

Socioeconomic Variables which Discriminate Diabetic and Non-Diabetic Adults in Bangladesh

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Abstract

It was evident from different studies that adverse socioeconomic conditions, like low level of education, lower income, higher age, obesity, habit of taking restaurant food, unwillingness in physical work or physical exercise, involvement in sedentary entertainment, etc. are the risk factors of prevalence of diabetes. Assuming these facts true for all social conditions, an attempt was made to verify the validity of these hypotheses among adult population of Bangladesh. The study was conducted on 785 adult members of age 18 years and above.

Among the respondents the percentages of urban, Muslim and male adults were 86.6, 89.6 and 68.8, respectively. The prevalence rates of diabetes were similar among these 3 social groups. The prevalence rate was increasing with the increase in age. Low level of education, higher mobility in respect of profession and income were the responsible factors for the prevalence of diabetes. The other responsible variables for prevalence were level of obesity and marital status of the adults. The most responsible variable for the prevalence of diabetes was marital status followed by age, income and body mass index. This was noted from discriminant analysis.

Keywords: *Prevalence of Diabetes; Socioeconomic Variables; Association between Prevalence of Diabetes and Socioeconomic Variables; Discriminant Analysis; Correlation Coefficient of Variable and Discriminant Function Score*

Introduction

Diabetes is a chronic non-curable disease which changes the lifestyle of human being. It occurs when the pancreas cannot produce sufficient insulin or when the body cannot effectively use the insulin which is produced. The common consequences of diabetes are (i) increased risk of heart attacks and strokes among adults [1], (ii) increased level of blood sugar when combines with reduced blood flow, neuropathy in the feet increases which enhances the foot ulcers, infection and limb amputation, (iii) occurrences of blindness due to diabetic retinopathy. Besides these diseases, the other problems are cancer, chronic kidney disease, osteoporosis, Alzheimer's disease, cataracts and others. These diseases are the major health burden in industrialized countries and are increasing rapidly in the developing countries. Currently most of the Asian countries are a heading towards developing countries and there is an increasing trend of diabetic population in these countries [2]. The number of diabetic population has arisen from 108 million in 1980 to 422 million in 2014 and the figure will be increased up to 700 million in 2045 [3]. Contribution of Asian countries is more than 60% to world diabetic population [2]. The global prevalence of diabetes among adults over 18 years of age has arisen from 4.7% in 1980 to 8.5 % in 2014. The rate of increase is rapid in low-and middle income countries. Some of the Asian countries are middle-income countries where urbanization is spreading widely, adversely affecting the lifestyle of the populations. In these countries the environmental effects are favorable for the prevalence of diabetes [2]. Due to increase in prevalence of diabetes there was an increasing death rate due to this. In 2016, an estimated 1.6 million

deaths were directly caused by diabetes [3]. Another 2.2 million deaths were attributable to high blood glucose in 2012 [4]. The prevalence of diabetes among adults aged 20 - 70 years is expected to rise to 438 million in 2030 [5]. Studies conducted during 1999 to 2009 provided the information that people with more deprived socioeconomic status have greater incidence, more prevalence and higher mortality [6] due to type 2 diabetes.

From the above discussion, it may be concluded that socioeconomic condition is a responsible factor for the risk of prevalence of diabetes. Research from both developed and developing countries [7-11] showed that low level of education [7,12], low income [9,10,13,14], currently married and age 45 years and above [14], obesity [15], habit of taking restaurant food [15], are the risk factors of prevalence of diabetes. Moreover, low exercise, involved in sedentary activities are the risk factors of obesity [16,17]. In another study, it was reported that sex, occupation and type of work were associated with obesity [18]. Again, obesity was associated with prevalence of diabetes [18-22]. Increasing prevalence of diabetes is associated with socioeconomic status [1,4,6,23-28]. In this paper attempts were made to study the association of different socioeconomic variables with prevalence of diabetes and to detect the most responsible group of variables for the discrimination of diabetic and non-diabetic adults in Bangladesh.

Methodology

The present analysis was done using the data collected from 785 adults investigated in families of 2 percent randomly selected students of American International University - Bangladesh during the summer semester 2015 - 2016. The selected students were trained and requested to collect information from the adult members of their families through a pre-designed and pre-tested questionnaire. Each questionnaire contained questions related to age, height, weight, gender, marital status, education, occupation, monthly family income, food habit, smoking habit, physical activity, prevalence of any type of non-communicable diseases, treatment of the diseases, etc. Among these variables, some were qualitative in nature. For analytical purpose, all the variables were noted in nominal scores. The investigated units were classified by level of obesity, where level of obesity was decided by the value of body mass index [BMI = weight in kg/(height in meter)²; underweight = BMI < 18.5, normal = 18.5 ≤ BMI < 23, overweight = 23 ≤ BMI < 27.5 and obese, if BMI ≥ 27.5; [29,30].

