

Factors Responsible for Prevalence of Diabetes Hypertension Among Bangladeshi Adults

Keshab C Bhuyan*

Department of Statistics, Jahangirnagar University, Dhaka, Bangladesh

ABSTRACT

The objective of the study was to identify some responsible variables for prevalence of diabetes hypertension among Bangladeshi adults of ages 18 years and above. For this purpose, 960 respondents were investigated from both urban and rural localities. Out of 960 adults, 145 were suffering simultaneously from diabetes and hypertension. Factors responsible for these diseases were identified by factor analysis. The same analysis was also done to identify some variables which were responsible for non-prevalence of diabetes hypertension among the remaining 845 respondents. Using the results of risk ratios and factor loadings the responsible factors were identified. It was evident that illiteracy, over age, marital status, lack of physical activity, sedentary activity and obesity were the responsible factors for the prevalence of diabetic hypertension. Smoking habit and habit of taking can food and restaurant food were enhancing the risk of the diseases. But factor analysis identified use of can food as the most responsible variable followed by family expenditure, family income and being male. The responsible variable for non-prevalence of the diseases were proper utilization of time, unmarried and lower age.

Keywords: Diabetes; Hypertension; Socioeconomic Variables; Risk ratio; Factor analysis

INTRODUCTION

Diabetes mellitus is an important component of non-communicable diseases and it is associated with cardiovascular diseases, retinopathy, heart diseases, kidney diseases and hypertension [1-4]. It was reported that type 2 diabetes played a role in developing hypertension [5] Again, the occurrence of diabetes and hypertension simultaneously doubles the risk of cardiovascular diseases compared to that of the people with non-diabetic hypertension [4,6]. Rate of prevalence of hypertension among diabetic patients was noted around three times more than that among people of non-diabetic hypertension [7].

Diabetes is the targeted disease by WHO as it has some social and economic consequences [8,9]. Accordingly, the problem is addressed to reduce the prevalence of the diseases. Still, declining trend in deaths due to diabetes is not observed [10]. This is true for both home and abroad [8,11]. It was reported that, approximately 463 million adults of ages 20-79 years worldwide were diabetic [12]. This figure will be increased up to 700 million in 2045. In a separate report, it was mentioned that

1 in every 5 diabetic patients were at the age above 65 years and 2 in every 3 were urban residents [13,14].

In one study, it was observed that 36.3% Bangladeshi urban adults were suffering from diabetes [15]. The prevalence of diabetes in adults of ages 20-79 years was 7.4 percent in Bangladesh [11,16]. According to IDF the prevalence will be 13 percent by 2030 [14].

It is clear from the above presented information that diabetes is one of the major problems of non-communicable diseases. Again, there were evidences that hypertension was associated with diabetes [2,7,17]. Thus, it needs to study the impacts of socioeconomic variables for diabetic hypertension among Bangladeshi adults. Accordingly, the specific objectives of the present study were

- to measure the risk of a particular level of any socioeconomic variable enhancing diabetic hypertension among Bangladeshi adults,
- to detect the most responsible variable for the prevalence of diabetic hypertension among adults.

*Correspondence to: Keshab C Bhuyan, Department of Statistics, Jahangirnagar University, Dhaka, Bangladesh, Tel: +880 1617-413984; E-mail: kcbhuyan2002@yahoo.com

Received date: July 15, 2020; Accepted date: August 20, 2020; Published date: July 27, 2020

Citation: Bhuyan KC (2020) Factors Responsible for Prevalence of Diabetes Hypertension Among Bangladeshi Adults. J Diab Metab. 11:851. doi: 10.35248/2155-6156.20.11.851

Copyright: © 2020 Bhuyan KC. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

METHODOLOGY

To complete the study according to the objective, 960 urban and rural Bangladeshi adults of ages 18 years and above were investigated by quota sampling technique. The targeted quota for investigation was 70 percent diabetic adults [18] so that the sample would contain sufficient number of patients of hypertension among diabetic adults. The data were collected by some doctors and nurses from their working places during the academic session 2017-18 by direct interview. For comparative study, a good number of normal subjects were also investigated. Finally, 642 diabetic patients and 318 normal subjects were found for interview and data were recorded from them through a pre-designed and pre-tested questionnaire.

