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Research Article

# Socioeconomic Variables Responsible for Prevalence of Kidney Diseases in Patients of Diabetes Elevated Blood Pressure

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## Abstract

This study was an attempt to identify socioeconomic variables responsible for prevalence of kidney diseases in diabetic- elevated blood pressure patients observed in 995 adults of 18 years and above residing in both rural and urban areas of Bangladesh. There were 67% diabetic patients, 45.4% patients of elevated blood pressure, and 4.7% patients of kidney diseases. Among the investigated respondents 20 (2.0%) were suffering simultaneously from diabetes, kidney diseases and elevated blood pressure. Eighty percent of these patients' group were from rural area and prevalence rate in them was 3.0%. This rate was significantly higher compared to the prevailed rate in urban adults (0.9%). The rural people had 3.5 times risk of prevalence of the diseases under consideration. Males, married persons, elderly people of age 40 to less than 50 years, secondary level educated adults, adults of upper medium economic condition, and diabetic patients of early stage had also higher risk of prevalence. However, residence and duration of diabetes discriminated the patients' group from other adults.

**Keywords:** Diabetes; Discriminant Analysis; Elevated Blood Pressure; Kidney Diseases; Risk Ratio; Socioeconomic Variables

## Introduction

The two most common non-communicable diseases are obesity and diabetes and these two are more prevalent among people of any age group, though it is very common disease among elderly people and are the sources of many other non-communicable diseases, viz. cardiovascular diseases, retinopathy, heart diseases, kidney diseases, and hypertension, etc. [1-6]. Obesity and diabetes are two interrelated NCDs and the number of diabetes cases are in increasing trend everywhere [7-13]. The death rate due to NCDs are also in increasing trend in the worldwide [6]. WHO in 2023 [6] reported that the deaths due to NCDs were 41 million each year and this death was equivalent to 74% of all deaths worldwide. WHO also reported that every year 17 million people had died of NCDs before reaching the age 70 years and 86% of this death occurred in low-and-medium income countries and these countries were also experienced of 77% death of NCDs. Among these deaths the number of deaths due to diabetes including kidney diseases were 2.0 million. Diabetes was the direct cause of 1.5 million deaths and 48% of all deaths due to diabetes occurred before the age 70 years [14]. The number of deaths due to diabetes was 537 million in 2021; the figure will be 643 million in 2030, 783 million in 2045, and 1.3 billion in 2050 [15].

The leading cause of kidney disease is type 2 diabetes. Leading cause of chronic kidney disease [CKD] is type 2 diabetes, and CKD is common affecting 13% of the adult population globally [16,17]. The incidence of CKD as a result of type 2 diabetes worldwide in 2017 had increased 74% compared with 1990 [18,19]. The increasing trend still exists in different countries [20]. Current estimate of kidney disease patients was more than 850 million people worldwide [21,22]. The burden of chronic kidney disease is more in low and middle-income countries [23]. This burden becomes more if the patients suffer simultaneously from diabetes and kidney diseases. Usually, diabetes kidney diseases [DKD] develop among 20-50% diabetic patients worldwide [24]. DKD is the leading cause of CKD and end stage of kidney disease and it is closely associated with risk of cardiovascular disease, heart attack, and heart failure [24-28]. Prevalence of DKD is increasing rapidly in low-and-middle

countries [27]. The problem is acute among rural people, poor people, farmers, and among smokers [8,22,29,30].

The elevated blood pressure is the most common modifiable risk factor for premature cardiovascular disease, and it coexists with other risk factors of heart disease and diabetes is one of the causes of elevated blood pressure [31-45]. It seems that diabetes, kidney disease, and elevated blood pressure/hypertension are interrelated non-communicable disease and the risk factors of these disease are residence, age, occupation, economic condition, and duration of diabetes [30-32]. The present study was an attempt to identify the responsible socioeconomic variables for the prevalence kidney diseases among patients of diabetic - elevated blood pressure.

