aged 18 and above. Univariate analysis and logistic regression analysis were utilized to evaluate the relationship between diabetes and several factors, including age, residence, division, education, wealth, and nutritional status (based on BMI), with distinct analyses for men and women. Findings reveal that older age was significantly associated with increased diabetes risk. Among men, individuals aged 55-59 have approximately 3.88 times higher odds of diabetes compared to those aged 18-19. Urban residence, particularly in Sylhet and Dhaka, was linked to a higher risk. Surprisingly, men with higher education level were found to be significantly associated with higher diabetes risk. Compared to those with no education, individuals with complete secondary education have approximately 1.608 higher odds of developing diabetes. Higher socioeconomic status was associated with a higher risk of diabetes. Overweight and obese men had significantly higher odds of developing diabetes with ORs 1.386 and 1.690. Also, among women, older age was a significant risk factor, with women aged 55-59 being 5.111 times more likely to develop diabetes compared to younger women. Rural residence was associated with a lower risk of diabetes compared to urban residence. Similar to men, Higher socioeconomic status and BMI were also associated with increased diabetes risk. But while significant associations between diabetes risk and divisions and education levels were observed among men, no such associations were found among women. The research underscores the necessity for focused public health initiatives to mitigate disparities in diabetes prevalence, especially among older adults, urban populations, and individuals with elevated BMI. The limitations encompass the cross-sectional design of the data, which constrains causal inferences, and dependence on self-reported information, which may introduce bias. Future research ought to concentrate on longitudinal studies and incorporate more extensive behavioral and genetic data to enhance the understanding of diabetes risk in Bangladesh.

Keywords: Diabetes prevalence, BDHS 2022, socioeconomic factors, urban-rural disparities, BMI, public health intervention, logistic regression.

INTRODUCTION

Diabetes Mellitus (DM) represents a major global health concern, impacting around 537 million individuals globally as of 2022, a figure projected to rise to 643 million by 2030 (International Diabetes Federation, 2021). In the year 2000, the global prevalence of Type 2 diabetes was recorded at 151 million individuals. This figure

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experienced a threefold increase, reaching 463 million by 2019. Projections indicate an annual rise of 9 million cases until the middle of the century. Diabetes is a chronic condition affecting how the body regulates blood sugar. Type 1 diabetes, an autoimmune disorder, occurs when the body attacks its insulin-producing cells, leading to insulin deficiency and high blood sugar. This type typically begins in childhood or adolescence and requires lifelong insulin therapy. Type 2 diabetes, the most common form, develops when the body becomes resistant to insulin or doesn't produce enough, often linked to obesity, sedentary lifestyle, and family history (Tuomi, 2015). Gestational diabetes develops during pregnancy and typically resolves after childbirth, but it increases the risk of future diabetes (Mazumder et al., 2022). Other less common types include secondary diabetes, often caused by underlying health conditions, and maturity-onset diabetes of the young (MODY), a genetic form that usually begins in adolescence or early adulthood (Forouhi et al., 2010).
Plasma blood glucose, also known as blood sugar, is the concentration of glucose in the blood. A normal fasting blood glucose level is generally considered to be between 70 and 99 milligrams per deciliter (mg/dL) or 3.9 to 5.5 millimoles per liter (mmol/L) (Aktar et al., 2023).

South Asia, encompassing Bangladesh, is witnessing a notably swift rise in the prevalence of diabetes, attributed to shifts in epidemiological patterns and alterations in lifestyle behaviors. Bangladesh identified as one of the most impacted countries in the region (Behboudi-Gandevani et al., 2019). Bangladesh currently holds a position within the top 10 countries worldwide that exhibit the most significant prevalence of diabetes. The Bangladesh Demographic and Health Survey (BDHS) 2022 indicates the age-standardized prevalence of diabetes among adults aged 35 years and older has risen significantly over the past two decades. In 2001, the prevalence was approximately 5%. By 2022, this figure had increased to 20.4%. This data reflects that approximately over 13.1 million adults (aged 20–70+) in Bangladesh are currently living with diabetes. The BDHS data indicates that undiagnosed diabetes continues to pose a significant challenge, with 6% of the population lacking awareness of their diabetic condition (Islam et al., 2021; Akter et al., 2014). By the year 2045, projections indicate that the incidence of diabetes in Bangladesh will increase significantly, potentially reaching 15 million cases. Despite the increasing incidence of diabetes, the availability of healthcare services continues to be constrained, especially in rural regions. The majority of diabetes care facilities are located in urban centers, which poses challenges for the 75% of the population residing in rural areas to obtain essential care (Mohiuddin, 2019; Rahman 2015).