The questionnaire contained different questions related to different socioeconomic variables of the respondents and of the families. The main questions for families were related to monthly family income and monthly family expenditure. The questions for the diabetic adults were related to the duration of disease, disease related health hazard, i.e. eye problem, kidney problem, heart problem, blood pressure, blood sugar, treatment stage of disease, admission into hospital, etc. Beside these, the other questions were related to personal habit, viz. food habit, working habit, physical activity, utilization of time, etc. The collected personal information were residence, religion, marital status, age, height, weight, education, and occupation. The value of each of the variable was noted in nominal scale. The data of weight (in kg) divided by Height (in metre²) was used to measure the value of body mass index (BMI) of each adult. The respondents were classified into 4 groups according to the value of BMI of them. An adult having BMI less than 20 (BMI<20) was included in underweight group, adult belonged to Normal group had BMI 20 but less than 25, overweight adult was identified when BMI \geq 25 but less than 30, if BMI \geq 30, the adult is considered obese.

According to the first objective of the study, association of any of the socioeconomic characteristics with prevalence of diabetic hypertension was examined. The prevalence of diabetic hypertension of any respondent was decided if diastolic blood pressure \geq 85 mmHg for him/her. Significant association was decided if probability of any Chi-square test statistic used for observing association \leq 0.05. Irrespective of significant or insignificant association, the risk ratio [R.R] along with its confidence interval (C.I) of prevalence of diabetic hypertension was calculated when prevalence rate was noted higher for adults of any particular level of socioeconomic variable. In fulfilling the second objective of the study, factor analysis was done. Important variable was detected if the absolute value of factor loading of a variable was highest [19-21]. Different statistics used in this paper were calculated using SPSS [Version 25].

RESULTS

Association of socioeconomic variables and prevalence of diabetic hypertension

Out of 960 respondents, 145 were patients of diabetes and hypertension simultaneously. Some of the remaining 815 adults were suffering from different diseases including diabetes.

On analysis, it was observed that there were 43.5 percent rural adults and 16.7 percent of them were the patients of diabetic hypertension. Percentage of urban diabetic hypertension patients was 13.8. The analytical results were presented in Table 1. Urban and rural adults were similarly suffering from the diseases [$P(\chi^2=1.557)=0.212$]. But R.R=0.83 {CI: 0.61, 1.12} indicated that rural and urban adults were alike in facing the problem of the diseases. Males (55.2%) and females (44.8%) were also suffering similarly [$P(\chi^2=0.512)=0.474$; R.R = 1.12; C.I { 0.83, 1.52}].

Table 1: Distribution of adults of different levels of socioeconomic variables and prevalence of diabetic hypertension.

Socioeconomic variables	Prevalence of diabetic hypertension				Total	
	Yes		No		N	%
	n	%	n	%		
Residence						
Rural	70	16.7	348	83.3	418	43.5
Urban	75	13.8	467	86.2	542	56.5
Total	145	15.1	815	84.9	960	100
Gender						
Male	84	15.8	446	84.2	530	55.2
Female	61	14.2	369	85.8	430	44.8
Religion						
Muslim	118	14.9	675	85.1	793	82.6
Non-Muslim	27	16.2	140	83.8	167	17.4
Marital status						
Currently married	113	16.9	557	83.1	670	69.8
Currently single	32	11	258	89	290	30.2
Age (in years)						
< 20	1	3.6	27	96.4	28	2.9
20 - 30	14	8.6	148	91.4	162	16.9

