Hypertension in Bangladesh: Identification of the Potential Risk Factors

Sabrina Rahaman[1,*], Sharmin Islam[1], S.M. Nasim Azad[1], and Md. Farhad Hossain[2]

[1]*Department of Statistics, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj-8100, Bangladesh*

[2]*Department of Statistics, Comilla University, Cumilla, Bangladesh*

***Abstract*- Nowadays Hypertension is one of the egregious public health problems in the world. This is a dramatically increasing health problem in Southeast Asia, particularly in Bangladesh. Many people do not have any idea about the medical facilities. This paper aim is to identify the relationship between hypertension and the risk factors associated with diseases in Bangladesh. Data has been collected from BIRDEM (Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine, and Metabolic Disorders) and we have a total of 144267 patient's information that was registered at BIRDEM in the year 2014-2015, after dropping missing information we got valid information of 9620 patients. The variables age, sex, place of residence, education, occupation, physical exercise, income, heredity, and weight has been considered as potential risk factors for hypertension. The binary logistic regression model has been applied to detect the impact of risk factors from selecting the independent variable of the Pearson chi-square test and finally calculated the odds ratio (OR) for each independent variable. All statistical analysis was completed using R.**

***Index Terms*- Hypertension, risk factors, Diabetes patients, binary logistic regression models, odds ratio.**

I. INTRODUCTION

Hypertension or 'high blood pressure' is an emergent public health issue as it is increasing the risks of non-communicable disease (NCDs) in the world. Hypertension is the major risk factor for cardiovascular diseases (CVD), cancer, chronic respiratory diseases, stroke, and heart failure and is also causes maternal deaths in pregnancy (Alwan, 2011). Though the mortality rate has decreased significantly over the last couple of decades of deaths due to risk factors are increasing at an alarming rate (Malik, 1996). Hypertension is a rising problem not only in Bangladesh but also in Asia. Many studies related to hypertension have been conducted in Bangladesh but our main concern is to determine the factors associated with hypertension among the Diabetes patients in Bangladesh.

1.1 Rationale of the study

While Hypertension becomes a serious issue in the health condition of the population of Bangladesh, there is little or very little information on Hypertension in Bangladesh is analyzed. The analysis that was done earlier has certain limitations, the analysis included were heterogeneous in terms of the age groups studied and classification of hypertension (Chowdhury, 2016). The maximum number of studies was conducted among rural populations and they were unable to generate an estimate for urban Bangladesh (Ahmed, 2014). There are some research works conducted abroad which to the same extend resemble this research, "Identifying the risk factors for hypertension", but the context of those countries where researches were done differs from that of Bangladesh. Literature indicates that no elaborate study has been conducted in the area of identifying the risk factors for hypertension (Dickinson and Nicolson, 2006).

1.2 Objective of the study

1. To determine the consequences of hypertension or high blood pressure to other diseases.
2. To determine the causes of hypertension or high blood pressure.
3. To determine the most vulnerable ages for hypertension or high blood pressure.

II. LITERATURE REVIEW

Hypertension or high blood pressure is the force our blood exerts on our arteries as it follows through our bodies. Blood is carried from the heart to all parts of our body in vessels called arteries. When blood pressure is at its highest then the heartbeats, pumping the blood, this is called systolic pressure. When the heart is at rest between beats our blood pressure falls, this is the diastolic pressure (Lim et al. 2010). Alauddin et al. (2014) mentioned that blood pressure and salt intake are the risk factors among the people aged 30 years or more in rural areas of Bangladesh. Shaibal and Purnima (2015) discussed the prevalence of hypertension among the rural Bangladeshi adult population (>18 years) and they showed that the pooled estimate for the prevalence of hypertension in 2972 adults was 20.88% (18.75% - 22.87%) which almost double than the previously estimated value. Anupama et al. (2016) noted that hypertension is an important risk determinant for chronic kidney diseases and age, sex and cardiovascular were a significant predictor for chronic kidney diseases for the rural population in South India.

III. METHODOLOGY

3.1 Sampling Design and Data collection:

To find the risk factors and most effective factors for hypertension in Bangladesh we applied the Binary logistic regression model. We collect secondary data from the

Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) 2014-2015. We have to collect 9620 data in our study. For that, we select Age, Sex, and Place of Residence, Education, Occupation, Income, Physical Exercise, Heredity, and Weight of the respondents. Our study aimed to identify the risk factors for hypertension in Bangladesh who registered at BIRDEM in the year 2014-15.

