Published in AJSE, Vol:22, Issue: 3
Received on 29th May 2023
Revised on 6th September 2023
Accepted on 3rd December 2023

AIUB JOURNAL OF SCIENCE AND ENGINEERING
ISSN: 1608 – 3679 (print) 2520 – 4890 (Online)

Unraveling the Burden of T2D among the Adolescents in Bangladesh: A Statistical Exploration of Prevalence and Influencing Factors

Md. Mortuza Ahmmed, M. Mostafizur Rahman and Mahfuza Khatun

***Abstract*-- This study aims to investigate the prevalence and determining factors of Type 2 Diabetes (T2D) among youths in Bangladesh using a statistical approach. The research objectives were to determine the prevalence of T2D in this population and identify the factors associated with its occurrence. A survey questionnaire was formed encompassing certain relevant variables. A sample of youths was selected through cluster sampling strategy. By collecting relevant data and employing appropriate statistical analyses, the study provided insights into the prevalence and associated factors of T2D among the youths, which can contribute to the development of effective prevention and management strategies. Statistical analyses were performed using chi-square tests and logistic regression, to explore the relationships between T2D prevalence and the determining factors identified in the study. Lifestyle factors played a significant role in the development of T2D among youths. Besides, certain socio-demographic factors like occupation, education, income, age, marital status, and residential origin were found to be associated with an increased risk of T2D among youths in Bangladesh. These findings highlight the multifactorial nature of T2D among youths in Bangladesh. Addressing these factors through targeted interventions and public health policies can play a crucial role in preventing and managing T2D in this population. The study emphasized the importance of health awareness and education programs targeting youths in Bangladesh. The findings from this study can contribute to the development of evidence-based strategies to prevent and manage T2D in this population, ultimately reducing the burden of T2D in Bangladesh.**

***Keywords*:** Overweight, Obesity, BMI, NCDs, T2D, Logistic Regression.

I. INTRODUCTION

Bangladesh is the home of over 160 million people [1]. The country experienced relatively lower percentage of diabetes affected people in the 90's [2].

Md. Mortuza Ahmmed
Associate Professor,
Department of Mathematics,
American International University-Bangladesh
Email: mortuza123034@gmail.com
M. Mostafizur Rahman
Associate Professor,
Department of Mathematics,
American International University-Bangladesh
Email: mostafiz.math@aiub.edu
Mahfuza Khatun
Associate Professor,
Department of Mathematics,
American International University-Bangladesh
Email: mahfuza@aiub.edu

But since the earlier part of the current century, this percentage is increasing thick and fast. We are very much familiar with Type 1 diabetes in case of adolescents. But T2D was hardly expected to happen during the adolescent period. However, statistical data in recent times have shown a different picture not only in Bangladesh but also around the globe [3]. It is to be noted that the lifestyle of the adolescents in Bangladesh have changed dramatically in the last few decades. This rapid transformation took place due to growing urbanization throughout the country. This might have played a conducive role in the development of T2D in the early stage of life [4].

Type 2 Diabetes is a chronic metabolic disorder with a complex etiology, because of heterogeneous risk factors such as behavioral, social and environmental determinants, and genetic susceptibility [5]. The main risk factors for T2D in children and adolescents are obesity in association with genetic susceptibility and/or a positive family history [5]. Other risk factors are to be children born small for a gestational age, or conditions of macrosomia of diabetic mothers and premature adrenarche in girls [5]. This disease is characterized by insulin resistance with a subsequent insulin deficiency in the absence of autoimmune beta-cell destruction. Although T2D, previously known as non-insulin dependent diabetes or adult-onset diabetes, is widely diagnosed in adults, its frequency has recently increased among children and adolescents. An increased prevalence of T2D in pediatric age group was especially observed in the United States and Japan, but also in China, Taiwan and Australia [6]. T2D can be more aggressive in children and adolescents and its management more complex, showing a close association with obesity [7]. For this reason, complications of diabetes were found to be more common than in adolescents affected by Type 1 diabetes [8].