Socioeconomic disparities significantly influence diabetes outcomes in Bangladesh. Individuals with higher socioeconomic status, who possess enhanced access to healthcare services, exhibit a greater likelihood of early diagnosis and receiving suitable treatment. Conversely, individuals from lower-income demographics, especially those residing in rural regions, encounter substantial obstacles in obtaining diabetes care. The process of urbanization has played a significant role in the increasing prevalence of diabetes in Bangladesh. People residing in urban environments tend to participate in less physical activity and have a higher intake of processed, calorie-rich foods, which notably elevates their likelihood of developing diabetes (Blas et al., 2010; Shivashankar et al., 2019; Ramachandran et al., 2014).

The Bangladesh Demographic and Health Survey (BDHS) 2022 provides a valuable dataset for examining the prevalence of diabetes along with its related socioeconomic and lifestyle determinants. This study aims to examine the prevalence, trends, and associated factors of and diabetes in Bangladesh using secondary data from the Bangladesh Demographic and Health Survey (BDHS) 2022. Specifically, the study seeks to: Identify Associated Factors to Explore socio-economic, demographic, and lifestyle factors that are associated with diabetes.

The findings of this study will contribute to a better understanding of the diabetes epidemic in Bangladesh and inform policy makers, healthcare providers, and researchers in their efforts to address this growing public health challenge.

MATERIALS AND METHODS

Source of Data

The primary source of data for this study is the Bangladesh Demographic and Health Survey (BDHS) 2022. The BDHS is a nationally representative survey conducted by the National Institute of Population Research and Training (NIPORT) in Bangladesh (NIPORT, 2020). It collects data on a wide range of demographic,

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socioeconomic, and health-related indicators, making it a valuable resource for studying health issues in the country. The protocol for the 2022 BDHS received clearance from both the ICF Institutional Review Board ethics committee and the Bangladesh Medical Research Council (BMRC). From the BDHS 2022, survey a sample of 7727 women and 6253 men aged 18 and older's interviews was considered, excluding the missing data. The data collected in the survey include information on diabetes diagnosis, demographic characteristics, socioeconomic factors, and lifestyle behaviors. The BDHS data provides a robust and representative dataset for examining the prevalence of diabetes and its associated factors in Bangladesh. The study utilizes a cross-sectional design, analyzing data collected from the Bangladesh Demographic and Health Survey (BDHS) 2022. This nationally representative survey provides a rich dataset on a wide range of demographic, socioeconomic, and health-related variables. The sampling frame used for the 2022 BDHS is the Integrated Multi-Purpose Sampling Master Sample, selected from a complete list of enumeration areas (EAs) covering the whole country. It was prepared by the BBS for the 2011 population census of the People's Republic of Bangladesh. The sampling frame contains information on EA location, type of residence (city corporation, other than city corporation, or rural), and the estimated number of residential households. A sketch map that delineates geographic boundaries is available for each EA. The survey is based on a two-stage stratified sample of households, to select participants from different regions of Bangladesh, ensuring that the sample represents the diverse population of the country. This study included adult respondents aged 18 and older, with a total sample size of 13980.

Methods

Univariate and logistic regression statistical analyses were conducted to examine the distribution of variables, identify associations between diabetes and potential risk factors, and control for confounding factors. The univariate analysis provides a descriptive overview of the study population, highlighting key demographic and socioeconomic factors. This analysis presents the univariate analysis of the background characteristics of the respondents in the study. These characteristics include age, gender, type of place of residence, division, education level, and wealth quantile. We have used frequency distribution and graph for this analysis.
Logistic regression analysis was used to assess the statistical significance of the relationships.

In a regression problem, we use binary logistic regression when the response variable is dichotomous in nature. We often observe that one or more explanatory variables could be categorical or continuous. These types of problems are generally handled by coding dichotomous variable 0 and 1 dummy variable regression (Talukdar & Hossain, 2020).
Let us then consider logistic function is

$$Y_j = \frac{\exp(\beta_0 + \sum_{i=1}^{n} \beta_i X_{ij})}{1 + exp(\beta_0 + \sum_{i=1}^{n} \beta_i X_{ij})}$$

Where , i = 1,2,3,….,n.
j = 1,2,3,….,n.

Let,
Y_{ij} = Respondent having diabetes (No = 0, Yes =1)
X_{ij} = Different associated factors
and β_j's are regression coefficients.

The definitions of the dependent variable and independent variables are shown in the Table 1 and Table 2.

This methodological approach allows for a comprehensive analysis of diabetes prevalence and its associated factors in Bangladesh, providing valuable insights for public health policy and interventions.

Statistical Analysis

Frequency distribution presents the frequency analysis of diabetes prevalence and its associated factors. By examining the distribution of these variables, we can gain insights into the prevalence of diabetes within the study population and identify potential risk factors.

The bar charts and pie charts provide visual representations of the frequency distributions of the background characteristics. These visualizations offer a clear and concise overview of the demographic composition of the

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study population. These visualizations enhance the understanding of the study population and provide valuable context for the subsequent analysis of diabetes prevalence and its associated factors.

