

Factors Responsible for Prevalence of Cardiovascular Disease Among Patients with Elevated Blood Pressure

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Abstract

In this paper, an attempt was made to identify the risk factors associated with the prevalence of cardiovascular disease (CVD) in Bangladeshi patients with elevated blood pressure. The patients were observed in investigating 995 adults of 18 years and above. The data of these adults were collected from some diagnostic centers located in urban and semi-urban areas when the adults were visiting the centers for their blood and urine screening tests. Among the investigated adults, 452 were patients with elevated blood pressure; 39 of these patients were suffering from CVD. The objective of the study was to identify some socioeconomic factors for the simultaneous prevalence of the diseases among the group of 39 patients. The risk of these two non-communicable diseases was significantly higher for younger adults, for physically inactive adults, and for diabetic patients of early stages. Higher risk was also noted for non-Muslim people, females, secondary educated persons, housewives, adults belonging to families of upper medium economic condition, processed food consumers, and underweight adults. The patients' group was well discriminated from others for the variables age, habit of doing physical work, and economic condition.

Keywords: elevated blood pressure, cardiovascular disease, socioeconomic factors, risk ratio, discriminant analysis

Abbreviations: CVD: cardiovascular disease; BMI: body mass index

Introduction

Cardiovascular diseases (CVDs) indicate the disorders of the heart and blood vessels of human beings. The most common problem of CVDs is heart attack and stroke. The other problems are cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, etc. The damage of heart conditions starts due to

longstanding untreated elevated blood pressure [1–7]. Elevated blood pressure is the most common modifiable risk factor for premature CVD, and it coexists with other risk factors of heart disease [4, 8–13]. The risk of CVDs is approximately twice among people suffering simultaneously from diabetes and hypertension compared to the risk of CVDs among people with non-diabetic hypertension [14, 15]. Again, diabetes has a role in developing hypertension/elevated blood pressure among adults [16–20]. Even the simultaneous prevalence of obesity and hypertension doubles the risk of death from CVDs [21–23].

CVDs are the leading cause of death globally and the number of deaths accounted for 17.9 million in 2019, and the number of deaths will be 22.2 million in 2030; 85% of these deaths were due to heart attack and stroke [24]. More than 75% of these deaths take place in low- and middle-income countries [24]. However, CVD prevalence and deaths are a global burden [25, 26]. In Bangladesh also it is problem and there were different studies to identify the risk factors of CVDs [27, 28]. Major risk factors for CVDs are high cholesterol, high blood pressure, smoking, drinking, diabetes, obesity, physical inactivity, poor nutrition, unhealthy diet, air pollution, and raised blood lipids [24, 27–34].

In this paper, an attempt was made to identify socioeconomic factors responsible for the prevalence of CVD among Bangladeshi patients with elevated blood pressure.

Methodology

The present analysis was based on data recorded from 995 adults aged 18 years and above residing in both urban and rural areas of Bangladesh. These adults were interviewed when they were visiting an urban diagnostic center and a semi-urban diagnostic center for their blood and urine screening tests. The adults provided, on request, some information about their existing physical problem and their family history. They were interviewed by some nurses and medical assistants working in the centers. The provided information was recorded in a predesigned and pre-tested questionnaire. The survey work was done during the session 2018-19.