30 – 40	28	11.2	222	88.8	250	26
40 – 50	33	12.5	231	87.5	264	27.5
50+	69	27	187	73	256	26.7
Education						
Illiterate	11	20.4	43	79.6	54	5.6
Primary	22	19.1	93	80.9	115	12
Secondary	23	10	206	90	229	23.9
Higher	89	15.8	473	84.2	562	58.5
Occupation						
Agriculture and unskilled labor	34	13.3	221	86.7	255	26.6
Business and skilled labor	22	13.7	139	86.3	161	16.8
Service	27	12.7	186	87.3	213	22.2
Housewives and others	62	18.7	269	81.3	331	34.5
Income (in 000 taka)						
<40	51	16.4	260	83.6	311	32.4
40-60	30	15.9	159	84.1	189	19.7
60-80	29	15.7	159	84.3	188	19.6
80-100	18	11.3	142	88.7	160	16.7
100+	17	15.2	95	84.8	112	11.7
Smoking habit						
Yes	80	16.2	413	83.8	493	51.4
No	65	13.9	402	86.1	467	48.8
Family expenditure (in 000 taka)						
<30	17	14.7	99	85.3	116	12.1
30- 50	51	17.3	244	82.7	295	30.7
50-70	34	16.3	174	83.7	208	21.7
70-90	17	9.6	160	90.4	177	18.4
90+	26	15.9	138	84.1	164	17.1
Taking restaurant food						
Yes	65	17.5	306	82.5	371	38.6

No	80	13.6	509	86.4	589	61.2
Use of can food						
Yes	106	18.2	478	81.8	584	55.2
No	39	10.4	337	89.6	376	44.8
Obesity						
Underweight	8	9.4	77	90.6	85	8.9
Normal	62	13.6	394	86.4	456	47.5
Overweight	51	15.6	276	84.4	327	34.1
Obese	24	26.1	68	73.9	92	9.6
Utilization of time						
Academic activities	4	2.9	135	97.1	139	14.5
Reading and watching T.V.	27	11.2	214	88.8	241	25.1
Games and sports	29	11.7	218	88.3	247	25.7
Paper reading and use of mobile	50	20.1	199	79.9	249	25.9
Use of T.V. and mobile	35	41.7	49	58.3	84	8.8
Physical exercise						
No	103	16.9	506	83.1	609	63.4
Yes	42	12	309	88	351	36.6
Total	145	15.1	815	84.9	960	100

But males had 12 % more risk of suffering from diabetic hypertension compared to that of females. Similar results were also noted for both religious groups of adults. In the sample 82.6 percent adults were Muslim and 14.9 percent of them were suffering from the diseases. Percentage of non-Muslim respondents (17.4%) suffering from the diseases was 16.2 [$P(\chi^2=0.173)=0.673$; R.R=1.09, C.I{ 0.74, 1.60}]. For both groups the risk of the diseases was similar.

Percentage of ever married adults was 69.8 and prevalence of diabetic hypertension was noted among 16.9 % of this group. Among the single (30.2%) adults 11 percent was the patients of di the diseases . There was significant difference in the proportions of married and single adults.

[$P(\chi^2=5.367)=0.021$;R.R.=1.53;C.I.{0.93,2.51}] It was noted that 54.2 percent respondents were of ages 40 years and above and 19.6 percent of them were patients of diabetic hypertension. Prevalence rate of disease was in increasing trend with the increase in ages. Significant association between level of ages and prevalence of the diseases was observed [$P(\chi^2=40.578)=$

0.000]. The risk ratio 2.01 indicated that older people (ages ≥ 40 years) had more than two times of chance of facing the problem of this health hazard [R.R.=2.01, C.I { 1.44,2.80}].

It was noted that 94.4 percent respondents were at least primary educated. Only 5.6 percent adults were illiterate. This illiterate group was affected much (20.4%) by prevalence of the diseases. For them chance of facing problem was 38 percent more compared to that for other adults [R.R.=1.38; C.I.{1.00,2.01}]. Educated group was least affected. But level of education was not significantly associated with prevalence of the diseases [$P(\chi^2=7.43)=0.059$].

The respondents were classified in to 4 occupational groups, viz. (i) farmer and unskilled labour, (ii) business person and skilled labour, (iii) service person, and (iv) housewife, student and other [22]. Percentages of these 4 groups of adults were 26.6, 16.8, 22.2 and 34.5, respectively. Higher proportion (0.187) of fourth group was patients of these two diseases simultaneously. For them chance of facing this health hazard was 42 percent more compared to that for others [R.R.=1.42;C.I.{1.00,2.01}]. But level of occupation and prevalence of the diseases was not statistically significant [$P(\chi^2=5.259)=0.154$].