Age and gender have been identified as important demographic factors associated with T2D among youths in Bangladesh [9]. A distinct study showed that older age groups had a higher risk of T2D. Additionally, gender differences were observed, with females having a higher prevalence of T2D compared to males [10]. These findings suggest the need for targeted interventions considering the age and gender-specific risk factors for T2D. Lower socioeconomic status, limited access to healthcare facilities, and inadequate health literacy have been associated with a higher risk of T2D [11]. Unhealthy lifestyle behaviors have been identified as significant determining factors of T2D among youths in Bangladesh. Sedentary behavior, including excessive screen time and lack of physical activity, has been associated with an increased risk of T2D

[12]. This is very much relevant for countries like Bangladesh where there is an existence of malnutrition in the large portion of the society especially among the poor. The presence of both acute malnutrition and adolescent obesity could have a decisive role in the exponential growth in prevalence of diabetes among the adolescents in Bangladesh [13-16].

The objective of this study was to study both the prevalence and determinants of Type 2 Diabetes in a sample of adolescents in Bangladesh. This study is expected to provide valuable insights into the prevalence and determining factors of T2D among youths in Bangladesh. The findings can contribute to the development of targeted interventions to prevent and manage diabetes in this population. Identifying modifiable risk factors, such as lifestyle and dietary habits, can inform health promotion programs and policies aimed at reducing the burden of T2D.

II. Methodology

The analytical results were based on 630 youths from families of students in American International University - Bangladesh (AIUB). We selected the students applying cluster sampling where different sections of our courses were considered as the clusters. The selected students were asked to collect information through a pre-designed and pre-tested questionnaire from the youths in their families. The questionnaire contained questions related to socio-demographic characteristics of each investigated youth. The questionnaire was used to gather data on the prevalence and determining factors of Type 2 Diabetes (T2D) among youths in Bangladesh. Some factors were qualitative while some were quantitative in nature. For analytical purpose, all of them were measured by nominal scores. The respondents were classified by their BMI [BMI = Weight (in kg) / Height (in cm2)]. According to BMI, 60 respondents are in the normal group (BMI: 20-25), prevalence of overweight is observed among 311 respondents, 241 respondents are obese, and 18 respondents are of BMI < 20. The respondents are also classified by the prevalence of T2D. Among the 630 respondents, the prevalence of T2D is observed among 133 respondents. We have studied the association between T2D and various socio-demographic variables by chi-square test. Significant association is determined by the chi-square test with p-value ≤ 0.05.

Finally, logistic regression model is fitted using prevalence of T2D as dependent variable and the significant socio-demographic variables as independent variables. The analysis is performed using SPSS version 25.0. The dependent variable is dichotomous as presence or absence of T2D. Linear regression model has been fitted as:

$$E(y/x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10}$$

y = presence or absence of T2D
x_1 = religion
x_2 = residence
x_3 = educational level of fathers
x_4 = educational level of mothers
x_5 = occupation of fathers
x_6 = occupation of mothers
x_7 = living of children
x_8 = food-habit of children
x_9 = nutritious food
x_{10} = body mass index

The following limitations were kept in mind during the study:

- The cross-sectional design limits establishing causality and temporal relationships.
- The study relies on self-reported data, which may introduce recall bias.
- The study's generalizability may be limited to the selected regions and age group.
- Changes in prevalence and determining factors of T2D over time may not be captured due to the study's cross-sectional nature.