Frequency distribution, pie chart, bar charts were used to examine the distribution of variables, identify associations between diabetes and potential risk factors, and control for confounding factors. Odds ratio was used in Logistic regression to assess the statistical significance of the relationships. Analyses were conducted using Microsoft excel and IBM SPSS.

RESULTS AND DISCUSSION

Background Characteristics

This section presents the univariate analysis of the background characteristics of the respondents in the study. These characteristics include age, gender, type of place of residence, division, education level, and wealth quantile. Understanding the distribution of these variables is essential for providing context for the subsequent logistic regression analysis.

This univariate analysis provides a baseline understanding of the demographic characteristics of the study population (Cleff & Cleff, 2014). The findings reveal a relatively young population with a majority of respondents residing in rural areas. The most common educational level is the respondents with no education (25.5%), while the wealth distribution is relatively balanced across the quantiles. These characteristics will be further explored in logistic regression analysis. We have used frequency distribution for the univariate analysis here.

From Table 3, we can see that the majority of participants were aged 20-44, with the largest group being 20-24 (12.4%). The second and third largest groups were 35-39 (11.7%) and 25-29 (11.4%), respectively. This suggests that diabetes prevalence in the study population may be influenced by factors associated with younger age groups, such as lifestyle choices, genetic predisposition, or early-onset diabetes.

The figure 1, indicates that a majority of respondents (65.9%) reside in rural areas, while 34.1**%** reside in urban areas. This suggests that diabetes prevalence in the study population may be influenced by factors associated with rural or urban living. Rural areas often have different lifestyles, access to healthcare, and dietary habits compared to urban areas, which could impact diabetes risk.

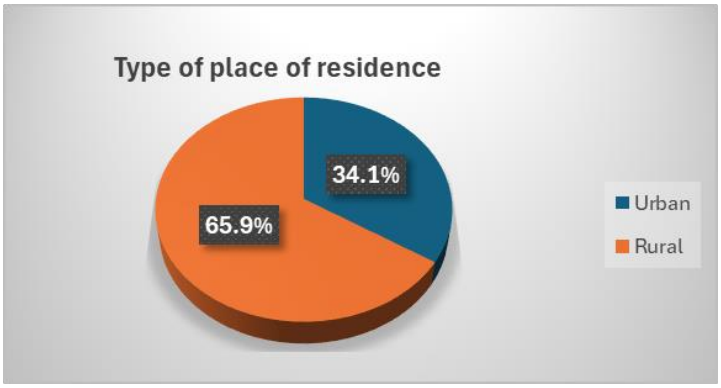

Figure 1: Respondents based on type of place of residence

Also, the table 3 indicates that the majority of respondents are from Chattogram (14.1%), followed by Dhaka (13.0%), Khulna (12.9%), Rajshahi (12.8%), and Rangpur (12.6%). While Sylhet and Mymensingh have slightly lower percentages at 12.3% and 11.6% respectively and Barisal has the lowest representation at 10.7%. This data suggests that diabetes may be more prevalent or have different risk factors in certain divisions of Bangladesh. For example, if the prevalence of diabetes is higher in Chittagong or Dhaka compared to other divisions, it could be due to factors such as lifestyle, diet or access to healthcare in those regions.

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We can see from the table 3 that the most common educational level among respondents is the respondents with no education (25.5%), followed by incomplete secondary education (23.3%), Higher education (16.1%) and incomplete primary education (13%). Participants with Complete secondary education is the least common (9.6%) across all the education levels. This suggests that diabetes prevalence in the study population may be influenced by factors associated with education level, such as socioeconomic status, access to healthcare, and health literacy.

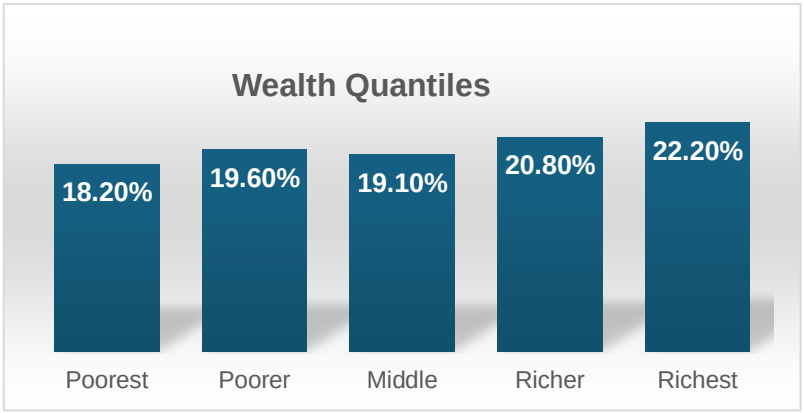

Figure 2: Respondents based on wealth quantiles

From the figure 2, we can see that the richest quantile has the highest representation (22.2%), followed by the Richer quantile (20.80%). The remaining quantiles (Middle, Poorer, Poorest) have relatively similar proportions (19.10%, 19.6%, and 18.2%). This suggests that diabetes prevalence in the study population may be influenced by factors associated with wealth, such as access to healthcare, nutrition, and lifestyle.

