European Journal of Medical and Health Sciences
Vol 6 | Issue 6 | November 2024
ISSN 2593-8339

RESEARCH ARTICLE

Identification of Responsible Socioeconomic Variables for Prevalence of Retinopathy in Obese-Diabetic Adults

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ABSTRACT

This study analysed data collected from 995 adults aged 18 years and above in Bangladesh. The analysis was performed to identify the variables responsible for the prevalence of retinopathy in obese-diabetic adults. There were 30.2% obese adults, 67.0% diabetic patients, and 12.4% patients with retinopathy. All these non-communicable diseases were noted in 4.7% of the adults. This same rate was noted in males and females also. A higher prevalence rate was found in secondary educated adults (7.6%), adults of families of upper medium income (9.8%), adults of optimum blood pressure (6.3%), and patients with diabetes for longer periods (12.7%). The risks of prevalence for secondary educated adults, adults belonging to upper-medium income groups of families, adults with optimum blood pressure, and diabetic patients of longer duration were 1.99, 2.24, 2.20, and 3.08 times, respectively. All 4.7% of the patients were obese. Logistic regression analysis revealed that age, smoking habits, blood pressure, body mass index, and duration of diabetes were the identified variables responsible for the prevalence of retinopathy in obese-diabetic adults.

Submitted: October 04, 2024

Published: November 15, 2024

10.24018/ejmed.2024.6.6.2220

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Keywords: Diabetes, logistic regression, obesity, retinopathy.

1. Introduction

Overweight and obesity result from excessive energy intake, but less energy expenditure; hence, excessive fat accumulation occurs in the body. This occurs when a person habituates consuming processed food containing more sugar, salt, and fatty acids. Consequently, the person faces the problem of many non-communicable diseases, especially, diabetes, hypertension, cardiovascular diseases, kidney diseases, retinopathy, etc., [1]–[8]. The prevalence of overweight and obesity and its associated diseases is in increasing trend in many countries, specially, in developed countries over the last decades due to upward mobility in economy and social status, and the problem has shifted towards lower socioeconomic groups of people [9]–[14]. Some of the problems induced by obesity have been reported in various studies in Bangladesh. These are simultaneous prevalence of obesity-diabetes, obesity-heart disease, obesity-kidney diseases, obesity-retinopathy, obesity-hypertension, obesity-disability [9]–[25]. The number of patients with these diseases is increasing daily as the number of obese people is increasing worldwide. The World Health Organization reported that approximately 2.5 billion adults aged 18 years and above worldwide were overweight, and 890 million of these were obese [1], [18]. Obesity also enhances diabetes and other non-communicable diseases. Currently, the number of diabetic patients aged 20–79 years is approximately 579 million worldwide. This number is predicted to increase to 643 million by 2030 and 783 million by 2045 [19]. A study in Bangladesh showed that there were 13.5% obese-diabetic adults [20]. Again, high blood pressure increases the risk of developing type-2 diabetes [21]. Poor and uncontrolled hypertension have also been reported to be the causes of diabetic retinopathy [22], [23].

It was reported that at least 2.2 billion people have a near, or distance vision impairment and the problem is in increasing trend with the increase in ages of people [24]. Except age, other socioeconomic factors responsible for prevalence of diabetic retinopathy are gender, economic status, marital status, sedentary activity, obesity, hypertension, habit of taking process food, and duration of diabetes [23]. In this study, an attempt was made to identify the responsible socioeconomic variables which were enhancing the prevalence of retinopathy among obese and diabetic patients.

2. Materials and Methods

The analysis presented here aimed to identify some socioeconomic variables using the data collected from 995 adults aged 18 years and above. Data were collected by nurses and medical assistants working in diagnostic centres in Bangladesh's urban and semi-urban areas. The adults were interviewed during the 2018–2019 session when they visited diagnostic centres for blood and urine screening tests.