Prior to the survey work, there was a decision by the researcher to collect data from 50.1% males and 49.9% females as the sex ratio of the country was 50.1:49.9 during the study period [35]. Accordingly, the investigated male and female respondents were 498 and 497, respectively. The recorded data were mostly socio-demographic, and some were on the health conditions of the adults. The prevalence of diseases among the adults, the duration of suffering from the diseases, and the stage of treatment by the registered medical practitioner/rural medical assistants were recorded. Their working status and their lifestyle were also recorded. Most of the recorded data were qualitative variables, except age, height, body weight, family income, family expenditure, and duration of suffering from the diseases. Each of the qualitative variables was transformed to a nominal scale. For ease of analysis, the variable age and the variable duration of diabetes were expressed in classes. The economic condition of the family of any one respondent was considered as lower (if the monthly 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 Tk 50–100 thousand 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). To identify the obese adults, the body mass index (BMI) (BMI, weight in kg divided by height in m²), was measured and any respondent was identified as 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 [36, 37]. According to blood pressure (BP) mmHg measurement, the respondents were classified into two groups. In one group, 452 respondents had BP (120– < 129)/ < 80 and they were identified as patients with elevated blood pressure [7]. 126 respondents were suffering from CVDs, among them 39 had elevated blood pressure. These 39 adults were considered as the patients' group.

The study variable was the prevalence of CVDs among patients with elevated blood pressure. We had two groups of adults; in one group there were 39 patients with CVDs along with elevated blood pressure. In another group, there were 956 respondents free of the simultaneous prevalence of the two diseases under consideration. These two groups were discriminated using discriminant analysis. The analysis helps in identifying the responsible variables for

discrimination. A variable was identified as the most responsible one for which the absolute correlation coefficient of the study variable with discriminant function score was significantly higher [38–41].

Further analysis was performed to study the association of the study variable with each of the other socio-demographic variables. The risk ratio for a level of any socio-demographic variable for which the prevalence rate of the study variable was highest [42, 43]. The responsible level of a variable for the prevalence of the study variable was decided when the risk ratio became greater than one.

Results

The investigated adults were 995, among them 3.9% were suffering simultaneously from elevated blood pressure and CVDs. Some of them (53.8%) were from rural areas and the remaining were urban people. The sample rural adults were 53.4% and 4% of them were patients with CVD in the presence of elevated blood pressure. The corresponding percentage among urban adults was 3.9. These two percentages were statistically similar and for both these groups the risk of prevalence was almost the same [$\chi^2 = 0.004$, p-value = 0.951; RR = 1.02, CI (0.56, 1.85)]. Non-Muslim adults were 4.8% of the sample and 4.8% of them were patients of two non-communicable diseases under consideration. This group had 26% more risk of prevalence of the diseases, but prevalence rates in Muslim and Non-Muslim adults were not significantly different [$\chi^2 = 0.325$, p-value = 0.569; RR = 1.26, CI (0.57, 2.80)]. Female respondents were 49.9% in the sample; the prevalence rate was 4.4%. This rate was not significantly different than the rate that prevailed in males (3.4%) [$\chi^2 = 0.678$, p-value = 0.410]. For females, the risk of prevalence was 30% more compared to the risk of prevalence in males [RR = 1.30, CI (0.70, 2.42)]. There were only 6.9% of single adults in the sample; the prevalence rate was 4.3%. This rate was slightly more in married adults (3.9%). These two rates were statistically similar, though single adults had 12% more risk of prevalence [$\chi^2 = 0.036$, p-value = 0.849; RR = 1.12, CI (0.35, 3.55)]. Middle-aged adults (25– < 40 years) were 40.3% of the sample and the prevalence rate was 6.5. This rate was significantly higher than the rates that prevailed in adults of other age groups [$\chi^2 = 13.895$, p-value = 0.003]. The risk of prevalence in this group of adults was 2.96 times compared to the risk of adults of other age groups [RR = 2.96, CI (1.54, 5.71)]. The lowest prevalence rate was observed in elderly people (0.5%) of ages 50 years and above and the second lowest rate prevailed in respondents of ages 40 – < 50 years. Secondary-level educated adults were 23.8% in the sample and the prevalence rate in them was 5.9%. This rate was higher than the rate that prevailed in adults of other levels of education. The lowest rate (3.0%) was observed in higher-educated respondents. However, the differential rates of prevalence in respondents of different levels of education were not significantly different [$\chi^2 = 4.319$, p-value = 0.229]. However, secondary-level educated persons had 79% more risk of prevalence than the risk of other adults [RR = 1.79, CI (0.95, 0.38)]. Sample housewives were 23.1% and the prevalence rate in them was 5.7%. The rates in other adults of different professions were lower than the rate that prevailed in all sample adults, though all the rates were similar [$\chi^2 = 2.583$, p-value = 0.630]. The risk of prevalence for housewives was 1.66 times the risk for other adults [RR = 1.66, CI (0.87, 3.18)]. There were only 6.1% of respondents belonging to families of upper-medium economic condition; the prevalence rate in them was 8.2%. This rate was significantly higher than the rate that prevailed in all adults [$\chi^2 = 7.134$, p-value = 0.048]. The second higher rate (4.8%) was noted in the respondents of families of higher economic conditions. The risk of prevalence in adults belonging to upper-medium economic conditions was 2.25 times compared to the risk in other adults [RR = 2.25, CI (0.91, 5.54)].

