ISSN: 2308-5096(P) ISSN 2311-620X (O)
[International Journal of Ethics in Social Sciences
Vol. 8, No. 1, October 2024]

Socio-demographic Determinants of Hypertension in Bangladesh: A Case Study in Rajshahi District

Mazharul Islam [1]

Abstract

The non-communicable diseases like hypertension are emerging as a major health problem in Bangladesh. Recently, this has been given high research priority by the Government of Bangladesh. The purpose of the study was to investigate the socio-demographic determinants of hypertension in Bangladesh. The data were collected from the Rajshahi district using stratified multistage sampling with a technique based on the scheduled questionnaire for this study. To identify the determinants, statistical tools have been used such as percentage distribution, point bi-serial correlation, phi correlation, binary backward logistic regression method including Likelihood ratio test, Hosmer-Lemeshow test, Nagelkerke R^2, Sensitivity and specificity, receiver operating characteristics (ROC) curve and bootstrapping technique, etc. It has been revealed that 71.90% of respondents are normotensive and 28.10% are hypertensive. Among all respondents 31.70% are illiterate, 30.30% are habituated with a sedentary lifestyle and 22.40% are with hereditary hypertension. The significant effects of age, sedentary lifestyle, working hours (>8 hrs) per day, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, and taking excess salt intake have been found positive. Also, it has been found that educational level and taking regular exercise have a negative impact on hypertension. This information helps the decision-maker to make better decisions. Also, another study may be conducted for depth understanding and more information.

Keywords: Hypertension, Socio-demographic Determinants, Logistic Regression, ROC Curve.

[1] Assistant Professor, Department of Business Administration, Bangladesh Islami University, E-mail: mazislam@yahoo.com

1. INTRODUCTION

A branch of study combining sociology and demography; of, pertaining to, or characterized by a combination of sociological (related to sociology) and demographic (relating to populations) characteristics. The study of hypertension is devoted to socio-demographic aspects. Hypertension is nothing but high blood pressure and blood pressure is the lateral pressure exerted on the walls of the arteries by blood flowing through the arteries. This hypertension is an important factor in various severe diseases. At present, hypertension is increasing day by day worldwide.

Specially, developing countries are thus likely to face an enormous burden of chronic non-communicable diseases in the near future and hypertension is the most important disease which is the leading cause of morbidity and mortality in the industrial world as well as becoming an increasingly common disease in the developing countries (WHO, 2001; WHO, 1978). Worldwide prevalence estimates for hypertension may be as much as 1 billion individuals and approximately 7.10 million deaths per year may be attributable to hypertension (Chobanian et al., 2003). In Latin America and the Caribbean, hypertensive disorders are the first leading cause of maternal deaths (26.7%) and in Asia and Africa, 9.1% of maternal deaths are caused by hypertensive disorders; also, 16.1% in developed countries (Khan et al., 2006).

Maternal hypertension is a most important risk factor for low birth weight infants and the rate of low birth weight of black women is more than twice that of white women (Odell et al., 2006). In the global context, hypertensive disorder of pregnancy was responsible for 6% of the burden of all maternal conditions and it was estimated that deaths due to hypertensive disorders of pregnancy represented 13% of all maternal deaths (Dolea et al., 2003). So, it is not a national problem for any country; it is also an international problem. Thus, the study tries to state the hypertension problem by reviewing the literature and investigating the impact of socio-demographic determinants on hypertension in Bangladesh.

2. LITERATURE REVIEW

Hypertension is a most important risk factor of cardiovascular diseases **(**Chobanian, et al. 2003). The World Health Organization reports that suboptimal systolic blood pressure (>115 mm Hg) is responsible for 62% of cerebrovascular diseases and 49% of ischemic heart disease, with little variation by sex. In addition, suboptimal blood pressure is the number one attributable risk for death throughout the world (WHO, 2002a). Bangladesh is a high-mortality developing country (WHO, 2002a). Among the top ten leading causes of death in Bangladesh, Ischemic heart disease is the first leading cause of death, accounting for 12% of total deaths (WHO, 2002b). Also, 10.57% of deaths have occurred by hypertension (where 7.97% is female and 12.51% is male), heart disease, and stroke; the prevalence of morbidity by blood pressure is 6.2% (BBS, 2007; Begum, 1996). Many researchers (Tosell et al., 2001; Bond et al., 2000; Dehoff et al., 2004, etc.) have studied the in-depth patterns of hypertension in different populations of the world. In Bangladesh, some researchers (Ullah, 1976; Syeed et

al., 1994; Chen et al., 2006; Saha et al., 2006; Zaman et al., 2010; Khanam et al., 2011; Islam and Majumder, 2012; Moniruzzaman et al., 2013, etc.) have studied the fundamental situation of hypertension but there is no individually in-depth assessment of hypertension in socio-demographic aspect.

Thus, the socio-demographic determinants of hypertension should be properly investigated. The findings (obtained by logistic regression) of this study may help to understand or establish the socio-demographic determinants of hypertension. This paper is meant to investigate the impact of some selected socio-demographic determinants on hypertension in Bangladesh.