It was decided to collect the data from 50.1% males and 49.9% females to maintain the sex ratio of the country, which was 50.1:49.9 during the study period [25]. Thus, we included 498 males and 497 females in the sample. The collected data were related to different socio-demographic characteristics along with information on suffering from different diseases and the treatment stages of those diseases. Information was recorded from all investigated adults using a pre-designed and pre-tested questionnaire. The recorded data included residence, religion, marital status, age, education, occupation, family income, family expenditure, smoking habits, sedentary activity, physical work, food habits, blood pressure, fasting blood sugar, duration of diabetes, duration of suffering from other diseases, and stage of treatment by the registered medical practitioner/rural medical assistants. Some data were qualitative, and some information was noted by quantity. During the analysis, all the variables were noted on a nominal scale. Before using a nominal scale, the variables of age, economic condition, blood pressure, body mass index, and duration of diabetes were expressed in classes. There were four groups of respondents, according to their age. The age intervals of the four groups were less than 25 years, 25 to less than 40 years, 40 to less than 50 years, and 50 years and above. The economic conditions of the families were determined as lower if the monthly income in Taka. (Tk.) (if income of a family was <Tk. 50 thousand and expenditure was <Tk. 40 thousand), medium (if income was Tk. 50–100 thousand and expenditure was between Tk. 40 = <80 thousand), upper-medium (if income was 50–100 thousand taka and expenditure was between Tk. 80 = < 100 thousand Taka) and higher (if income was Tk. 150 and above and expenditure was Tk. 120 thousand and above). According to body mass index (BMI; weight in kg divided by height in meters), respondents were divided into four groups. These groups were underweight if (BMI < 18.5), normal if (18.5 < BMI < 23.0), overweight if (23.0 < BMI < 27.5) and obese if (BMI ≥ 27.5) [26]. The investigated adults were classified into four groups according to their level of blood pressure (BP, mmHg). The first group was of optimal blood pressure (BP < 120/80), the second group was of normal blood pressure (BP < 130/85), the third group was of high normal blood pressure (BP < 140/90), and the fourth group was of hypertensive blood pressure (BP ≥ 140/90) [27], [28]. There were five groups of adults according to the duration of diabetes. The first group was free of diabetes; the duration of diabetes in the second group was <5 years; the duration was 5 to less than 10 years for the third group; it was 10 to less than 15 years for the fourth group, and those who were suffering for 15 years and above belonged to the fifth group.

The study variable was the prevalence of retinopathy in obese adults with diabetes; 47 (4.7%) were adults possessing this characteristic. The influence of any of the socioeconomic variables on the prevalence of the study variable was observed by fitting a logistic regression model [29]–[32]. A significant coefficient of a variable noted in fitting the model indicated that the variable was influential in enhancing the prevalence rate of retinopathy in obese-diabetic adults. According to the study's objective, the association of the study variables with other socio-demographic variables was investigated. Irrespective of the significance of the association, the responsible level of a variable for the prevalence of the study variable at a higher rate was also identified by calculating the risk ratio (R.R.) along with confidence interval (CI) [33], [34].

3. Results

The investigated adults were 995. 4.7% of them suffered from obesity, diabetes, and retinopathy simultaneously. There were 53.4% rural and 46.6% urban adults. The prevalence rate of these three diseases in each group of respondents was 4.7%. Thus, the risk of prevalence of the diseases for both urban and rural people was the same (R.R. = 1.00, CI: [0.57, 1.75]). There were no differences in the prevalence rates between urban and rural people (χ^2 = 0.001, p-value = 0.980]. The Muslim respondents in the sample were 85.2%; among them, the prevalence rate was 4.8%, against an overall rate of 4.7% in all respondents. The risk of prevalence for Muslim respondents was 18% higher than it was for non-Muslim respondents (R.R. = 1.18, CI: [0.51], [2.73]). Table I illustrates that the prevalence of the diseases under consideration was independent of religion ($\chi^2 = 0.158$, p-value = 0.691). Female respondents were 49.9% of the sample. The prevalence rate was 5.4%, which was slightly higher than that of all the respondents. However, rates in males and females were not significantly different, although females had 35% higher risk of prevalence (R.R. = 1.35, CI: [0.77], [2.37]; χ^2 = 1.109, p-value = 0.292). There were 40.3% of adults in the age group 25 years but less than 40 years, the prevalence rate was 6.5%. The prevalence risk was 83% higher in adults than in adults of other age groups (R.R.= 1.83, CI: [1.04], [3.21]). The lowest prevalence rate (1.5%) was noted in elderly people aged 50 years and above. The second lowest rate (4.4%) prevailed in adults aged 40 years but less than 50 years. However, differential prevalence rates in adults of different age groups were insignificant (χ^2 = 7.202, p-value = 0.066). The percentage of married adults was 93.1, and 5.0% of them were suffering from obesity-diabetes-retinopathy. The prevalence risk for these married adults was 3.43 times compared to that for single adults (R.R. = 3.43, CI: [0.48], [24.49]). However, marital status was independent of the disease prevalence ($\chi^2 = 1.766$, p-value = 0.184). Secondary level educated adults in the sample were 23.8%; their prevalence rate was 7.6%. This rate was higher, although not significantly, than that in all adults (χ^2 = 5.806, p-value = 0.121). However, secondary-level educated adults had a 99% higher prevalence risk than the others (R.R. = 1.99, CI: [1.12], [3.52]). The lowest prevalence rate (3.1%) was observed in illiterate adults,