## Materials and Methods

To fulfil the objective of the study an analysis was performed using the data collected from 995 adults of ages 18 years and above. These adults were residing in both urban and rural areas of Bangladesh. They were visiting an urban diagnostic center and a semi-urban diagnostic center with an objective of screening test of their blood and urine. The visiting adults were the respondents of this study and data were collected from those who were agreed to provide the information on socioeconomic characteristics of them. They were interviewed by some nurses and medical assistants working in those centers. The provided information of each adult was recorded in pre-designed and pre-tested questionnaire. The survey work was completed during the academic session 2018-19.

During the survey session the sex ratio of the country was 50.1: 49.9 [46]. Accordingly, the data were recorded from 50.1% males and 49.9% females. Thus, the number of male and female respondents were 498 and 497, respectively. Socio-demographic data and information on health conditions of respondents including treatment stage of them by medical practitioners and/or by rural medical assistants were recorded. All the data, except age, income, expenditure, duration of suffering from the disease, were qualitative variable. The qualitative variables were recorded in nominal scale for ease of analysis. The qualitative variables age and duration of diabetes were finally measured in classes. The classes of age were less than 25 years, 25 to less than 40 years, 40 to less than 50 years, and the last class was 50 years and above. The classes of duration of diabetes were less than 5 years, 5 to less than 10 years, 10 to less than 15 years, and another class was of ages 50 years and above. The economic condition of each family was evaluated depending on their monthly income and monthly expenditure. Here also the families were grouped into 4 groups. These groups were low income group (if monthly income of a family was < Tk.50 thousand and expenditure was < Tk. 40 thousand), medium income group (if income was Tk. 50 - 100 thousand and expenditure was between Tk.40 - < 80 thousand), upper medium income group (if income was 50 - 100 thousand taka and expenditure was between Tk. 80 - < 100 thousand taka), and higher income group ( if income was Tk. 150 and above and expenditure was Tk.120 thousand and above). Body mass index, (BMI, weight in kg divided by height in meter$^2$) was measured for each respondent, and respondents were grouped into 4 groups. These groups were underweight group (if BMI < 18.5), normal group (if 18.5 < BMI < 23.0), overweight group (if 23.0 < BMI < 27.5), and obese groups (if BMI ≥ 27.5) [47,48]. There were two groups of adults depending on their blood pressure measurement (BP mmHg). In one group there were 452 adults who had BP (120 - < 129)/ < 80 and they were considered as patients of elevated blood pressure [49]. There were 667 (67.0%) diabetic patients, 92 (9.2%) patients of kidney disease. Number of diabetic patients was 81 (8.1%) having elevated blood pressure, and there were 20 patients who were suffering simultaneously from kidney disease, diabetes, and elevated blood pressure. These 20 patients were the targeted adults for whom the impacts of socioeconomic variables under study.

Thus, the study variable under consideration was prevalence of kidney disease among patients of diabetic-elevated blood pressure. The identified 20 patients were discriminated from the remaining 875 adults. The process of discrimination would identify the most responsible variable for discrimination of two groups of adults. The most responsible variable is one for which the absolute correlation coefficient of the variable with discriminant function score is significantly higher [50-53]. As a part of further analysis, the association of the study variable with other socio-demographic variables were observed. The responsible level of a variable for the prevalence of the study variable in higher rate was identified by calculating risk ratio, irrespective of significance of association [54,55].