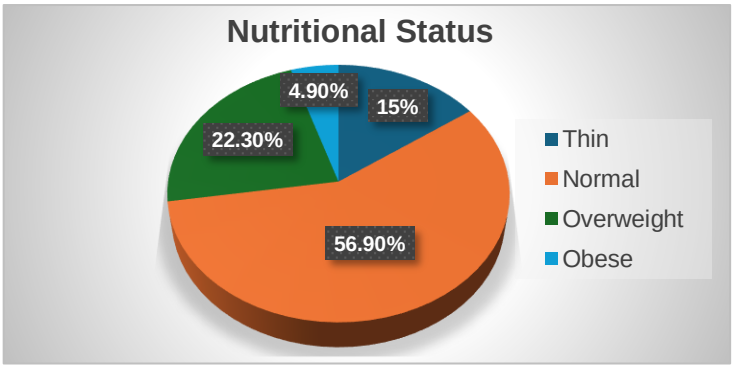

Figure 3: Respondents based on Nutritional Status

Also figure 3 indicates that the majority of respondents have a normal BMI (56.9%), followed by overweight (22.30%) and thin (15%). Only 4.9% of respondents have an obese BMI, rest 0.9% of respondents data were missing. This suggests that diabetes prevalence in the study population may be influenced by factors associated with nutritional status, such as metabolic health and lifestyle.

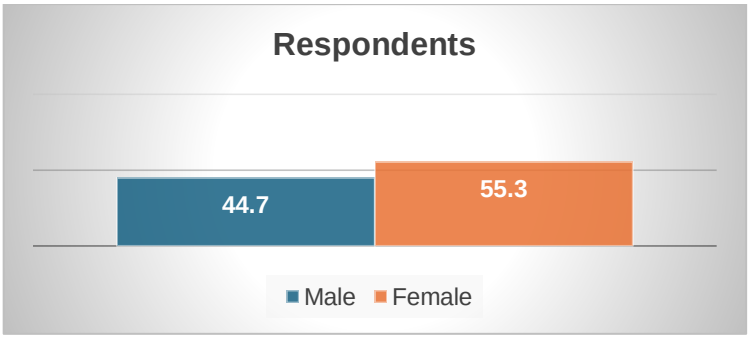

Figure 4: Male and female respondents

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From figure 4, we can see that the majority of respondents are female (55.3%), while 44.7% are male. This suggests that diabetes prevalence in the study population may be influenced by gender-specific factors, such as hormonal differences or lifestyle behaviors.

Results of Logistic regression analysis of risk factors associated with diabetes among Bangladeshi men aged 18 and older:

At first Logistic regression analysis was conducted to examine the association between age and the risk of diabetes among men. The results indicate that age is a significant predictor of diabetes risk. The logistic regression analysis indicates that age is significantly associated with diabetes risk among men. The Table 4 indicates that, as age increases, the odds of developing diabetes also increase significantly. For example, individuals aged 55-59 have approximately 3.88 times higher odds of diabetes compared to those aged 18-19. These findings highlight the importance of early detection and prevention measures, particularly for older men.

The logistic regression analysis indicates that place of residence is also significantly associated with diabetes risk among men. We can see from the Table 4 that, we can see that compared to urban residents, rural residents have significantly lower odds of developing diabetes (OR = 0.721). This suggests that rural areas may have protective factors against diabetes, such as different lifestyles, dietary habits, or access to healthcare resources. From the Table 4, the logistic regression analysis indicates that division is significantly associated with diabetes risk among men. Compared to Barishal, residents of Sylhet have significantly higher odds of developing diabetes (OR = 1.648), also Dhaka (OR=1.595). These findings suggest that geographical factors may play a role in diabetes risk, and further research is needed to explore the underlying reasons for these differences.

The logistic regression analysis indicates that education level is significantly associated with diabetes risk among men. Compared to those with no education, individuals with complete secondary education have significantly higher odds of developing diabetes (OR = 1.608). These findings suggest that Higher education level may be associated with lifestyle changes such as sedentary work, dietary habits, or urban living that increase diabetes risk.

Again, we can see from the Table 4 which indicates that wealth quantile is significantly associated with diabetes risk among men. Compared to the poorest quantile, individuals in the richest quantile have significantly higher odds of developing diabetes (OR = 2.016). These findings suggest that socioeconomic factors may play a role in diabetes risk, with higher wealth being associated with increased risk.