followed by the rate observed in higher-educated adults (3.8%). The percentage of retired adults was 12.3, with a prevalence rate of 6.6, which was higher than that of all respondents. Lower prevalence rates were noted in farmers (3.8%), businesspeople (4.3%), and service personnel (4.6). Retired individuals had a 47% higher prevalence risk than others (R.R. = 1.47, CI: [0.70], [3.07]). However, the prevalence rates in adults in different occupational groups were not significantly different ($\chi^2 = 1.209$, p-value = 0.877).

The sample of smokers was 33.1%, and the prevalence rate was 3.3%. This rate was lower than that in nonsmokers (5.4%). The risk of prevalence among smokers was only 0.62.

This risk was higher among nonsmokers (R. R. = 1.62, CI: [0.84], [3.14]). However, smoking habits were independent of the prevalence of retinopathy-obesity-diabetes (χ^2 = 2.080, p-value= 0.149). The percentage of respondents involved in sedentary activity was 44.4; the prevalence rate among them was 5.0%. This rate was 4.5% among adults who were not involved in sedentary activities. These two rates were not significantly different ($\chi^2 = 0.114$, p-value = 0.736). The prevalence risk for adults in sedentary activity was 10% more than for other adults (R.R. = 1.10, CI: [0.63], [1.92]). The percentage of respondents habituated to taking processed food was 36.5; the prevalence rate was 5.8. The risk of prevalence of the diseases in them was 41% higher than the risk for adults who were not habituated to taking processed food (R.R. = 1.41, CI: [0.80], [2.47]). The prevalence rate of the diseases in adults not habituated to taking processed food was 4.1%. The two prevalence rates were statistically similar ($\chi^2 = 1.431$, p-value = 0.232). There were 51.7% physically inactive adults; 5.3% of them were suffering from retinopathy-obesity-diabetes. For them, the risk of the prevalence of the disease was 26% more than that of physically active adults (R.R. = 1.26, CI: [0.72], [2.22]). The prevalence of the diseases was independent of physical work ($\chi^2 = 0.662$, p-value = 0.416).

There were 30.2% obese adults in the sample; all 47 patients of retinopathy-obesity-diabetes were obese. The level of body mass index was significantly associated with the diseases under study ($\chi^2 = 114.282$, p-value < 0.001). Blood pressure levels were significantly associated with the prevalence of the diseases, and the highest prevalence rate (6.3%) was noted in adults with optimum blood pressure ($\chi^2 = 7.896$, p-value = 0.048). They were 54.3% in the sample. For them, the prevalence risk was 2.20 times compared to the risk of other adults (R.R. = 2.20, CI: [1.17], [4.12]). The prevalence rate was significantly decreased with the increase in blood pressure. It was also observed that no hypertensive adults were suffering simultaneously from retinopathy-obesity-diabetes. The percentage of diabetic patients in the sample was 67.0. Most (29.2%) of them suffered for less than 5 years; the prevalence rate in them was 5.8%. This rate significantly increases with the increase in the duration of diabetes ($\chi^2 = 30.225$, p-value < 0.001). The highest prevalence rate (12.7%) was observed in patients aged 15 years and above. This group of adults were 7.1% of the sample. The risk of prevalence of the diseases was 3.08 times for this group of adults (R.R. = 3.08, CI: [1.55], [6.12]).

4. Results of Logistic Regression Analysis

The model was fitted to study the influence of socioeconomic variables on the simultaneous prevalence of retinopathy, obesity and diabetes. The prevalence of these three non-communicable diseases was considered a dependent variable fitting the model. The explanatory variables were residence, religion, gender, marital status, age, education, occupation, economic condition, smoking habit, the habit of taking processed food, the habit of doing physical work, involvement in sedentary activity, body mass index, blood pressure, and duration of diabetes. The fitted model was satisfactory, as observed as the analysis should—2loglikelyhood = 252.258 and Nagelkerke $R^2 = 0.377$. The detailed results were presented in Table II.