## Results and Discussion

The results presented here were based on analysis of data collected from 498 males and 497 females. The prevalence rates of simultaneous health hazard kidney disease-diabetes-elevated blood pressure among males and females were 2.4% and 1.0%, respectively against the rate 2.0% in all 995 adults (Table 1). This differential in rates in males and in females were not significantly different, though males had 50% more risk of prevalence compared to the risk of females [= 0.808, *p*-value = 0.369; R.R. = 1.50, C.I. (0.62, 3.64),]. Among the respondents 53.4% were rural people, prevalence rate in them was 3.0%. This rate was significantly higher than the prevailed rate in urban adults (0.9%) [ = 5.817, p-value = 0.016]. Rural people were at higher risk of prevalence by 250% compared to the risk of urban residents [R.R. = 3.50, C.I. (1.18, 10.39)]. Most of the respondents were Muslims (85.2%), the prevalence rate in them was 2.%. The same rate prevailed in non-Muslim adults also. The prevailed rates in people of two religious groups were not sta-

tistically different and both groups had similar risk of prevalence [ = 0.001, *p*-value = 0.977; R.R. = 0.98, C.I. (0.30, 3.16)]. The percentage of married persons was 93.1 and prevalence rate in them was 2.2%. None of the investigated single adults was patient of kidney disease-diabetes-elevated blood pressure. However, the prevalence rate in married people was not significantly higher and investigated single adults had no risk of prevalence [ = 1.521, *p*-value = 0.217]. There were 20.4% adults of ages 40 years and above but less than 50 years, the prevalence rate in this group was 3.4%. This rate was higher, though not significantly, compared to the rate prevailed in adults of other age groups [ = 4.692, p-value = 0.196]. But the risk of prevalence for this group was 110% more [R.R. = 2.10, C.I. (0.85, 5.19)]. There was an increasing trend in prevalence rate upto the age group below 50 years. Rate (0.5%) was lowest among the elderly people.

The percentage of secondary level educated adults was 23.8, the prevalence rate in his group was 3.0% and risk of prevalence for them was 72.0% more compared to the risk of adults of other levels of education [R.R. = 1.72, C.I. (0.69, 4.26)]. But education was not associated with simultaneous prevalence of kidney disease, diabetes, and elevated blood pressure [= 3.649, *p*-value = 0.302]. Independence of occupation and prevalence of the diseases under study was noted [ = 1.058, p-value = 0.901] in the analysis.

The highest prevalence rate (2.3%) was observed among service persons, and they were 30.7% in the sample. For this group of adults, the risk of prevalence was 22.0% more [R.R. = 1.22, C.I. (0.49, 3.03)]. The second highest rate was 2.2%, and it prevailed in