The logistic regression analysis indicates that nutritional status is significantly associated with diabetes risk among men. Again, from Table 4, we can see that compared to individuals with a thin BMI, those with an overweight (OR = 1.386, p = 0.019) and Obese (OR = 1.690, p = 0.037) BMI have significantly higher odds of developing diabetes. These findings highlight the importance of maintaining a healthy weight and addressing obesity to reduce the risk of diabetes.

Results of Logistic regression analysis to examine the association between different risk factors and the risk of diabetes among Bangladeshi women aged 18 and older:

From the Table 5 the logistic regression analysis indicates that age is significantly associated with diabetes risk among women. As age increases, the odds of developing diabetes also increase significantly. From Table 5, compared to those aged 18-19, we can see that women aged 55-59 and aged 70+ have 5.111 and 4.92 times higher odds of developing diabetes respectively. These findings highlight the importance of early detection and prevention measures, particularly for older women.

The logistic regression analysis indicates that place of residence is significantly associated with diabetes risk among women. From Table 5, we can see that compared to urban residents, rural residents have significantly lower odds of developing diabetes (OR = 0.691). This suggests that rural areas may have protective factors against diabetes, such as different lifestyles, dietary habits, or access to healthcare resources.

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The logistic regression analysis examines the association between division of residence and diabetes risk among Bangladeshi women, with Barishal as the reference category. From table 5, we can see that, none of the divisions show statistically significant differences in diabetes risk compared to Barishal, as all p-values are greater than 0.05. Although women from Dhaka division have slightly higher odds of diabetes (OR = 1.285), but the association is not statistically significant (p = 0.058), suggesting no strong evidence of regional influence on diabetes risk among women in Bangladesh. Similarly, no statistically significant association was observed between education levels and diabetes risk, as all p-values exceeded the 0.05 threshold.

The logistic regression analysis indicates that wealth quantile is significantly associated with diabetes risk among women. From Table 5, we can see that compared to the poorest quantile, individuals in the richer (OR = 1.391, p = 0.006) and richest quantile (OR = 1.577, p = 0.000) have significantly higher odds of developing diabetes. These findings suggest that socioeconomic factors may play a role in diabetes risk, with higher wealth being associated with increased risk.

From Table 5, the logistic regression analysis indicates that nutritional status is significantly associated with diabetes risk among women. Compared to individuals with a thin BMI, those with an overweight (OR = 2.408, p = 0.000) and obese (OR = 3.195, p = 0.001) BMI have significantly higher odds of developing diabetes. These findings highlight the importance of maintaining a healthy weight and addressing obesity to reduce the risk of diabetes.

Concluding remarks

This research investigated the occurrence of diabetes and its related factors in Bangladesh, utilizing data from the 2022 Bangladesh Demographic and Health Survey (BDHS). The results underscore notable patterns associated with age, gender, urban-rural residency, socioeconomic status, educational attainment, and geographical variations in the prevalence of diabetes. The results are consistent with numerous significant investigations carried out on diabetes in Bangladesh.

Prevalence of Diabetes Across Age Groups

The present investigation revealed a notable increase in the prevalence of diabetes with advancing age, the logistic regression analysis indicates that age is significantly associated with diabetes risk among men and women. As age increases, the odds of developing diabetes also increase significantly. For men, individuals aged 55-59 have approximately 3.88 times higher odds of diabetes compared to those aged 18-19 and also, women aged 55-59 have approximately 5.11 times higher odds of diabetes compared to those aged 18-19. The results are corroborated by the research conducted by Khan et al. (2022), which indicated a significant rise in diabetes prevalence among adults aged 50 and older, highlighting that this demographic shows elevated rates of diagnosis and treatment. Similarly, Ahsan et al. (2022) noted that individuals aged 55 years and older exhibited a heightened susceptibility to diabetes, with older women demonstrating an increased risk. Furthermore, Kibria (2021) indicated that the prevalence of diabetes among individuals aged 50-59 years was 16.2%, which is in close agreement with the findings of the present study. The documented rise in prevalence among older demographics is corroborated throughout the literature, affirming that age constitutes a significant risk factor for diabetes. Moreover, the elevated medication utilization observed in males aged 70 and older, as well as females aged 60 to 64, underscores the necessity for continuous diabetes management within aging demographics, as highlighted by Khan et al. (2022).

This observation aligns with the results reported by Ahsan et al. (2022), who similarly noted a marginally elevated prevalence of diabetes in women, particularly within older age demographics. Khan et al. (2022) observed that women exhibited a higher likelihood of receiving a diabetes diagnosis and demonstrated greater proactivity in pursuing treatment, especially within urban environments. The elevated prevalence of medication utilization among women in this study, particularly within the 60-64 age group, reinforces the hypothesis that women exhibit a greater propensity to regulate their diabetes via pharmacological interventions. This is consistent with the findings of Khan et al. (2022), which indicate that women exhibited higher levels of engagement in healthcare practices pertaining to diabetes management.