The investigated units were classified by the prevalence of diabetes. In a separate study [15], it was reported that there 331 patients of diabetes and another 14 cases were noted who were suffering from diabetes and heart diseases. Thus, the prevalence of diabetes was noted among 345 adults. The other 440 investigated units were either free of diabetes or any non-communicable disease. The association of prevalence of diabetes with any of the socioeconomic variables was studied by chi-square test and significant association was decided if p-value of chi-square statistic ≤ 0.05. The coefficient of contingency was calculated and in some cases the odd ratios were calculated to decide the risk level of prevalence of diabetes for a particular level of socioeconomic variable.

The responsible socioeconomic variable to discriminate between diabetic and non-diabetic adults was detected by discriminant analysis [16,31,32]. One of the component of analysis is the correlation coefficient of discriminant function score and a study variable. The highest correlation coefficient in magnitude indicates the most responsible variable for discrimination.

Results

Out of 785 respondents the prevalence of diabetes was noted among 43.9 percent of them (Table 1). The percentage of respondents from urban area was 86.6 and prevalence of diabetes was recorded among 43.5 percent of them. There was no significant variation in the prevalence rates between the urban and rural groups of adults ($\chi^2 = 0.363$, p-value = 0.547). The coefficient of association was 0.022. The odd ratio 0.88 indicated that there was no reason to believe that urban adults were at higher risk of prevalence of diabetes compared to rural adults. Insignificant variation in the prevalence rates were also observed among Muslim (89.6%) and Non-Muslim adults (10.4%) ($\chi^2 = 0.213$, p-value = 0.645). The coefficient of association between religion and prevalence rate of diabetes was 0.016. The odd ratio 0.90 indicated that no special religious group was at higher risk of prevalence of diabetes. Similar conclusion could be made for the preva-

Prevalence rates for both males (68.8%) and females (31.2%). In this analysis the chi-square statistic for test of association between gender and prevalence of diabetes was found 1.669 with p - value 0.196. The coefficient of association was 0.046. The odd ratio 0.82 indicated that male and female adults were almost similarly exposed to prevalence of diabetes, though prevalence rate was slightly higher (47.3%) compared to the same among male (42.4%).

Socioeconomic variables	Prevalence of diabetes		Total
	Yes	No	
Residence	Number (%)	Number (%)	Number (%)
Rural	49 (46.7)	56 (53.3)	105 (13.4)
Urban	296 (43.5)	384 (56.5)	680 (86.6)
Total	345 (43.9)	440 (56.1)	785 (100.0)
Religion			
Muslim	307 (43.7)	396 (56.3)	703 (89.6)
Non- Muslim	38 (46.3)	44 (53.7)	82 (10.4)
Gender			
Male	229 (42.4)	311 (57.6)	540 (68.8)
Female	116 (47.3)	129 (52.7)	245 (31.2)
Marital status			
Currently married	198 (50.6)	193 (49.4)	391 (43.4)
Currently single	147 (37.3)	247 (62.7)	394 (56.6)
Age (in years)			
< 20	16 (51.6)	15 (48.4)	31 (3.9)
20 - 25	122 (39.5)	187 (60.5)	309 (39.4)
25 - 30	15 (25.0)	45 (75.0)	60 (7.5)
30 - 45	51 (38.6)	81 (61.4)	132 (16.9)
45+	141 (55.7)	112 (44.3)	253 (32.3)
Education			
Illiterate	11 (50.0)	11 (50.0)	22 (2.8)
Primary	30 (60.0)	20 (40.0)	50 (6.4)
Secondary	55 (47.4)	61 (52.6)	116 (14.8)
Graduate	200 (41.7)	280 (58.3)	480 (61.1)
Post graduate	49 (41.9)	68 (58.1)	117 (14.9)
Occupation			
Agriculture	6 (30.0)	14 (70.0)	20 (2.5)
Business	35 (50.0)	35 (50.0)	70 (8.9)
Service	70 (39.1)	109 (60.9)	179 (22.8)
Retired	19 (46.3)	22 (53.7)	41 (5.2)
Housewife	65 (64.4)	36 (35.6)	101 (12.9)
Student	141 (39.9)	212 (60.1)	353 (45.0)
Others	9 (42.9)	12 (57.1)	21 (2.7)