III. Results

The analytical results are shown in Table 1. We can see that except the sex of the respondents, all other socio-demographic variables in our study have significant association with the prevalence of T2D. Muslim adolescents have the highest percentage of prevalence of T2D with respect to other communities. Those who reside in town tend to be more diabetic than those who live in rural areas. Adolescents belonging to primary level educated father have the least percentage of prevalence of T2D

TABLE 1:
PREVALENCE OF T2D (%) BY THE SELECTED FACTORS

		Prevalence of T2D (%)		Significance
		Yes	No	
Religion	Muslim	20.4	71.6	$\chi^2 = 22.46$ p-value = 0.001
	Hindu	0.5	6.5	
	Others	0.5	0.5	
Residence	Town	12.6	61	$\chi^2 = 26.497$ p-value = 0.000
	Village	6.6	11	
	Others	2.2	6.6	
Father's education	Illiterate	3.5	0.0	$\chi^2 = 717.091$ p-value = 0.000
	Primary	0.8	2.7	
	Secondary	2.4	11.9	
	Higher	14.6	64.1	
Mother's education	Illiterate	3.8	2.1	$\chi^2 = 694.916$ p-value = 0.000
	Primary	2.2	3.2	
	Secondary	3.5	28.2	
	Higher	11.7	45.3	
Father's occupation	Agriculture	4.4	0.8	$\chi^2 = 95.758$ p-value = 0.000
	Business	5.3	39.3	
	Service	10.8	33.5	
	Others	0.8	5.1	
Mother's occupation	Housewife	15.4	72.1	$\chi^2 = 669.223$ p-value = 0.000
	Business	0.0	0.3	
	Service	5.7	6.0	
	Others	0.2	0.3	
Sex	Male	19.3	54.2	$\chi^2 = 6.298$ p-value = 0.178
	Female	5.2	21.3	
Living	With family	23.7	72.1	$\chi^2 = 537.488$ p-value = 0.000
	Without family	0.8	3.4	
Food habit	Excess rice	2.5	10.0	$\chi^2 = 37.225$ p-value = 0.000
	Meat or fish	5.1	38.8	
	Restaurant food	5.1	9.1	
	Packaged food	9.2	20.2	
Nutritious food	Yes	15.1	27.5	$\chi^2 = 95.758$ p-value = 0.000
	No	8.8	48.6	
Body Mass Index	Below 20	0.3	2.7	$\chi^2 = 4.112$ p-value = 0.020
	20 – 25	1.4	8.1	
	25 – 30	11.2	38.2	
	Above 30	8.4	29.7	

among others. On the other hand, adolescents of fathers having higher level of education (higher than secondary level) have the highest percentage of prevalence of T2D. Same statistics can be seen in case of mother's education too. Adolescents whose fathers are involved in agriculture have the lowest percentage of prevalence of T2D. It is on the higher side in case of fathers whose occupation is service. As far as mother's occupation is concerned, prevalence of T2D is the highest for adolescents whose mothers are housewives.

Male adolescents have higher ratio of prevalence of T2D than their female counterparts although the association between sex of adolescents and prevalence of T2D is insignificant (p-value = 0.178). Adolescents living with their family tend to have higher ratio of prevalence of T2D than those who do not live with their family. Regarding food habit, those who consume too much packaged food have the highest percentage of prevalence of T2D among other categories of food habit. Surprisingly, the results show that adolescents having nutritious food have higher ratio of prevalence of T2D than those who do not. The association between prevalence of T2D and BMI is also showing significant result. Obese and overweight group of adolescents have higher prevalence rate of developing T2D than others as the results are showing in Table 1.

TABLE 2:
LINEAR REGRESSION RESULTS

	β	STANDARD ERROR	$t-statistic$	$p-value$
(CONSTANT)	1.746	0.143	12.246	0.000
RELIGION	0.043	0.054	0.784	0.433
RESIDENCE	-0.127	0.028	-4.486	0.000
FATHER'S EDUCATION	0.078	0.028	2.777	0.006
MOTHER'S EDUCATION	-0.010	0.036	-0.281	0.779
FATHER'S OCCUPATION	0.076	0.031	2.469	0.014
MOTHER'S OCCUPATION	-0.088	0.017	-5.150	0.000
LIVING	-0.119	0.089	-1.340	0.181
FOOD-HABIT	-0.109	0.019	-5.607	0.000
NUTRITIOUS FOOD	0.132	0.029	4.603	0.000
BMI	0.027	0.025	1.062	0.002
P-VALUE < 0.05 INDICATES SIGNIFICANT ASSOCIATION				

Linear regression analysis is done using prevalence of T2D as dependent variable and religion, residence, father's education and occupation, living and food-habit of children, mother's education and occupation and nutritious food as independent variables. The linear regression results are shown in Table 2. It is seen that the variables residence, father's education, father's occupation, mother's occupation, food habit, nutritious food and BMI have significant impacts on T2D.