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Urban-Rural Disparities

The study revealed a notable difference in diabetes prevalence between urban and rural populations. The logistic regression analysis indicates that place of residence is significantly associated with diabetes risk among men and women. Compared to urban residents, rural residents have significantly lower odds of developing diabetes among men (OR = 0.721) and women (OR = 0.691). The results align with the observations made by Ahsan et al. (2022), indicating that individuals residing in urban areas exhibit elevated diabetes prevalence attributed to increased sedentary behavior and poor dietary choices. Khan et al. (2022) emphasized that urban regions exhibit a higher prevalence of diabetes, attributed to enhanced access to healthcare services and the potential for earlier diagnosis. Furthermore, Kibria (2021) indicated that the prevalence of diabetes among urban residents was 13.2%, whereas it was 8.7% in rural regions, which is consistent with the results of this study. The elevated prevalence of diabetes in urban regions can be ascribed to variations in lifestyle and levels of physical activity, with urban inhabitants generally participating in reduced physical activity and exhibiting a higher consumption of processed foods, as evidenced by the research conducted by Swasey et al. (2020).

Socioeconomic (wealth quantile) and Educational Factors

The present study revealed that the prevalence of diabetes was markedly elevated among individuals situated in the wealthiest quintiles. The logistic regression analysis indicates that wealth quantile is significantly associated with diabetes risk among men and women. For men, compared to the poorest quantile, individuals in the richest quantile have significantly higher odds of developing diabetes (OR = 2.016). Also, for women, compared to the poorest quantile, individuals in the richest quantile have significantly higher odds of developing diabetes (OR = 1.577, p = 0.000). The results align with the observations made by Khan et al. (2022), indicating that individuals belonging to higher socioeconomic strata exhibited a greater likelihood of diabetes diagnosis and enjoyed enhanced access to healthcare services, which in turn contributed to elevated diagnosis rates. In a comparable manner, Kibria (2021) documented a diabetes prevalence of 18.3% within the wealthiest demographic, thereby reinforcing the findings of the present study. The level of education significantly influenced the prevalence of diabetes. The logistic regression analysis indicates that education level is significantly associated with diabetes risk among men but not for women. Compared to those with no education, individuals with complete secondary education have significantly higher odds of developing diabetes (OR = 1.608, p = 0.001). The correlation between educational attainment and access to healthcare services may elucidate this trend, this indicates a positive link between education and diabetes among men in the studied population. Despite expectations, higher education may be linked to diabetes risk due to sedentary lifestyles, dietary changes, and stress associated with urban or professional life.

Factor associated with nutritional status (BMI level)

The logistic regression analysis indicates that nutritional status is significantly associated with diabetes risk among men and women. Among men compared to individuals with a thin BMI, those with an overweight (OR = 1.386, p = 0.019) and obese (OR = 1.690, p = 0.037) BMI have significantly higher odds of developing diabetes. Also among women, compared to individuals with a thin BMI, those with an overweight (OR = 2.408, p = 0.000) and obese (OR = 3.195, p = 0.000) BMI have significantly higher odds of developing diabetes. These findings highlight the importance of maintaining a healthy weight and addressing obesity to reduce the risk of diabetes. The findings of this study are consistent with previous research by Bhowmik et al. (2015), Kibria (2021), and Chowdhury et al. (2015), which identified overweight and obesity as significant predictors of type 2 diabetes among Bangladeshi adults.

Geographical Variations(divisions)

This study revealed notable geographical disparities in diabetes prevalence. The city Sylhet has been found to be the most diabetes prone region among all other regions of Bangladesh for men, Compared to Barishal, residents of Sylhet have significantly higher odds of developing diabetes (OR = 1.648). But among women, no such significant association was found. Although compared to Barishal, residents of Dhaka having higher odds of developing diabetes (OR = 1.285) was observed. The results align with the observations made by Kibria (2021), indicating that Dhaka exhibited the highest prevalence of diabetes at 14.3%. Ahsan et al. (2022) observed

notable regional variations, linking elevated diabetes prevalence in urban centers such as Dhaka to lifestyle determinants and socioeconomic conditions. The geographical variations observed in this study indicate that factors such as urbanization, wealth concentration, and access to healthcare significantly influence the prevalence of diabetes. The results underscore the necessity for focused strategies in areas with elevated incidence, such as Sylhet and Dhaka, where the urban demographic may face increased vulnerability due to various lifestyle determinants.

The results of this study are consistent with the current body of research regarding the prevalence of diabetes in Bangladesh, substantiating that factors such as age, gender, urban-rural residence, socioeconomic status, education, and geography play crucial roles in determining the risk of diabetes.