The results indicated that there was a significant influence of each of the variable's age, body mass index, blood pressure, duration of diabetes, and smoking habit on the prevalence of retinopathy in obese-diabetic patients. It was also noted, from the values of Exp (B), that the rate of prevalence would be higher with the increase in the level of body mass index and duration of diabetes in adults. The risk of prevalence would be higher with the increase in the number of smoker adults. The results also indicated that the chance of prevalence for a graduate urban Muslim married obese and hypertensive housewife of age 50 years belonged to a high economic group of family and who was suffering from diabetes for 15 years but physically inactive and habituated in smoking and processed food was 0.28.

5. Discussion

Association of obesity with diabetes-retinopathy was reported in both home and abroad [5], [16], [23], [35]–[42]. In one study, it was reported that retinopathy was increased with higher BMI, and a longer duration of diabetes was one of the risk factors of diabetes-retinopathy [43]. It was also reported that different kinds of obesity were associated with diabetic retinopathy in type-2 diabetic patients [44]. This analysis also indicated that the prevalence rate of diabetes retinopathy among obese adults was significantly high (15.7%), and this rate was very high compared to the overall prevalence rate (4.7%) among the sample adults.

The prevalence rate was the same in urban and rural adults, and it was the same for all adults. An insignificant higher prevalence rate was noted in Muslims, females, married persons, secondary educated adults and retired persons. However, a very high prevalence risk was observed for married and secondary-level educated persons. A high prevalence risk was noted for adults aged 25–40 years and for adults with upper-medium economic conditions. Lifestyle factors viz, smoking habit, food habit, physical inactivity, and involvement in sedentary activity were not the significant risk-creating variables for the prevalence of retinopathy in obese-diabetic adults. A significantly higher prevalence rate was observed in adults with optimum blood pressure and diabetic adults who were suffering for 15 years and above. The prevalence risk was also high for these two groups of people. However, the results of logistic regression analysis indicated that the smoking habit was also a risky factor for the prevalence of retinopathy in obese-diabetic adults.

TABLE I: Distribution of Adults According to Prevalence of Retinopathy among Obese-Diabetic Adults

Socioeconomic variables	Prevalence of retinopathy among obese-diabetic adults				Total	
	Yes		No			
	N	%	N	%	N	%
Residence						
Rural	25	4.7	506	95.3	531	53.4
Urban	22	4.7	442	95.3	464	46.6
Total	47	4.7	948	95.3	995	100.0
Religion						
Muslim	41	4.8	807	95.2	848	85.2
Non-Muslim	6	4.1	141	95.9	147	14.8
Gender						
Male	20	4.0	478	96.0	498	50.1
Female	27	5.4	470	94.6	497	49.9
Marital status						
Married	46	5.0	880	95.0	926	93.1
Single	1	1.4	68	98.6	69	6.9
Age (in years)						
<25	9	4.6	187	95.4	196	19.7
25–40	26	6.5	375	93.5	401	40.3
40–50	9	4.4	194	95.6	203	20.4
50+	3	1.5	192	98.5	195	19.6
Education						
Illiterate	2	3.1	63	96.9	65	6.5
Primary	5	4.1	116	85.9	121	12.2
Secondary	18	7.6	219	92.4	237	23.8
Higher	22	3.8	550	96.2	572	57.5
Occupation						
Farming	4	3.8	100	96.2	104	10.5
Business	10	4.3	224	95.7	234	23.5
Service	14	4.6	291	95.4	305	30.7
Retire	8	6.6	114	93.4	122	12.3
Housewife	11	4.8	219	95.2	230	23.1
Socioeconomic condition						
Low	17	4.4	368	95.6	385	38.7
Medium	21	5.0	403	95.0	424	42.6
Upper medium	6	9.8	55	90.2	61	6.1
High	3	2.4	122	97.6	125	12.6
Smoking habit						
Yes	11	3.3	318	96.7	329	33.1
No	36	5.4	630	94.6	666	66.9
Involvement in sedentary activity						
Yes	22	5.0	420	95.0	442	44.4
No	25	4.5	528	95.5	553	55.6
Habit of doing physical work						
Yes	20	4.2	461	95.8	481	48.3
No	27	5.3	487	95.7	514	51.7
Habit of taking process food						
Yes	21	5.8	342	94.2	363	36.5
No	26	4.1	606	95.9	632	63.5
Level of blood pressure (mmHg)						
Optimum	34	6.3	506	93.7	540	54.3
Normal	10	3.6	270	96.4	280	38.1
High normal	3	2.6	113	97.4	116	11.7
Hypertensive	0	0.0	59	100.0	59	5.9
Body mass index						
Underweight	0	0.0	38	100.0	38	3.8
Normal	0	0.0	233	100.0	233	23.4