3.2 Statistical Equipment

In analyzed the hypertension data using some statistical tools, using R.3.6.0 we fit the logistic regression model and variables were analyzed by the chi-squared test according to their suitability. Finally, a binary logistic regression model was used to identify the significant risk factor for hypertension. Here, a tolerable 5% level of significance was considered for each of the tests.

3.3 Chi-square Test

Pearson's Chi-square test can be used to test the independence of two attributes. To test whether two attributes are independent or associated the null hypothesis of interest is

H_0: There is no association between two attributes.

An alternative hypothesis is

H_1: They are associated.

For testing the hypothesis of independence of the attributes, an observed set of frequencies are compared with a corresponding set of frequencies that are expected under the null hypothesis. Let O_{ij} *(i=1,2,3,...r and j= 1,2,3,...k)*denote observed frequency and E_{ij} (*i*=1,2,3,…k and *j*=1,2,3,…,k) denote the expected frequencies.

Then the chi-square test is,

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{e} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where,

χ^2 = Chi-square test statistics,

O_{ij} = Observed frequency,

E_{ij} = Expected frequency (Pearson, Karl, 1900).

IV. FINDINGS AND DISCUSSION

Age of Patients

The distribution of patients according to age is presented in table 1.1 and it is evident from the table that the highest number of patients (46.65 percent) belongs to age group 51-60. A considerable number of patients (5.08 percent) are in the age group$\leq$ 30. Thus we can comment that people in the age group 31-60 are at a greater risk of hypertension. Increase the age of respondents the possibility of hypertension also increases. Hence, this indicates that the older age (31-60 years) is one of the risk factors for developing hypertension.

Age was found to be closely associated with hypertension. Tests of association showed a significant relationship between age and hypertension (χ^2 =733.55, *p*=0.000).

Sex of Patients

The distribution of patients according to sex is presented in table 1.1 and it is evident from the table that 39.21 percent of patients belong to the male category. Thus we can conclude that the greater part of patients registered in BIRDEM is male. This may be because the male is more conscious than the female. Besides under our present social conditions, males get more facilities and freedom to access medical facilities. Also, the rate of the male may be higher in the general population. Tests of association showed there is no significant relationship between sex and hypertension (χ^2 =1.29, *p*=0.275).

Place of Residence of the Patients

The distribution of patients according to a place of residence is presented in table 1 and it is evident from the table that among all blood pressure registered in BIRDEM in the year 2014-2015, 39.62 percent come from a rural area, 60.31 percent comes from urban. That is the highest portion comes from the urban areas. The large portion may concentrate on urban for the following reasons, urban people are more conscious about health than the rural people. Medical facilities and communication facilities are better in urban areas than those of rural. Hypertension among the rural population may be less because they are exposed to hard physical labor.

Table 1: Association between hypertension and different selected demographic variables

Variables	Number of Respondents (%)		χ^2	*df*	*p* value
	Yes	No			
Age(in Years)					
$\leq$ 30	30(5.08)	560(94.92)			
31-40	270 (20.01)	1079(79.99)			
41-50	1080(37.46)	1803(62.54)			
51-60	1365(46.65)	1561(53.35)	733.55	5	0.000
61-70	694(43.19)	913(56.81)			
70 +	106(40.0)	159(60.0)			
Sex					
Male	2261(39.21)	3506(60.79)	1.29	1	0.275
Female	1556(40.38)	2297(59.62)			

Residence					
Rural	663(39.62)	1010(60.37)	0.0003	1	0.135
Urban	4793(60.31)	3154(39.68)			
Education					
Illiterate	264(31.92)	563(31.92)	22.38	1	0.175
Literate	3553(40.10)	5240(59.62)			
Occupation					
Farmer	154(36.67)	266(63.33)	8.78	4	0.000
Service	1369(38.40)	2196 (61.6)			
Business	990(39.71)	1503 (62.29)			
Housewife	998(41.81)	1389 (58.19)			
Retired & Others	306(40.53)	449 (59.47)			
Income					
Low	154(15.13)	266 (84.87)	934.73	3	0.000
Middle	1369(39.45)	2196 (60.55)			
Moderate	990(36.55)	1503(63.45)			
High	998(52.84)	1389 (46.16)			
Physical Exercise					
Yes	606(35.36)	1109(64.64)	16.22	1	0.000
No	3211(40.32)	4694 (59.38)			
Heredity					
No	1260(32.05)	2671(67.95)	168.83	2	0.000
Unknown	884(42.62)	1190(57.38)			
Yes	1673(46.28)	1942(53.72)			
Weight					
Normal	2096(15.13)	3709 (84.84)	645.48	2	0.000
Overweight	1619(36.55)	1185 (63.45)			
Underweight	227(12.84)	784 (87.16)			
H_0: There is no significant association between hypertension and different selected demographic variables					