There were 33.1% smoker adults in the sample and 4.0% of them were suffering simultaneously from CVD and elevated blood pressure. This prevalence rate was 3.9% among non-smoker respondents. The risks of prevalence for both smokers and non-smokers were almost the same [RR = 1.01, CI (0.81, 1.26)]. The two rates were also statistically similar [$\chi^2 = 0.001$, p-value = 0.971]. The percentage of respondents involved in sedentary activities was 44.4%. The prevalence rate in them was 4.1%. This rate was not statistically different from the rate that prevailed in respondents who were not involved in sedentary activity (3.8%) [$\chi^2 = 0.049$, p-value = 0.824]. For both these two groups, the risks were almost the same [RR = 1.07, CI (0.58, 1.09)]. There were 36.5% of respondents habituated to taking processed food and 3.3% of them were patients with CVD along with elevated blood pressure. For them, the

risk of prevalence was 0.58 times. On the other hand, the risk of prevalence was 1.29 times for the respondents not habituated to taking processed food. However, the prevalence rates in two groups of adults were not significantly different [$\chi^2 = 0.572$, p-value = 0.450]. The percentage of physically inactive adults was 51.7; the prevalence rate in them was 5.3% which was significantly higher than the rate that prevailed in physically active adults (2.5%) [$\chi^2 = 5.019$, p-value = 0.029]. The risk of prevalence for physically inactive adults was 2.11 times compared to the risk for physically active adults [RR = 2.11, CI (1.08, 4.12)].

The percentage of underweight respondents was 3.8 only, but a higher prevalence rate (5.3%) was noted in them. The risk of prevalence for them was 36% more compared to the risk of other adults [RR = 1.36, CI (0.34, 5.37)]. The next higher rate (5.0%) was observed in overweight adults and the lowest rate (2.3%) prevailed in obese adults. However, the prevalence rates observed in different groups of adults classified by level of obesity were statistically similar [$\chi^2 = 3.391$, p-value = 0.335]. There were 67.0% diabetic adults; some of the adults (29.2%) were suffering for less than 5 years. The prevalence rate (6.2%) in them was significantly higher than the rates observed in other adults [$\chi^2 = 10.064$, p-value = 0.048]. The risk of prevalence for them was 2.07 times compared to the risk of other adults [RR = 2.07, CI (1.12, 3.82)] (Table 1).