Disclosure statements

This research investigated the occurrence of diabetes and its related factors in Bangladesh, utilizing data from the 2022 Bangladesh Demographic and Health Survey (BDHS). Univariate analysis and logistic regression analysis was conducted throughout the research. The results underscore notable patterns associated with age, gender, urban-rural residency, socioeconomic status, educational attainment, and geographical variations in the prevalence of diabetes. The results are consistent with numerous significant investigations carried out on diabetes in Bangladesh.

Ethical approval

The BDHS surveys are conducted following ethical guidelines and standards, often receiving approval from both a local ethical review board in Bangladesh (such as the National Ethics Committee or the Ministry of Health and Family Welfare) and international ethical review boards. This ensures that the survey adheres to globally recognized ethical standards. All participants involved in the survey are provided with detailed information about the survey's purpose, procedures, and data collection methods. Researchers using BDHS data agree to use the data solely for statistical and research purposes, avoiding any attempts to re-identify individuals.

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Competing interests

The authors have no conflicts of interest to declare.

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APPENDIX

Table 1: Definition of dependent variable for Logistic regression analysis:

Dependent Variable	Categories	Values
Respondent with diabetes	Yes	1
	No	0

Table 2: Definition of independent variables for Logistic regression analysis:

Independent Variables	Categories with codes
Age	1="18-19", 2="20-24", 3="25-29", 4="30-34", 5="35-39", 6="40-44", 7="45-49",8= "50-54", 9= "55-59", 10= "60-64", 11= "65-69", 12= "70+"
Type of place of residence	1=Urban, 2=Rural
Division	1=Barishal, 2=Chittagong, 3=Dhaka, 4=Khulna, 5=Mymensingh, 6=Rajshahi, 7=Rangpur, 8= Sylhet
Highest educational level	0=No education, 1=Incomplete Primary, 2= Complete Primary, 3=Incomplete Secondary, 4=Complete secondary, 5=Higher
Wealth Quantile	1= Poorest, 2= Poorer, 3=Middle, 4=Richer,5=Richest
Nutritional Status	1=Thin, 2=Normal,3=Overweight,4=Obese

Table 3: Background characteristics and their univariate analysis

Background Characteristics	Number of respondents	Percent
Age Groups		
18-19	869	6.2
20-24	1728	12.4
25-29	1588	11.4
30-34	1494	10.7
35-39	1639	11.7
40-44	1327	9.5
45-49	1157	8.3
50-54	978	7.0
55-59	870	6.2
60-64	821	5.9
65-69	619	4.4
70+	890	6.4

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Type of place of Residence		
Urban	4767	34.1
Rural	9213	65.9
Divisions		
Barisal	1494	10.7
Chittagong	1971	14.1
Dhaka	1813	13.0
Khulna	1800	12.9
Mymensingh	1622	11.6
Rajshahi	1796	12.8
Rangpur	1763	12.6
Sylhet	1721	12.3
Education Levels		
No education	3560	25.5
Incomplete primary	1811	13.0
Complete primary	1745	12.5
Incomplete secondary	3253	23.3
Complete secondary	1342	9.6
Higher	2252	16.1
Don't know	17	0.1
Wealth index		
Poorest	2548	18.2
Poorer	2747	19.6
Middle	2668	19.1
Richer	2911	20.8
Richest	3106	22.2
Nutritional status (based on body mass index)		
Thin	2099	15.0
Normal	7956	56.9
Overweight	3111	22.3

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Obese	692	4.9
Missing	122	0.9
Total	13980	100.0

Table 4: Logistic regression analysis for men

Variables	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Odds ratio**	**95% C.I.**	
Age							**Lower**	**Upper**
18-19 (ref)						Reference		
20-24	-.337	.264	1.635	1	.201	.714	.425	1.197
25-29	.082	.253	.104	1	.747	1.085	.661	1.782
30-34	.439	.246	3.179	1	.075	1.550	.957	2.511
35-39	.575	.234	6.019	1	.014	1.777	1.123	2.813
40-44	.862	.236	13.345	1	.000	2.368	1.491	3.760
45-49	1.222	.235	27.043	1	.000	3.395	2.142	5.381
50-54	1.314	.236	30.888	1	.000	3.722	2.342	5.917
55-59	1.356	.244	30.928	1	.000	3.882	2.407	6.261
60-64	1.306	.246	28.161	1	.000	3.691	2.279	5.979
65-69	1.351	.249	29.512	1	.000	3.863	2.372	6.291
70+	1.352	.241	31.370	1	.000	3.863	2.408	6.200
Type of place of residence								
Urban (Ref)	...	..	…	..	…	Reference	..	..
Rural	-.328	.082	15.764	1	.000	.721	.613	.847
Division								
Barishal (Ref)	…	…				Reference	….	
Chattogram	.436	.158	7.611	1	.006	1.546	1.134	2.107
Dhaka	.467	.158	8.728	1	.003	1.595	1.170	2.175
Khulna	.344	.159	4.661	1	.031	1.411	1.032	1.928
Mymensingh	-.011	.178	.004	1	.952	.989	.698	1.403
Rajshahi	.120	.165	.526	1	.468	1.127	.815	1.559
Rangpur	.355	.161	4.859	1	.027	1.426	1.040	1.956
Sylhet	.499	.164	9.307	1	.002	1.648	1.195	2.271