| Socioeconomic characteristics | Prevalence of diseases under consideration | | | | Total | |
|---|---|---|---|---|---|---|
| | Yes | | No | | | |
| | Number | % | Number | % | Number | % |
| Gender | | | | | | |
| Male | 12 | 2.4 | 486 | 97.6 | 498 | 50.1 |
| Female | 8 | 1.0 | 489 | 99.0 | 497 | 49.9 |
| Total | 20 | 2.0 | 975 | 98.0 | 995 | 100.0 |
| Residence | | | | | | |
| Rural | 16 | 3.0 | 515 | 97.0 | 531 | 53.4 |
| Urban | 4 | 0.9 | 460 | 99.1 | 464 | 46.6 |
| Religion | | | | | | |
| Muslim | 17 | 2.0 | 831 | 98.0 | 848 | 85.2 |
| Non-Muslim | 3 | 2.0 | 144 | 98.0 | 147 | 14.8 |
| Marital status | | | | | | |
| Married | 20 | 2.2 | 906 | 97.8 | 926 | 93.1 |
| Single | 0 | 0.0 | 69 | 100.0 | 69 | 6.9 |
| Age (in years) | | | | | | |
| < 25 | 3 | 1.5 | 193 | 98.5 | 196 | 19.7 |
| 25 - 40 | 9 | 2.2 | 392 | 97.8 | 401 | 40.3 |
| 40 - 50 | 7 | 3.4 | 196 | 96.6 | 203 | 20.4 |
| 50+ | 1 | 0.5 | 194 | 99.5 | 195 | 19.6 |
| Education | | | | | | |
| Illiterate | 1 | 1.5 | 64 | 98.5 | 65 | 6.5 |
| Primary | 0 | 0.0 | 121 | 100.0 | 121 | 12.2 |
| Secondary | 7 | 3.0 | 230 | 97.0 | 237 | 23.8 |
| Higher | 12 | 2.1 | 560 | 97.9 | 572 | 57.5 |
| Occupation | | | | | | |
| Farming | 2 | 1.9 | 102 | 98.1 | 104 | 10.5 |
| Business | 5 | 2.1 | 229 | 97.9 | 234 | 23.5 |
| Service | 7 | 2.3 | 298 | 97.7 | 305 | 30.7 |
| Retire | 1 | 0.8 | 121 | 99.2 | 122 | 12.3 |
| Housewife | 5 | 2.2 | 225 | 97.8 | 230 | 23.1 |
| Economic condition | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Low | 4 | 1.0 | 381 | 99.0 | 385 | 38.7 |
| Medium | 12 | 2.8 | 412 | 97.2 | 424 | 42.2 |
| Upper medium | 2 | 3.3 | 59 | 96.7 | 61 | 6.1 |
| High | 2 | 1.6 | 123 | 98.4 | 125 | 12.6 |
| Smoking habit | | | | | | |
| Yes | 7 | 2.1 | 322 | 97.9 | 329 | 33.1 |
| No | 13 | 2.0 | 653 | 98.0 | 666 | 66.9 |
| Habit of taking process food | | | | | | |
| Yes | 8 | 2.2 | 355 | 97.8 | 363 | 36.5 |
| No | 12 | 1.9 | 620 | 98.1 | 632 | 63.5 |
| Habit of doing physical work | | | | | | |
| Yes | 9 | 1.9 | 472 | 98.1 | 481 | 48.3 |
| No | 11 | 2.1 | 503 | 97.9 | 514 | 51.7 |
| Involvement in sedentary work | | | | | | |
| Yes | 9 | 2.0 | 433 | 98.0 | 442 | 44.4 |
| No | 11 | 2.1 | 542 | 97.9 | 553 | 55.6 |
| Body mass index | | | | | | |
| Underweight | 1 | 2.6 | 37 | 97.4 | 38 | 3.8 |
| Normal | 5 | 2.1 | 228 | 97.9 | 233 | 23.4 |
| Overweight | 6 | 1.4 | 418 | 98.6 | 424 | 42.6 |
| Obese | 8 | 2.7 | 292 | 97.3 | 300 | 30.2 |
| Duration of diabetes (in years) | | | | | | |
| Did not arise | 0 | 0.0 | 328 | 100.0 | 328 | 33.0 |
| < 5 | 13 | 4.5 | 278 | 95.5 | 291 | 29.2 |
| 5 – 10 | 5 | 2.4 | 201 | 97.6 | 206 | 20.7 |
| 10 – 15 | 2 | 2.0 | 97 | 98.0 | 99 | 9.9 |
| 15+ | 0 | 0.0 | 71 | 100.0 | 71 | 7.1 |
| Total | 20 | 2.0 | 975 | 98.0 | 975 | 100.0 |

**Table 1:** Distribution of respondents suffering simultaneously from kidney disease diabetes and elevated blood pressure according to different socioeconomic characteristics.

housewives. The lowest rate (0.8%) was observed among retired persons. Economic condition of the families of respondents had no significant impact on prevalence of the diseases under consideration [= 3.896, *p*-value = 0.273]. But adults of families of upper medium economic condition had 70% more risk of prevalence [R.R. = 1.70, C.I. (0.40, 7.17)] than the risk of adults belonged to families of other economic conditions. The prevalence rate for this group was 3.3%. Lowest prevalence rate was 1.0, and it prevailed in adults of low economic condition.