Socioeconomic variables	Prevalence of cardiovascular diseases among patients of elevated blood pressure				Total	
	Yes		No		Number	%
	Number	%	Number	%		
Residence						
Urban	18	3.9	446	96.1	464	46.6
Rural	21	4.0	510	96.0	531	53.4
Total	39	3.9	956	96.1	995	100.0
Religion						
Muslim	32	3.8	816	96.8	848	85.2
Non-Muslim	7	4.8	140	95.2	147	14.8
Gender						
Male	17	3.4	481	96.6	498	50.1
Female	22	4.4	475	95.6	497	49.9
Marital status						
Married	36	3.9	890	96.1	926	93.1
Single	3	4.3	66	95.7	69	6.9
Age (years)						
< 25	6	3.1	190	96.9	196	19.7
25–40	26	6.5	375	93.5	401	40.3
40–50	6	3.0	197	97.0	203	20.4
50+	1	0.5	194	99.5	195	19.6
Education						
Illiterate	2	3.1	63	96.9	65	6.5
Primary	6	5.6	115	94.4	121	12.2
Secondary	14	5.9	223	94.1	237	23.8
Higher	17	3.0	555	97.0	572	57.5
Occupation						
Farming	4	3.8	100	96.2	104	10.5
Business	7	3.0	227	97.0	234	23.5
Service	11	3.6	294	96.4	305	30.7
Retired	4	3.3	118	96.7	122	12.3
Housewife	13	5.7	217	94.3	230	23.1
Economic condition						
Low	9	2.3	376	97.7	385	38.7
Medium	19	4.5	405	95.5	424	42.6
Upper medium	5	8.2	56	91.8	61	6.1

High	6	4.8	119	95.2	125	12.6
Smoking habit						
Yes	13	4.0	316	96.0	329	33.1
No	26	3.9	640	96.1	666	66.9
Involvement in sedentary activity						
Yes	18	4.1	424	95.9	442	44.4
No	21	3.8	532	96.2	553	55.6
A habit of taking restaurant food						
Yes	12	3.3	351	96.7	363	36.5
No	27	4.3	605	95.7	632	63,5
A habit of doing physical work						
Yes	12	2.5	469	97.5	481	48.3
No	27	5.3	487	94.7	514	51.7
Body mass index						
Underweight	2	5.3	36	94.7	38	3.8
Normal	9	3.9	224	96.1	233	23.4
Overweight	21	5.0	403	95.0	424	42.6
Obese	7	2.3	293	97.7	300	30.2
Duration of diabetes (years)						
Did not arise	9	2.7	319	97.3	328	33.0
< 5	18	6.2	273	93.8	291	29.2
5–10	10	4.9	196	95.1	206	20.7
10–15	1	1.0	98	99.0	99	9.9
15+	1	1.4	70	98.6	71	7.1
Total	39	3.9	956	96.1	995	100.0

Table 1: Distribution of respondents suffering from cardiovascular diseases along with elevated blood pressure according to socioeconomic variables.

Results of Discriminant Analysis

There were 39 respondents who were suffering simultaneously from CVDs and elevated blood pressure. One of the objectives of this analysis was to discriminate these 39 patients from the remaining 956 respondents so that some responsible socioeconomic variables could be identified for this discrimination. For this, the variables residence, religion, gender, marital status, age, education, occupation, economic condition, smoking habit, habit of taking processed food, involvement in sedentary activity, habit of doing physical work, BMI, and duration of diabetes were included in the analysis. In respect of these variables, the two groups of respondents were discriminated well as was observed from the results of Box's M-test = 156.614, p-value = 0.047, Wilk's Lambda = 0.976, $\chi^2 = 28.665$, and p-value = 0.047. The other results are presented in the table below (Table 2).

Variables	Correlation coefficient, r	Discriminant function coefficient	Wilk's Lambda	F	p-value
A habit of doing physical work	0.478	0.578	0.995	5.034	0.025
Age	0.466	0.565	0.995	4.798	0.029
Economic condition	-0.426	-0.534	0.996	4.523	0.048
Occupation	-0.255	-0.164	0.999	1.436	0.231
Body mass index	0.237	0.311	0.999	1.235	0.267
Education	0.210	0.424	0.999	0.973	0.324
Gender	-0.175	0.032	0.999	0.677	0.411
A habit of taking processed food	0.161	0.563	0.999	0.571	0.450
Duration of diabetes	0.152	-0.249	0.999	0.507	0.477
Religion	-0.121	-0.161	1.000	0.324	0.569
Involvement in sedentary activity	-0.047	-0.071	1.000	0.049	0.824
Marital status	-0.040	-0.078	1.000	0.036	0.849

Residence	0.013	-0.153	1.000	0.004	0.951
Smoking habit	0.008	0.256	1.000	0.001	0.971

Table 2: Results of discriminant analysis.