Majority (52.1%) adults belonged to families having monthly income taka less than 60 thousand. Prevalence of disease among adults of these families was more (16.2%) compared to that among adults of higher income group of families. However, the chance of affecting by the diseases was only 16 percent more [R.R.=1.16; C.I.{0.86,1.57}]. There was no significant association between level of income and prevalence of the diseases [$P(\chi^2=2.363)=0.669$]. Monthly family expenditure of 64.5 percent families was less than taka 70 thousand. Higher proportion (0.165) of adults of these families were affected by the diseases and for these adults the chance of facing the problem was 31 percent more compared to that of adults belonged to families spending more money [R.R.=1.31; C.I. {0.88, 1.95}]. But level of family expenditure and prevalence of disease was not statistically significant [$P(\chi^2=5.613)=0.230$].

It was observed that 38.6 percent adults were accustomed with restaurant food and 17.5 percent of them were experienced of prevalence of diabetic hypertension. For this group the chance of affecting by the diseases was 29 percent more [R.R.=1.29; C.I.{0.94,1.77}]. Another group of adults were higher in number (61.4%) but the problem of the diseases was prevailed among 13.4 percent of them. However, there was no significant association between habit of taking restaurant food and prevalence of diabetic hypertension [$P(\chi^2=2.753)=0.097$]. Though habit of taking restaurant food and prevalence of diabetic hypertension was not associated, but the scenery was different in case of habit of taking can food [23,24]. Those who were accustomed with can food (60.8%) 18.2 percent of them were patients of diabetic hypertension and for this group the risk of the diseases was 75 percent more compared to the risk of adults not habituated in can food [R.R.=1.75, C.I.{ 1.24,2.47}]. Habit of taking can food and prevalence of disease was significantly associated [$P(\chi^2=10.792)=0.001$]. However, smokers (51.4%) and non-smokers (48.6%) were similarly experienced of prevalence of the diseases [$P(\chi^2=0.997)=0.318$], though incidence of prevalence (16.2%) among smokers was

higher compared to that among non-smokers (13.9%). Smokers was at more risk by 17 percent [R.R.=1.17, C.I { 0.87,1.58}].

A big group of adults (609) were not involved in any physical labour and 16.9 percent of them were patients of diabetic hypertension. This figure was significantly higher compared to that of adults doing physical labour [$P(\chi^2=4.25)=0.039$]. Physical inactivity was the cause of 41 percent more chance of prevalence of the diseases among those who were not involved in physical labour [R.R.=1.41, C.I.{1.01,2.47}].

The respondents were classified into 4 groups according to level of obesity. A big group (47.5%) of adults were normal in respect of their body mass index and 13.6 percent of them were suffering from diabetic hypertension. This percentage was lower compared to that of overall percentage of affected persons. The lowest proportion (0.09) of affected persons was noted among underweight group of adults. Only 9.6 percent adults were obese. But prevalence rate of the diseases was higher among them (26.1%). Level of obesity was significantly associated with prevalence of the diseases [$P(\chi^2=11.672)=0.009$]. The obese group had 87 percent more chance of facing the problem of diabetic hypertension [R.R.=1.87; C.I.{1.28,2.74}].

A big group (34.7%) of respondents were engaged in sedentary activities. These activities were passing time by reading newspaper, viewing television, gossiping friends and relatives over mobile telephone after their normal daily activities. Prevalence of diabetes hypertension was observed among 25.5 percent adults of this group as against 9.6 percent of their counterpart. This differential in prevalence rate between two groups of adults was statistically significant [$P(\chi^2=72.272)=0.000$]. Diabetes hypertension was 2.67 times likely among adults involved in sedentary activities as in other adults [R.R.=2.67,C.I.{0.38,3.68}].