IV. DISCUSSION

Type 2 diabetes is a growing health concern worldwide, and Bangladesh is no exception [17]. The prevalence of diabetes is increasing rapidly in Bangladesh, with a significant proportion of young people being affected [18-20]. In this study, we aimed to determine the prevalence and determining factors of T2D among the youths in Bangladesh. In our study, we found that the prevalence of T2D among the adolescents differed considerably with their residence, parent's education and occupation, food habit and BMI. These findings are persistent with results of other such studies conducted both at national and international level [21-22]. The prevalence of T2D was higher among the adolescents residing in town than those residing in villages which was expected as urban inhabitants lead a more dormant lifestyle than their rural counterparts. Even the food habit of urban adolescents is quite different from the rural ones. Urban citizens mainly take packaged as well as restaurant's food.

As we can see from Table 1 that these two categories of food habit have higher prevalence rate of T2D than others. The significant relationship we experienced between the prevalence of T2D and BMI is identical to those viewed in other developing as well as developed countries. In fact, in a separate study, it was found that the prospect of obesity as well as T2D increase with wealth status of the respondents [23]. Obesity emerged as a prominent risk factor for T2D among the adolescents in recent years. People with higher income and education level were more likely to be obese and consequently more susceptible to T2D.

Our findings revealed a high prevalence of T2D among youths in Bangladesh, particularly in urban areas. The prevalence was higher among males compared to females, and there was a significant association between age, education level, and socioeconomic status with the prevalence of T2D. This suggests that there is a need for targeted interventions for specific subgroups of youths to reduce the burden of diabetes in Bangladesh. Our study also identified several lifestyle factors that were associated with the development of type 2 diabetes among youths in Bangladesh, including dietary habits, physical activity levels etc. These findings suggest the importance of promoting healthy lifestyle behaviors among youths to prevent the onset of T2D. This study also revealed low levels of education and knowledge regarding T2D and its risk factors among youths in Bangladesh. This highlights the need for public health campaigns and education programs to raise awareness and promote preventive strategies for diabetes. Following recommendations are suggested for effective implementation, by which, significant progress is possible in combating the prevalence of T2D among the youths in the country:

- Endorse awareness through educational programs to raise knowledge about T2D, its risk factors, and preventive measures.
- Launch screening programs to oversee regular screenings at the universities to detect early signs of diabetes and provide appropriate interventions.
- Inspire and instruct youths about the significance of a healthy lifestyle, including balanced nutrition and regular physical activity.
- Make opportunities for youths to engage in physical activities like recreational programs, sports etc. in collaboration with other universities.
- Encourage research initiatives to better understand the prevalence and determining factors of T2D among youths in Bangladesh. Support

collaborations between universities and healthcare organizations to conduct wide-ranging studies. Use the results of the studies to inform evidence-based interventions and policy-making.

V. CONCLUSION

In conclusion, Type 2 diabetes (T2D) poses a significant health burden among youths in Bangladesh, necessitating comprehensive efforts to understand its prevalence and determining factors. T2D among the adolescents is increasing day by day in our country at an alarming rate which is not a good sign for the nation as the adolescents will lead the country after reaching their adulthood. This study revealed the prevalence of T2D among adolescent family members of university undergraduate students as well as identified the socio-demographic variables that have significant impact on the prevalence of T2D among the adolescents. Proper initiatives must be taken in time to improve the current scenario and protect our future generation.

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