TABLE I: Continued

Socioeconomic variables	Prevalence of retinopathy among obese-diabetic adults				Total	
	Yes		No			
	N	%	N	%	N	%
Overweight	0	0.0	424	100.0	424	42.6
Obese	47	15.7	253	84.3	300	30.2
Duration of diabetes (in years)						
Did not arise	0	0.0	328	100.0	328	33.0
<5	17	5.8	274	94.2	291	29.2
5–10	14	6.8	192	93.2	206	20.7
10–15	7	7.1	92	92.9	99	9.9
15+	9	12.7	62	87.3	71	7.1
Total	47	4.7	948	95.3	995	100.0

TABLE II: Results of Logistic Regression Analysis

Socioeconomic variable	Coefficient, B	Standard error, S.E	Wald statistic	*p*	Exp (B)
Residence	−0.334	0.393	0.723	0.395	0.716
Religion	−0.530	0.535	0.982	0.322	0.589
Gender	−0.376	0.465	0.656	0.418	0.689
Marital status	−0.991	1.141	0.753	0.386	0.371
Age	−0.153	0.029	27.305	0.000	0.858
Education	−0.160	0.223	0.515	0.473	0.852
Occupation	−0.103	0.164	0.396	0.529	0.902
Economic condition	−0.267	0.263	1.030	0.310	0.766
Smoking habit	1.099	0.464	5.163	0.018	3.001
Habit of taking process food	0.814	0.471	2.989	0.084	2.257
Habit of doing physical work	−0.214	0.492	0.188	0.664	0.808
Involvement in sedentary activity	−0.441	0.395	1.246	0.264	0.643
Body mass index	0.148	0.029	25.437	0.000	1.160
Blood pressure	−0.068	0.034	4.104	0.043	0.934
Duration of diabetes	0.389	0.056	48.497	0.000	1.475
Constant	3.140	2.907	1.167	0.280	23.099

6. Conclusion

The results presented in this paper were observed by analysing the data collected from 995 Bangladeshi adults 18 years and above. The objective of the analysis was to identify some socioeconomic variables responsible for the prevalence of retinopathy in obese-diabetic adults. Among the respondents, 30.2% were obese, 67.0% were diabetic patients, 12.4% were suffering from retina problems, 22.0% were suffering simultaneously from obesity and diabetes, and 4.7% were patients of retinopathy, including obesity and diabetes. The objective of the work was to identify the responsible variables for the prevalence of the disease in this last group of patients.

The disease's same prevalence rate (4.7%) was observed in both urban and rural adults.

The rates prevailed: 4.8% in Muslims, 5.4% in females, 5.0% in married persons, 7.6% in secondary level educated persons, 6,6% in retired persons, 6.5% in adults of age group 25–40 years, 9.8% in adults belonged to families of upper medium economic condition. The lowest rate (1.5%) prevailed in elderly people 50 years and above. A higher prevalence rate (5.3%) was noted in physically inactive adults, in adults habituated in processed food (5.8%), and in adults involved in sedentary activity (5.0%). However, none of these rates were significantly higher. A significantly higher rate was observed in adults with optimum blood pressure (6.3%) and in diabetic patients who were suffering for 15 years and above (12.7%); however, obesity, longer duration of diabetes and processed food consumption were the responsible variables for the prevalence of the disease.

The prevalence of obesity and diabetes cannot be avoided as the economy of the country and, hence, the lifestyle of the residents of the country are on an upward trend. As a result, the prevalence rate of non-communicable diseases induced by obesity-diabetes is increasing day by day. However, there should be attempts to avoid the complex situation generated by the simultaneous prevalence of non-communicable diseases. People should follow some basic rules to maintain a healthy and peaceful life. These are the suggested steps which can be followed to maintain a healthy life:

1. Everyone should try to be physically active by walking every day for some time.
2. Everyone should avoid sedentary activity as much as possible.
3. Urban and rural people should avoid restaurants and processed, salty, and high-calorie food.

4. Everyone should avoid smoking and drinking alcohol.
5. Everyone should be careful so that their body weight and body mass index do not exceed the normal level.
6. People should be careful to control their blood sugar and blood pressure.

Government and other health service providers can guide the citizen so that they can lead healthy life. The rural and urban economically backward class of people should be provided free health service.

Acknowledgment

The authors express sincere gratitude to all participants for their invaluable contribution and to the dedicated staff for their cooperation in data collection.

Author Contributions

AB contributed to the research design, analysis, and manuscript draft. KC contributed to data collection and analysis supervision and manuscript writing/editing.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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