The percentage of smoker adults was 33.1, and prevalence rate in them was 2.1%. This rate was statistically similar to the rate (2.0%) prevailed among non-smokers [ = 0.035, *p*-value = 0.853]. The risks of prevalence in smokers and in non-smokers were almost similar [R.R. = 1.09, C.I. (0.44, 2.71)]. Among the respondents 36.5% were habituated in taking process food, and 2.2% of them were suffering from the diseases under consideration. This rate was not statistically different than the rate (1.9%) prevailed in adults who were not taking process food [= 0.109, *p*-value = 0.741]. The intake of process food was a risky factor for the prevalence of the diseases under consideration only by 16% [R.R. = 1.16, C.I. (0.48, 2.81)]. Physical inactivity was observed in 51.7% adults; the prevalence rate in them was 2.1%. This rate was insignificantly more than the rate (1.9%) prevailed in adults involved in physical work [ = 0.091, *p*-value = 0.763]. Physical inactivity was not the significant risk factor; it enhanced the risk only by 14% [R.R. = 1.14, C.I. (0.48, 2.73)]. There were 44.4% respondents involved in sedentary activity, the prevalence rate in them was 2.0%. Same prevalence rate also prevailed in adults not involved in sedentary activity. Sedentary activity was not the risk factor for prevalence of the diseases under study as risk ratio for sedentary activists was R.R. = 1.02 [C.I. (0.43, 2.44)]. Sedentary activity was independent of prevalence of the diseases [ = 0.003, *p*-value = 0.958].

The percentage of obese adults was 30.2, the prevalence rate in them was 2.7%, and obese adults had 54.0% more risk of prevalence compared to the risk of other adults [R.R. = 1.54, C.I. (0.64, 3.73)]. However, body mass index was independent of prevalence of the diseases [= 1.515, *p*-value = 0.679]. The percentage of diabetic patients of shorter period of less than 5 years was 29.2. The prevalence rate (4.5%) in them was significantly higher [ = 17.288, *p*-value = 0.002]. The risk of prevalence for this group of diabetic patients was 349% more compared to the risk of adults suffering for longer duration [R.R. = 4.49, C.I. (1.81, 11.15)]. Rate of prevalence was in decreasing trend with the increase in duration of diabetes.

## Results of Discriminant Analysis

This analysis was done to discriminate the patients' group of 20 adults from the remaining 975 respondents. The variables included in the analysis were gender, residence, religion, age, education, occupation, marital status, economic condition, body mass index, smoking habit, habit of doing physical work, habit of taking process food, involvement in sedentary activity, and duration of diabetes. The analysis was satisfactory as was observed from the results Wilk's Lambda = 0.975,  = 32.809, *p*-value = 0.008. Other results of analysis were presented in table 2.

| Socioeconomic variables | Correlation coefficient, r | Discriminant function coefficient | Wilk's Lambda | *F* | *p*-value |
|---|---|---|---|---|---|
| Residence | 0.671 | 0.860 | 0.995 | 5.840 | 0.016 |
| Duration of diabetes | -0.464 | -0.365 | 0.997 | 4.335 | 0.042 |
| Marital status | 0.342 | 0.346 | 0.998 | 1.520 | 0.218 |
| Gender | 0.249 | 0.295 | 0.999 | 0.807 | 0.369 |
| Education | -0.241 | -0.360 | 0.999 | 0.751 | 0.386 |
| Economic condition | -0.226 | -0.128 | 0.999 | 0.656 | 0.418 |
| Age | 0.122 | 0.426 | 1.000 | 0.195 | 0.659 |
| Habit of taking process food | -0.092 | -0.279 | 1.000 | 0.109 | 0.742 |
| Body mass index | -0.089 | 0.052 | 1.000 | 0.103 | 0.748 |
| Habit of doing physical work | 0.084 | -0.145 | 1.000 | 0.091 | 0.763 |
| Smoking habit | 0.052 | -0.095 | 1.000 | 0.034 | 0.853 |
| Occupation | 0.039 | -0.038 | 1.000 | 0.020 | 0.887 |
| Involvement in sedentary activity | -0.015 | -0.004 | 1.000 | 0.003 | 0.958 |
| Religion | -0.008 | -0.013 | 1.000 | 0.001 | 0.977 |

**Table 2:** Results of Discriminant Analysis.

It was seen that the absolute value of correlation coefficient of residence and discriminant function score was highest (r = 0.671) indicating that the most responsible variable in discriminating the patients' group from other adults was residence [53]. The second most responsible variable was duration of diabetes.