Habit of taking process food			
Yes	171 (40.3)	253 (59.7)	424 (54.0)
No	174 48.2	187 51.8	361 46.0
Income (in 000 taka)			
< 10	24 (28.9)	59 (71.1)	83 (10.6)
10 - 20	31 (37.8)	51 (62.2)	82 (10.4)
20 - 30	24 (38.7)	38 (61.3)	62 (7.9)
30 - 40	22 (43.1)	29 (56.9)	51 (6.5)
40 - 60	20 (51.3)	19 (48.7)	39 (5.0)
60+	31 (47.7)	34 (52.3)	65 (8.3)
No income	193 (47.9)	210 (52.1)	403 (51.3)
Change of food habit			
Yes	179 (43.1)	236 (56.9)	415 (52.9)
No	166 (43.9)	204 (56.1)	370 (47.1)
Intake of restaurant food			
Yes	144 (42.2)	197 (57.8)	341 (43.4)
No	201 (45.3)	243 (54.7)	444 (56.6)
Smoking habit			
Yes	49 (39.2)	76 (60.8)	125 (15.9)
No	296 (44.8)	364 (55.2)	660 (84.1)
Physical work			
Yes	164 (39.9)	247 (60.1)	411 (52.4)
No	181 (48.4)	193 (51.6)	374 (47.6)
BMI			
Underweight	6 (23.1)	20 (76.9)	26 (3.3)
Normal	27 (33.3)	54 (66.7)	81 (10.3)
Overweight	173 (43.5)	225 (56.5)	398 (50.7)
Obese	139 (49.6)	141 (50.5)	280 (35.7)

Table 1: Distribution of adults according to different socioeconomic variables and prevalence of diabetes.

The maximum (39.4%) respondents were of age 20 - 25 years. Among this group the prevalence rate of diabetes was 39.5 percent the next bigger group of respondents (32.3%) were of age 45 years and above and prevalence rate among them was 55.7 percent. Higher prevalence rate (51.6%) was also observed among the respondents of age less than 20 years. The differentials in prevalence rates among investigated units of different age groups were significant ($\chi^2 = 27.757$, p-value = 0.000). The coefficient of association was 0.185. The odd ratio 2.02 indicated that the chance of prevalence among adults of age 45 years and above was almost double than that of adults of other age groups. This chance was smaller for the adults of lower age groups (odd ratio =1.61 for the adults of age group 30 years and above). Though 51.6 percent respondents of age less than 20 years were diabetic patients, their chance to be exposed to diabetes was 38 percent more than the adults of other age groups (O.R.= 1.38). Again, this risk was less (O.R.= 0.74) for the respondents of age group 20 to 25 years compared to adults of other age groups.

Among the respondents 49.8 percent were currently married and 50.6 percent of them were diabetic patients. The prevalence rate was 0.373 among the adults who were living single. This variation in prevalence rates was significantly different for the variation in marital status ($\chi^2 = 15.234$, p-value=0.000). The coefficient of association was 0.138. The odd ratio 1.72 indicated that the currently married adults had more chance to be of diabetic patients by 72 percent.

Most of the investigated adults were graduate (61.1%) and prevalence of diabetes among them was 41.7%. There were 9.2 percent adults who were educated up to primary level. The prevalence rate among them was 0.569. However, change in level of education was not significantly associated with the change in prevalence of diabetes ($\chi^2 = 7.34$, p-value = 0.119). The coefficient of association between level of education and prevalence of diabetes was 0.096. The odd ratio 1.78 indicated that those who were educated up to primary level were more exposed to diabetes by 78 percent compared to the rate of exposed to diabetes by the adults of other levels of education. The post graduate adults were almost similarly exposed to prevalence of diabetes in comparison with exposure of adults of other levels of education (O.R. = 0.90). But the graduate adults were less exposed to prevalence of diabetes (O.R. = 0.69).

Majority (45.0%) of the respondents were students. The rate of prevalence of diabetes among them was 0.399. The next higher group of respondents were (22.8%) servicepersons and 39.1 percent of them were diabetic patients. The percentage of adult housewives was 12.9 and 64.4 percent of them were diabetic patients. The prevalence rates varied significantly with the variation of occupation of the adults ($\chi^2 = 28.804$, p value = 0.000). The coefficient of association of occupation and prevalence of diabetes was 0.172. Compared to the adults of different professions the housewives were 161% more exposed to diabetes. This was observed from the result of odd ratio, O.R = 2.61. The retired persons were also at higher risk of diabetes compared to the risk of different other professional groups (O.R = 1.11). Similar was the case for business persons (O.R.= 1.31).