Association test showed that there is no significant association between residence and hypertension.

Education Level of Patients

Education levels of patients who are registered in BIRDEM in year 20014-20015 are displayed in table 1 that about 31.92 percent of patients have illiterate and having hypertension. On the other hand, 40.10 percent of patients are literate and having hypertension. Thus we may conclude that the incidence of the disease is higher in educated people. Also, educated people are more conscious about their health and they come to the hospital in large proportions. Here the 40.10 percent of people having hypertension in literate categories which is higher than the illiterate people and association test also showed a significant association between education and hypertension.

Occupation Pattern of Patients

Information on the occupational status of patients is presented in table 1 as evident from table majority of female patients are housewives and 41.81 female people having hypertension. And among the male patients, farmers were less affected by hypertension than other occupations. Most of the retired male persons suffered from hypertension. We did not get any significant association between occupation and hypertension.

Income Level of Patients

The impact of income on hypertension was determined and it is evident from the table that about 15.13 percent of people having hypertension have come from low-income categories. But most of the hypertension patients came from high-income levels. Thus by considering socio-economic conditions, it is evident that higher socio-economic class patient has a higher risk of having hypertension. Likelihood of getting hypertension has low risk in low-income peoples. The middle-class patient has more risk for hypertension than low-income patient. The test of association also showed a significant association between income and hypertension.

Physical Exercise Habit of Patients

Physical exercise is a very important factor for hypertension. It is evident from the table that the majority of the patients do not take any kind of physical exercise. This is why maybe a large number of patients are suffering from various complications of hypertension. Thus physical inactivity or sedentary life is also a risk factor for developing hypertension. On the other hand, the patients who are involving physical exercise have less risk of having hypertension. Association tests also showed a significant relationship between physical exercise and hypertension.

Patients Heredity Characteristics

Family history is a major influencing factor for developing hypertension. It is observed from the table that about 46.28 percent of patients have hypertension whose family history was hypertension.

Thus we can conclude that heredity is the most important risk factor for hypertension because it influences the next generation having hypertension. The higher number of patients affected their heredity whose family history having hypertension. Association tests also showed a significant relationship between heredity and hypertension.

Weight of Patient

Overweight is a higher risk factor for hypertension. The underweight patient has a lower risk of hypertension. From the table, 1.1it It is noted that the majority of people having hypertension are overweight. Here 36.55 percent of overweight people have hypertension. But in normal-weight people are a lower chance of influence hypertension. The Association test also showed that there is a significant association between weight and hypertension.

Logistic Regression Analysis

Logistic Regression is one of the most important multivariate analysis in which the outcome variable is binary or dichotomous (cox, 1790). In this analysis, we have discussed only those variables, which are statistically significant at bivariate analysis level as well as the importance of some multivariate technique. The study used logistic distribution.

In logistic regression, there is a (binary or dichotomous) response. In a regression problem, we often observe that one or more explanatory variables could be qualitative or indicator variables. These types of problems are generally handled by dummy variable regression. Sometimes, even the explained variable could be an indicator variable. Let us express the variables by Y and X_1, $X_{2...}X_9$ is represented by the following logistic function-

$$Y_t = \frac{\exp(\beta_0 + \beta_1 X_{1i} + \cdots + \beta_9 X_{9i})}{1 + \exp(\beta_0 + \beta_1 X_{1i} + \cdots + \beta_9 X_{9i})}$$

Let, Y = Hypertension Status (No=0, Yes=1)

X_{1i} = Age (1= ≤ 30, 2 =31-40, 3=41-50, 4=51-60, 5=61-70, 6= 70+)

X_{2i} = Sex (Male=1, Female=2)

X_{3i} = Place of Residence (Rural=1, Urban=2)

X_{4i} = Heredity (No=0, Yes=1, Unknown=2)

X_{5i} = Education Status (Illiterate=0, Literate=1)

X_{6i} = Physical Exercise Status (No=0, Yes=1)

X_{7i} = Income (Low=0, Middle=1, Moderate =2, High=3)

X_{8i} = Occupation (Farmer=1, Service=2, Business=3, Housewife=4, Retired & Others=5)

X_{9i} = Wight (Normal=1, Overweight = 2, Underweight = 3)

$\beta_1, \beta_2 \ldots \beta_9$ is the regression coefficient.