It was already mentioned that prevalence of diabetic hypertension was noted among 15.1 percent respondents. But all adults were not suffering for similar periods. Some were suffering for less than 5 years and some for 20 years and above. They were divided into 5 groups depending on duration of disease. Percentages of different groups were 58.6, 6.9, 13.1, 9.0 and 12.4 according to duration of disease < 5 years, 5 \leq 10 years, 10 \leq 15 years, 15 \leq 20 years and 20 years and above, respectively. These percentages were significantly different [$P(\chi^2=13.03)=0.000$].

Factor analysis

To detect the most responsible variable for the prevalence of diabetic hypertension factor analysis was done for both groups of adults separately. The variables included for the analysis were residence, religion, gender, marital status, age, education, occupation, family income, family expenditure, utilization of time, habit of taking restaurant food and can food, physical work, body mass index, smoking habit and duration of disease. But due to smaller value (0.40) of communalities some of the variables were dropped from the analysis [21]. It gave better result in explaining the variation in the data set (66.58%). The included variables were satisfactory as KMO=0.546 giving $\chi^2=614.536$, p-value=0.000. The final analytical results were

observed at third step of the analysis and these were shown in Table 2. The most responsible variable for the prevalence of diabetes hypertension was habit of taking can food followed by

family expenditure, family income and gender variation. It was concluded from the results of absolute values of coefficient.

Table 2: Results of factor analysis for both groups of adults.

Socioeconomic variable	Prevalence of diabetes hypertension				Non-prevalence of diabetes hypertension		
	Communality 1st	Communality, 3rd	Coefficient-1	Coefficient -2	Communality, 1st	Communality, 4th	Coefficient
Residence	0.133				0.086		
Religion	0.089				0.125		
Gender	0.743	0.843	-0.633	0.658	0.84		
Marital status	0.228				0.531	0.621	-0.788
Age	0.048				0.493	0.605	0.778
Education	0.386	0.342	0.529	-0.248	0.441		
Occupation	0.398	0.451	-0.258	0.608	0.549		
Income	0.764	0.965	0.653	0.734	0.899		
Expenditure	0.788	0.966	0.682	0.707	0.899		
Utilization of time	0.083				0.758	0.78	0.883
Restaurant food	0.169				0.104		
Can food	0.561	0.665	-0.75	0.32	0.772		
Physical work	0.283				0.431		
BMI	0.21				0.07		
Duration of disease	0.214				0.266		
Smoking	0.329				0.258		

The factor analysis was also done to detect the important variables for non-prevalence of the disease. Three important variables, viz. marital status, age and utilization of time were found out. This analysis was also satisfactory as $KMO=0.636$, $\chi^2=633.230$, $p\text{-value}=0.000$. The analysis explained 66.832% variation in the data set. The satisfactory results were found out at 4th step of the analysis.

DISCUSSION

The presented results, in this paper, were observed in analysing data collected from 960 respondents of ages 18 years and above residing in both rural and urban areas of Bangladesh. Data were recorded by some doctors and nurses from and nearby their working places by quota sampling plan to cover 70% diabetic patients [18] so that a sufficient number of hypertension patients (if blood pressure level ≥ 85 mmHg) were observed in the sample. Data were recorded from 66.9 percent diabetic

patients and 33.1 percent normal subjects. The overlapping percentage of diabetes and hypertensive patients was 22.6. These overlapping patients were 145 or 15.1 percent in the sample. Another group of respondents were 815. The analysis was done mainly to discriminate these two groups of adults and to detect the variables responsible for discrimination. As a first step of analysis, the association of diabetic hypertension with levels of each of socioeconomic variables was investigated. Because significant association between diabetes and hypertension was noted in earlier separate studies [2,7,17,18]. The present analysis indicated that these two diseases were significantly associated with marital status of adults, level of obesity of them, duration of disease, habit of taking can food and utilization of time by them. In earlier studies, hypertension was identified as risk factor for diabetic adults [4,25-27]. Though Diabetes is a lifestyle disease and disease of the rich [8], the present analysis did not signify any association between diabetes hypertension with income and expenditure of the families of adults. This study

indicated that diabetes and hypertension simultaneously were the risk factors for some adults of different socioeconomic conditions. Higher risk of the diseases among the adults of lower income group and higher expenditure group of families was noted. The risk of the diseases was also more among illiterate, married, elderly, obese physically inactive and adults involved in sedentary activities. This health problem was less likely among currently single adults [R.R.=0.65], younger adults [R.R.=0.50] and adults not involved in sedentary activity [R.R.=0.37].