The percentage of respondents without income was 51.3. Among them 47.9 percent were diabetic patients. The highest prevalence rate (51.3%) was observed among the respondents having income (40 - 60) thousand taka (Bangladesh currency). The lowest prevalence rate was noted among the adults who had income less than 20 thousand taka. There was significant association between level of income of the respondents and prevalence of diabetes ($\chi^2 = 13.339$, p value = 0.038). The coefficient of association was 0.129. The odd ratio 1.39 indicated that those who had no income were at more risk of prevalence of diabetes by 39 percent compared to the risk of respondents of other income groups. Lower income (< 20 thousand) group of respondents were at lower risk of diabetes (O.R.= 0.57) compared to the risk of adults of other income levels. Highest income group of adults (60 thousand and above) were also at higher risk of prevalence of diabetes by 18 percent compared to the adults of other income levels (O.R.= 1.18).

Among the investigated adults 52.9 percent reported that their food habit was changed. But change of food habit had no influence on prevalence of diabetes ($\chi^2 = 0.238$, p - value = 0.625). The coefficient of association was 0.017. The odd ratio 0.93 indicated that the change of food habit did not increase the risk of prevalence of diabetes. Again, 43.4 percent adults reported that they were habituated in taking restaurant food and 42.2 percent of them were diabetic patients. But prevalence of diabetes was independent of habit of taking restaurant food ($\chi^2 = 0.724$, p - value = 0.395). The coefficient of association was 0.03. The odd ratio 0.98 also indicated that the risk of prevalence of diabetes was almost similar for the adults irrespective of habituated or not habituated in taking restaurant food. Similar was the case with habit of smoking. There were 15.9 percent smokers and 39.2 percent of them were diabetic patients. However, smoking habit was not associated with prevalence of diabetes ($\chi^2 = 1.361$, p - value = 0.243). Smokers were not more exposed to prevalence of diabetes (O.R. = 0.79). However, there was significant association between prevalence of diabetes and habit of taking process food ($\chi^2 = 4.902$, p -value = 0.027). The coefficient of association was 0.079. But the odd ratio 0.73 did not indicate that the intake of process food created the extra problem for diabetes.

The level of obesity was significantly associated with prevalence of diabetes ($\chi^2 = 12.026$, p - value = 0.007). The coefficient of association was 0.123. The percentage of overweight and obese adults was 86.4. Among the obese adults 49.6 percent were diabetic patients and this group of adults were 43 percent more exposed to diabetes (O.R. = 1.43).

Discriminant analysis

The results presented above provided the evidence that some of the socioeconomic characteristics were significantly associated with prevalence of diabetes. This association indicated that a particular socioeconomic variable enhanced the prevalence of diabetes and due to this variable the adults were at more risk of prevalence of diabetes. For example, obesity enhanced the risk of diabetes. At this stage one might be interested to detect the most responsible variable for prevalence of diabetes. The detection of such responsible variable can be done by discriminant analysis. From the discriminant analysis (Table 2) it was noted that the most responsible variable for discrimination between diabetic and non-diabetic adults was marital status followed by BMI, income and age. This was observed from the absolute value of correlation coefficient of the discriminant function score and a variable. The analysis was significant as Wilks $\Lambda = 0.824$ and the corresponding $\chi^2 = 61.106$ with p - value = 0.000.

Variable	Coefficient of function	Correlation coefficient	Variable	Coefficient of function	Correlation coefficient
Residence	-0.075	-0.075	Income	0.645	0.423
Religion	0.081	0.058	Food habit	0.005	0.061
Gender	-0.108	0.161	Restaurant food	-0.039	0.106
Marital status	-0.594	-0.464	Process food	0.178	0.277
Age	0.151	0.404	Smoking habit	0.111	0.146
Education	-0.310	-0.273	Physical work	0.317	0.300
Occupation	0.204	0.001	BMI	0.339	0.458

Table 2: Results of discriminant analysis.