## Discussion

Due to urbanization change of lifestyle of human beings is noted very much. As a result, the intake of process food, reduction in physical work, and increase in sedentary activity are common resulting increasing trend in prevalence of diabetes and its related diseases [56,57]. One of the diabetes related diseases is kidney disease. Another diabetes related disease is elevated blood pressure. The responsible variables for the simultaneous prevalence of any two these diseases are residence, age, education, occupation, economic condition, smoking habit, and disability [29,58]. This study was an attempt to identify the risk and responsibility of socioeconomic variables in enhancing the simultaneous prevalence of these 3 diseases.

This study indicated that the variable residence had positive impact in enhancing the prevalence of kidney disease in patients of diabetic- elevated blood pressure and rural people had higher risk of prevalence. Variation in prevalence was not affected by the variation of gender of respondents. But males had 50% more risk of prevalence. All the investigated married persons were suffering simultaneously from all the three diseases. Age level was independent of prevalence, but people of age group 40 to less than 50 years had 110% more risk of prevalence. Each of the variable's education, occupation, and economic condition had no influence in enhancing the rate of prevalence, but secondary level educated people and adults of upper medium economic condition had higher risk of prevalence. Body mass index and prevalence of the diseases under study were not significantly associated, but obese adults had 54.0% more risk of prevalence. The lifestyle factors considered in the present study were smoking habit, habit of taking process food, habit of doing physical work, and involvement in sedentary activity. None of these lifestyle factors generated the risk of prevalence

of the diseases. Duration of diabetes and simultaneous prevalence of kidney disease-diabetes and - elevated blood pressure was significantly associated, and early stage of diabetes was the very high-risk level for the prevalence of the diseases under consideration.

The variable residence and duration of diabetes well discriminated the patients' group from other adults.

## Conclusion

The information provided here were based on analysis of data collected from 995 Bangladeshi adults residing in both rural and urban areas. The objective of the analysis was to identify some socioeconomic characteristics responsible for simultaneous prevalence of kidney disease-diabetes-elevated blood pressure. These three diseases prevailed in 2% investigated adults. The percentages of rural people, Muslim adults, males, married persons, secondary level educated people, adults of ages 40 to less than 50 years, service persons, adults of upper medium economic condition, obese people, and diabetic patients suffered for less than 5 years were 53.4, 85.2, 50.1, 93.1, 23.8, 30.7, 6.1, 30.2, and 29.2, respectively. Among the above-mentioned levels of the socioeconomic characteristics only rural residence and shortest period of suffering from diabetes were the risky level of prevalence. The patients' group of 20 adults were discriminated well from the remaining 975 respondents due to the variable's residence and duration of diabetes. Muslims, males, adults of ages 40 - 50 years, secondary level educated persons, adults of upper medium economic condition, and obese adults had higher risk of prevalence. But the related variables were not significantly associated with the prevalence of the disease. All the lifestyle variables mentioned in the analysis were independent of the prevalence.

Obesity and diabetes are two associated variables, and these two variables create many types of health hazard among the people. Due to change of economic condition of country and its people the influence of these two variables cannot be avoided. But there should be attempts by the government and by the social workers to reduce the rate of prevalence of obesity and diabetes in both rural and urban people. Government should conduct medical camp in both rural and urban areas to encourage the citizens to be cautious against the health hazard originated from diabetes.

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## Conflict of Interest

Authors declare no conflict of interest.

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