It was seen that the correlation coefficient of the variable habit of doing physical work with discriminant function score was highest followed by age and economic condition. It indicated that the habit of doing physical work was the most responsible variable for discriminating the patients with CVD along with elevated blood pressure from other adults. The other two responsible variables were age and economic condition.

Discussion

Non-communicable diseases create different health hazards including hypertension/elevated blood pressure. Again, elevated blood pressure is the most common risk factor for CVDs [44, 45]. This is true for both developed and developing countries. The problem is acute in low and middle countries and the problem prevails more in Southeast Asia, particularly in Bangladesh [4, 46]. In a separate study in Bangladesh, it was observed that the risks of elevated blood pressure were higher among urban residents, married persons, and physically inactive persons [47]. Religion, higher education, retirement, and the habit of eating processed food were the risk factors for hypertensive heart disease [47]. In this paper, an investigation was done to identify the risk factors for the prevalence of CVD among patients with elevated blood pressure.

Among the investigated adults, 452 were suffering from elevated blood pressure and 39 of them had cardiac problems. Rural adults, non-Muslim adults, females, and married persons were facing the problem at higher rates, though there was no significant difference in rates that prevailed in their respective counterparts. A significantly higher prevalence rate was noted among younger adults of the age group 25 to less than 40 years. Higher rates also prevailed in secondary-level educated persons and housewives. However, these higher rates were not significantly different than the rates observed in adults of other levels of education and professions. A significantly higher rate was noted in adults belonging to upper-medium economic conditions.

The lifestyle factors of smoking habit, involvement in sedentary activity, habit of taking processed food, and any level of BMI had no impact in enhancing the rate of prevalence of CVDs in people suffering from elevated blood pressure. However, physical inactivity had a significant impact on enhancing the prevalence rate. Prevalence of diabetes was the cause of CVDs in patients with elevated blood pressure. But higher prevalence rate prevailed among newly affected diabetic patients.

Conclusion

The analytical results presented here were based on data collected from 995 adults of 18 years and above. These respondents were residents of both urban and rural areas. The majority of them were Muslims and married persons. Males and females were almost similar in proportions. Younger adults were higher in proportions. The majority of the respondents were highly educated; another big group of adults were service persons. A bigger group of respondents were from families of medium economic condition. The majority of the respondents were physically inactive. There were 70% diabetic adults and 42.6% overweight adults.

The prevalence rate of patients with CVD along with elevated blood pressure was 3.9%. The variables age, economic condition, physical work, and duration of diabetes had a significant impact on enhancing the prevalence rate of the disease under consideration. The risk of prevalence for younger adults, adults belonging to families of upper economic condition, physically inactive adults, and newly affected diabetic patients was higher. These 4 variables were responsible for discriminating the patients' group from others. The most responsible variable was physical inactivity followed by age and economic condition. The variables residence, religion, gender, education, occupation, smoking habit, sedentary activity, habit of taking processed food, and BMI had no impact in accelerating the prevalence rate of CVDs among people with elevated blood pressure.

The influences of the responsible variables on CVD among patients with elevated blood pressure cannot be avoided as the standard of living of the people is in increasing trend due to the upward movement of the economic condition of the people of the country. However, the adverse effect of some of the socioeconomic variables responsible for the prevalence of CVDs can be avoided if people become conscious and try to lead life in a healthy way. They should be cautious in leading the life avoiding the diseases or consult the doctor immediately when they face any health hazard. Registered health workers should encourage people to maintain a healthy life. Government can do a lot of work by introducing some rules and regulations for the welfare of public health.

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Competing Interests

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