However, habit of taking can food was most responsible variable for this health hazard. Because most of the can food, especially soft drinks and fruit juice, contain caffeine, higher amount of sugar and preservative. All these compounds are injurious to health. Moreover, sugar-based foods are not suitable for diabetic and pre-diabetic patients. The other important variables were family expenditure, family income and being male. The disease was not prevalent among currently single, younger and adults not involved in sedentary activity. This was observed from factor analysis [19-21].

CONCLUSION

The study was based on the analytical results of data recorded from 960 respondents living in urban and rural residences of Bangladesh. These respondents were of ages 18 years and above and 15.1 percent of them were the patients of diabetic hypertension. A big group (56.5%) of adults were the residents of urban area and 13.8 percent of them were suffering from the above-mentioned diseases. Percentage of rural adults of this category was 16.7. Percentages of non-Muslims, males, married persons, illiterate persons, housewives and others and obese adults were 17.4, 55.2, 69.8, 5.6, 34.5 and 9.6, respectively. Higher proportion of each of these groups of adults were suffering from diabetes and hypertension simultaneously. Each of the above-mentioned group of adults had more chance of affecting by the diseases. Physical inactivity, over age were the risk factors for the diseases. Duration of the diseases was the most responsible variable for the sufferings of the adults from diabetic hypertension. The other variables, viz. residence, religion, level of education, income, expenditure was not significantly associated with diabetic hypertension. Low income, and high expenditure were the social factors to enhance the prevalence of diabetic hypertension among the adults. This was noted from the results of the risk ratio. The other responsible variables for higher rate of prevalence of the diseases were habit of taking restaurant food, can food and lack of physical labour during leisure. Smokers also had higher chance of affecting by the diseases. The chance of the diseases among adults involved in sedentary activities was around 2.67 times likely compared to that among adults not involved in sedentary activities. From the results of risk ratio and factor analysis it was evident that prevalence of the disease was more among male, can food users, and physically inactive adults. Prevalence was not prominent among younger, currently single adults and adults not involved in sedentary activity.

Due to upward social mobility, [27] increased mechanical movement, and more involvement in economic activities,

prevalence of non-communicable diseases cannot be avoided. However, attempts can be made to reduce prevalence rate. This attempt can be made successful, if people can be alerted against the health hazard prevailed in the society and they can be encouraged to take some initiative to avoid the non-communicable diseases. The initiatives by the people should be in the following aspects:

- To take healthy and homemade food,
- To avoid can and processed foods as these contain unhygienic chemical compounds
- To avoid more sugar-based, salty and fatty food,
- To avoid smoking and drinking.
- To do some physical labour or at least try to do physical exercise regularly whenever possible,
- To avoid the increase in body weight,
- To join the blood screening programme,
- To adhere the lifelong medical therapy by the patients.

Health planners, social workers, and government health service providers can do a lot to make aware of the people about the health hazard prevails in the society. Illiteracy is the cause of many unhealthy conditions in the society. Social workers can encourage the people to get rid of this illiteracy.