Table 2: Logistic regression analysis

Variables	Regression coefficient	Estimated Value	*p*-Value	Odds Ratio
Age	≤ 30 (Ref)			
	31-40	0.168		1.18
	41-50	0.890		2.44
	51-60	1.244	0.00	3.47
	61-70	1.782		5.94
	70+	1.955		4.06
Sex	Male (Ref)			
	Female	0.096	0.00	1.10
Heredity	No(Ref)			
	Yes	0.476	0.00	1.61
	Unknown	0.541		1.12
Residence	Urban(Ref)			
	Rural	-0.266	0.342	0.77
Education	Illiterate(Ref)			
	Literate	0.142	0.00	1.15
Income	Low(Ref)			
	Middle	1.265	0.00	3.54
	Moderate	1.164		3.20
	High	1.820		6.17
Physical Exercise	No			
	Yes	-0.317	0.00	0.72
Occupation	Farmer(Ref)			
	Service	-0.115		0.89
	Business	-0.088		0.92
	Housewife	-0.057	.290	0.94
	Retired & Others	-0.009		0.99
Weight	Normal(Ref)			
	Overweight	1.798	0.00	2.22
	Underweight	-0.779		0.46

*** Ref = Reference categories

The above table shows the fitted regression model. Using R.3.6.0 we fit the logistic regression model. Here hypertension is the dependent variable. We fit logistic regression model hypertension against the independent variable age, sex, residence, heredity, education, occupation, income, weight, and physical exercise. From the fitted logistic

regression model, we show that two variables (residence and occupation) are insignificant. This means that there is no between hypertension and two variables. But when we find odds ratio and confidence interval we observe that same conclusion as the p-value.

The Odds Ratio (OR) can be interpreted as how much more likely it is that an observation is a member of the target group rather than a member of the other group. The null value of the odds ratio is 1. If OR=1this indicates exposure does not affect the outcome. If OR>1 means exposure higher associated with outcome and if OR<1 this indicates that exposure lower associated with outcome.

For the value of odds ratio in the age group 31-40 is 1.18 this means that if we compare the reference category it conclude that 1.18 times less associated than reference category and also the age group 61-70 the odds ratio is 5.94 this means that the people in the age is 5.94 times higher risk for hypertension compared to the reference category. Similarly, the odds ratio in the literate group is 1.15 that the literate people 1.15 times have a lower chance by hypertension compare to the illiterate people. Weight is one of the important factors for hypertension. The value of the odds ratio in the overweight category is 2.22. This means that the people who are overweight 2.22 times higher risk having hypertension compare to normal weight.

V. CONCLUSIONS AND REMARK

In our study, the main objective is to identify factors associated with hypertension in Bangladesh. The study also found other key risk factors for hypertension, such as age, sex, heredity, area, physical exercise, occupation, income. This indicates that age (above 40 years) is one of the risk factors for developing hypertension. Besides under our patient social conditions, males get more facilities and freedom to access medical facilities. Also, the rate of the male may be higher in the general population. The family history is a major influencing factor for developing hypertension. The highest portion comes from urban areas. The large portion may concentration in urban for the following reasons, urban people are more conscious about health than the rural people. Medical facilities and communication facilities are better in urban areas than those of rural. Hypertension among the rural population may be less because they are exposed to hard physical labor. The incidence of the disease is higher in educated people. Also, educated people are more conscious about their health and they come to the hospital in a large proportion. A large number of patients are suffering from various complications of hypertension. Thus physical inactivity or secondary life is also a risk factor for developing hypertension.

We recommend that the government and other concerned authorities should take proper steps to ensure the facilities aware of the people about dangerous hypertension. Different press media (Newspapers and mass media) can play an important role in this situation.

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