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Education level								
No education (Ref)						Reference		
Incomplete primary	.255	.132	3.735	1	.053	1.290	.996	1.671
Complete primary	.305	.133	5.295	1	.021	1.357	1.046	1.761
Incomplete secondary	.241	.123	3.853	1	.050	1.272	1.000	1.619
Complete secondary	.475	.148	10.336	1	.001	1.608	1.204	2.147
Higher	.342	.135	6.399	1	.011	1.408	1.080	1.835
Don't know	.484	.680	.507	1	.476	1.623	.428	6.153
Wealth Quantile								
Poorest (Ref)						Reference		
Poorer	.070	.143	.240	1	.624	1.073	.810	1.420
Middle	.435	.139	9.876	1	.002	1.546	1.178	2.028
Richer	.478	.139	11.869	1	.001	1.613	1.229	2.117
Richest	.701	.148	22.519	1	.000	2.016	1.509	2.693
Nutritional Status								
Thin (Ref)						Reference		
Normal	.178	.116	2.343	1	.126	1.194	.951	1.500
Overweight	.326	.139	5.535	1	.019	1.386	1.056	1.818
Obese	.525	.252	4.341	1	.037	1.690	1.032	2.768

Table 5: Logistic regression analysis for women

Variables	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Odds ratio**	**95% C.I.**	
Age							**Lower**	**Upper**
18-19 (ref)	…	..		…		Reference	…	..
20-24	.034	.231	.022	1	.883	1.035	.658	1.627
25-29	.216	.227	.904	1	.342	1.241	.795	1.938
30-34	.577	.221	6.839	1	.009	1.781	1.156	2.744

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35-39	.848	.218	15.089	1	.000	2.336	1.523	3.584
40-44	1.165	.220	27.960	1	.000	3.206	2.082	4.937
45-49	1.464	.223	43.184	1	.000	4.323	2.793	6.689
50-54	1.481	.231	40.941	1	.000	4.396	2.793	6.919
55-59	1.631	.230	50.433	1	.000	5.111	3.258	8.018
60-64	1.381	.239	33.345	1	.000	3.978	2.490	6.357
65-69	1.585	.256	38.433	1	.000	4.880	2.957	8.055
70+	1.593	.244	42.508	1	.000	4.920	3.047	7.942
Type of place of residence								
Urban (Ref)	…..	…	…	…	…	Reference	…	…
Rural	-.369	.073	25.683	1	.000	.691	.599	.797
Division								
Barishal(Ref)						Reference		
Chattogram	.158	.130	1.474	1	.225	1.172	.907	1.513
Dhaka	.250	.132	3.598	1	.058	1.285	.992	1.664
Khulna	-.155	.138	1.262	1	.261	.856	.653	1.123
Mymensingh	-.228	.150	2.307	1	.129	.796	.593	1.068
Rajshahi	-.192	.139	1.903	1	.168	.825	.629	1.084
Rangpur	.126	.136	.853	1	.356	1.134	.868	1.482
Sylhet	.116	.138	.701	1	.402	1.123	.856	1.473
Education level								
No education (Ref)						Reference		
Incomplete primary	.078	.110	.498	1	.480	1.081	.871	1.342
Complete primary	.024	.117	.041	1	.840	1.024	.814	1.288
Incomplete secondary	.061	.108	.316	1	.574	1.063	.860	1.313
Complete secondary	-.096	.149	.418	1	.518	.908	.678	1.216
Higher	-.047	.139	.115	1	.734	.954	.726	1.253
Don’t know	-19.477	22953.083	.000	1	.999	.000	.000	.

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Wealth Quantile								
Poorest(Ref)						Reference		
Poorer	.202	.121	2.787	1	.095	1.224	.965	1.552
Middle	.197	.121	2.628	1	.105	1.218	.960	1.545
Richer	.330	.121	7.445	1	.006	1.391	1.097	1.764
Richest	.455	.128	12.654	1	.000	1.577	1.227	2.027
Nutritional Status								
Thin (Ref)						Reference		
Normal	.354	.121	8.539	1	.003	1.425	1.124	1.807
Overweight	.879	.128	47.295	1	.000	2.408	1.875	3.094
Obese	1.162	.152	58.237	1	.000	3.195	2.371	4.305

*p <0.05, Statistically significant; ** p <0.001, highly statistically significant