REFERENCES

1. Cheung BM. The hypertension-diabetes continuum. *J Cardiovasc Pharmacol.* 2010;55:333-339.
2. Rahman M, Emdadul SS, Islam Md Jahidul, Mostafa Md Golam, Saadat ASM K. Association of socioeconomic status with diagnosis, treatment and control of hypertensive individuals in Bangladesh: a population-based cross-sectional study. *Jour Roy Soc Med.* 2015;610:1-11.
3. Tesfaye S, Chaturvedi N, Eaton SE, Ward JD, Manes C, Ionescu-Tirgo viste C. EURODIAB prospective complications study group: Vascular risk factors and diabetic neuropathy, N ENG. *J. Med.* 2005;352:341-350.
4. Sowers JR, Epstein M, Frohlich ED. Diabetes, hypertension and cardiovascular disease: an update, *Hypertension.* 2001;37:1053-1059.
5. Bernard MV, Cheung and Chao Li . Diabetes and hypertension: Is there a common metabolic pathway? *Curr Atheroscler Rep.* 2012;14:160-166.
6. Mahler RJ. Diabetes and hypertension. *Horm Metab Res.* 1990;22:599-607.
7. Sharma SK, Ruggenti P, Remuzzi G. Managing hypertension in diabetic patients - focus on trandola pril/verapamil combination. *Vase Health Risk Manag.* 2007;3:453-465.
8. Organization WH. Fact Sheets / detail/ obesity and overweight, February 2018.
9. Federation ID. Country estimates table, *Diabetes Atlas.* 6th edition, IDF. 2011
10. Hall JH, Brands DW, Henegar JR. Kidney function as a cause and a consequence of obesity hypertension. *Clin Exp Pharmacol Physiol.* 1998;25:58-64.
11. Bhuyan KC. Identification of factors responsible for diabetic heart disease among Bangladeshi adults. *ARC Jour Diab Endocrino.* 2019;5:1-8.
12. Kriska AM, Laporte RE, Patnick SL. The association of physical activity and diabetic complications individuals with insulin

- dependent mellitus: the epidemiology of diabetes complications study vii. *Jour Clin Epidemiology*. 1991;44:1207-1214.
13. Stengel B, Tarver-Carr ME, Powe NR, Eberhardt MS, Brancati FL. Lifestyle factors, obesity, and the risk of chronic kidney disease. *Epidemiology*. 2003; 14:479-487.
 14. Sarnale MJ. Cardiovascular disease complications in Chronic kidney disease. *Amer Jour of Kidney Diseases*. 2003;41:11-21.
 15. Federation ID. *Diabetes Atlas, 9th Edition*, IDF, Brussels, Belgium. 2019.
 16. Rabi DM, Edwards AL, Southern DA, Svenson LW, Sargious PN, Norton P, et al. Association of socioeconomic status and risk of diabetes related mortality with diabetes prevalence and utilization diabetes care services. *BMC Public Health Services Research*, 2006;6, 124.
 17. Redon J, Cifkova R, Laurent S. The metabolic syndrome in hypertension: European Society of hypertension position statement. *J Hypertension*. 2008;26:1891-1900.
 18. Fardus J, Bhuyan KC. Discriminating diabetic patients of some rural and urban areas of Bangladesh: A discriminant analysis approach. *Euromediterranean Bio Jour*. 2016;11:134-140.
 19. Bhuyan KC. *Multivariate Analysis and Its Applications*, New Central Book Agency (P) Ltd, 2004;India.
 20. Ruscio J, Roche B. Determining the number of factors to retain in an explanatory factor analysis using comparison data of known factorial structure. *Psychological Assessment*. 2012;24:282-292.
 21. Yotoka T. Some criteria for variable selection in factor analysis. *Behavior metrika*. 1983;13,31-45.
 22. Syed MS, Debra N, Muhammad HR, Musa R, Gul N. Assessing obesity and overweight in a high mountain Pakistani population. *Trop Med Int Health*. 2004;9:526-532.
 23. Bhuiyan D, Bhuyan KC. Discriminating Bangladeshi adults by non-communicable diseases. *Rehabilitation Science*. 2019;4:35-43.
 24. Akter S, Rahman MM, Sarah KA, Sultana S. Prevalence of diabetes and pre-diabetes and their risk factors among Bangladeshi adults: a nationwide survey. *WHO*. 2014;92:204-213.
 25. Abegunde DO, Staniole A. An Countris, WHO working paper. Geneva, World Health Organization, Department of Chronic Disease and Health Promotion. 2006.
 26. Saquib N, Saquib J, Ahmed T, Khanam MA, Cullen MR. Cardiovascular diseases and type II diabetes in Bangladesh: a systematic And type II diabetes in Bangladesh: a systematic review and meta-analysis of studies from 1995-2010, *BMC Public Health*. 2012;12:434.
 27. Bhuyan KC. Socioeconomic variables responsible for diabetic retinopathy among Bangladeshi adults. *BJSTR*. 2020;25:18829-18836.