Discussion

The present analysis was done to discriminate between diabetic and non-diabetic adults of 18 years and above using the data recorded from 785 adults living in both urban and rural areas of Bangladesh. Most (86.6%) of the respondents were from urban area and a big group (43.5%) of them were diabetic patients. The percentage of rural diabetic patients was 46.7. However, these prevalence rates were statistically similar. Prevalence of diabetes was noted statistically similar irrespective of religion and gender of the adults. These phenomena of prevalence of diabetes were reported in other studies also [14,15]. Higher prevalence rate (55.7%) was observed among the adults of age 45 years and above. Similar findings were reported in both home and abroad [15,22,33]. The risk of prevalence was increasing with the increase in age. The adults of age 45 years and above had 60 percent more risk [34] to be diabetic. The risk of currently married adults was more than the risk of currently single adults (R.R = 1.32). Similar result was reported earlier [18]. It was reported that low level of education was a risk factor for prevalence of diabetes [7]. The present analysis also provided the similar information as the risk ratio was 1.70 for the adults educated up to primary level. But the overall prevalence rates were not statistically different for the adults of different levels of education. The prevalence rate of diabetes was highest (64.4%) among housewives followed by the rate of business persons (50%) and retired persons (46.3%). This rate was lowest (30.0%) among farmers. Their risk ratio was also less (0.58) which indicated

that the farmers were not at the risk of diabetes. But for the business persons the risk of diabetes was around 57 percent more compared to the risk of other professionals (R.R = 1.57). Upward social mobility of adults in respect of occupation pushed them towards diabetes. This phenomenon was reported in another study [18]. Among the investigated adults majority (51.3%) had no income. But for them the risk of diabetes was 17 percent more (R.R = 1.17) compared to that of adults of other income groups. Similar result was reported abroad [12]. Again, higher income group of adults were (income 40 thousand taka and above) 13.3 percent and prevalence rate among them was 49 percent. For this group the risk of diabetes was higher (R.R = 1.23) compared to the risk of adults of other income levels. Similar result was reported in another study [18].

The change of food habit, habit of taking restaurant food and smoking habit of the adults had no significant impacts on prevalence of diabetes. But non-involvement of adults in physical activities enhanced the rate of prevalence. This group were at more risk of diabetes by 20 percent compared to the risk of adults who were doing some physical activities (R.R = 1.20). Similar finding was reported in other studies [16,17]. The habit of taking process food was not independent of prevalence of diabetes. But the risk ratio 0.86 did not provide any evidence which was unfavorable for the adults who were taking processed food. This analysis also provided the information that level of obesity and prevalence of diabetes were significantly associated. Similar results were reported in both home and abroad [18-22]. The risk of prevalence of diabetes among overweight and obese adults was 9 percent more compared to the risk of adults who were not obese.

There was significant difference between diabetic and non-diabetic adults in respect of some of the socioeconomic variables. The most responsible variable for this difference was marital status followed by BMI, income and age.

Conclusion

The study was planned to identify some socioeconomic variables responsible in discriminating some diabetic and non-diabetic adults of age 18 years and above living in rural and urban areas of Bangladesh. It was observed that in respect of marital status, body mass index, income and age the diabetic and non-diabetic adults were significantly different. It was evident from the results of higher absolute values of correlation coefficients of the variables and discriminant function score. The most responsible variable for discrimination was marital status. Married adults were 72% more exposed to the prevalence of diabetes. Obese adults had 43% more chance to face this health problem. The adults of age 45 years and above were more than two times exposed to the prevalence of diabetes. Beside these variables, lower level of education, being housewife, and lower income level were the influencing variables for this health hazard.

The effects of diabetes mellitus include long term damage, dysfunction and failure of various organs. It is also associated with health hazard such as gangrene, blindness, kidney failure [12-15] and also with some other non-communicable diseases. According to different studies [18-21] it was observed that Asia and Eastern Pacific regions were particularly affected due to these diseases. Bangladesh belongs to these regions and hence non-communicable diseases including diabetes are the major health burden for the people of Bangladesh.

Therefore, attention is to be focused

- (i) To halt the rise in diabetes by encouraging people to participate in blood screening programs regularly,
- (ii) To encourage people to be involved in either some sorts of physical activities or to do some physical exercises,
- (iii) To motivate people so that they can avoid sedentary entertainment and unhygienic activities,
- (iv) To motivate the urban people to walk a while or they can be encouraged not to avail the vehicles in their movement towards their working place, if it is within walking distance,

- (v) To encourage people so that they can give up smoking habit and habit of taking fast food and high calorie food from restaurant.

The health authority can play a decisive role to implement the above suggested steps.

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