3. DATA AND METHODS

3.1 Data

Using stratified multistage sampling, the data of size 2250 were collected using personal interviews from the population of all people aged above 10 years in the Rajshahi district. Hypertension was measured as a binary explained variable (absent or present) where age and educational level were measured as quantitative explanatory variables; also, sedentary lifestyle, working hours (>8 hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol and excess salt intake were measured as binary explanatory variables. In the case of qualitative variables (sedentary lifestyle, working hours (>8 hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol and excess salt intake), 01 (one) was indicated for present and zero for absent of possessed characteristic. Also, the quantitative variables (age and education) were measured with year.

3.2 Measurement of Hypertension

Blood pressure is measured in millimeters of mercury (mm Hg). Normal blood pressure varies with age, weight, and physical status. Normally, it ranges from 100 to 139 for systolic and from 60 to 89 for diastolic. Thus, blood pressure $\geq$ (140/90) is considered as hypertension and $\leq$ (100/60) is as low blood pressure or hypotension (Bernier, et al., 1997).

3.3 Methods

To examine the general relationship between hypertension and other explanatory variables (age, educational level, sedentary lifestyle, working hours (>8 hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol and excess salt intake), phi correlation and point bi-serial correlation have been used. After examining the existence of the general relationship between hypertension and other explanatory variables, the causal relationship has been analyzed using the binary

backward stepwise logistic regression model. To test the significance of explanatory variables mentioned in the model likelihood ratio test and Wald test have been used. Also, to assess the goodness of fit of the model, the Hosmer-Lemeshow test statistic and Negelkerke R square and receiver operating characteristic (ROC) curve have been used.

4. RESULTS AND DISCUSSION

To draw a basic concept on the background of the study, the percentage distribution of the considered variables in Table 1 is conducted.

Table 1: Percentage Distribution of Socio-demographic Characteristics

Characteristics	**Percent (%)**	**Characteristics**	**Percent (%)**	**Characteristics**	**Percent (%)**
Age (Interval Based on Percentiles) in Years		Working Hour (> 8 hrs) Per Day		Hereditary Hypertension	
10-16	5.70	No	76.2	No	77.6
17-18	5.00	Yes	23.8	Yes	22.4
19-25	17.20	Total	100.0	Total	100.0
26-35	25.20	Taking Regular Exercise		Smoking	
36-39	7.70	No	14.40	No	83.4
40-46	14.80	Yes	85.60	Yes	16.6
47-60	16.90	Total	100	Total	100.0
61-65	2.50	Social Stress		Taking Alcohol	
66-80	4.20	No	90.8	No	97.20
81-95	0.80	Yes	9.2	Yes	2.80
Total	100	Total	100.0	Total	100.0
Educational Level		Occupational Stress		Taking Excess Salt	
Illiterate	31.7	No	78.9	No	48.8
Primary	21.6	Yes	21.1	Yes	51.2
Secondary	33.2	Total	100.0	Total	100.0

Higher Secondary	7.0	Mental Stress		Hypertension	
Graduate and Above	6.5	No	67.3	No	71.9
Total	100.0	Yes	32.7	Yes	28.1
Sedentary Life Style		Total	100.0	Total	100.0
No	69.7				
Yes	30.3				
Total	100				

Among the total respondents, the maximum percentages (25.20%) were in the age group 26-35 years. Our study (Table 1) shows that 31.70% of respondents were illiterate where 68.30% were literate by primary (21.60%), secondary (33.20%), higher secondary (7%), and graduate as well as above (6.5%). A sedentary lifestyle is a type of lifestyle with no or irregular physical activity. A person who lives a sedentary lifestyle may colloquially be known as a couch potato. In this present context, 30.30% of respondents are habituated to a sedentary lifestyle. The well-known and well-established normal working hours per day is 8. However, the same table (Table 1) shows that 23.80% of respondents were working above 8 hours regularly in the study area. Here, regular exercise means physical activeness with normal works of life. 85.60% of respondents took regular exercise. Social stress means pressure that is imposed by the social environment, occupational stress means one kind of pressure is created by the occupational environment and mental stress means pressure that is unexpected by family burden including personal confidential tension. In the situation of social, occupational, and mental stress, 9.2%, 21.10%, and 32.70% were involved with the mentioned characteristics. Hereditary hypertension means hypertension is or was available in any family member. The hereditary hypertension was 22.40%. In addition, 16.60% were smokers and 2.80% of respondents took alcohol. Taking excess salt means taking salt out of curry and 51.20% of respondents took excess salt. Finally, 28.10% were hypertensive patients among the total respondents in our study area.

In statistics, dependence refers to any statistical relationship between two random variables or two sets of data. Correlation refers to any of a broad class of statistical relationships involving dependence. Hence, before finding out the risk factors of hypertension it is important to verify the relationship between hypertension and other selected variables or characteristics. From this view researchers have employed some methods (point bi-serial correlation and phi

correlation method) to study the relationship between hypertension and other selected variables and the results are represented in Table 2.

Table 2: Results of Association between Hypertension and Socio-demographic Variables

	Hypertension	Correlation Coefficients	P-Value
Point Bi-serial Correlation (r_{pbc})	**Age**	$r_{pbc} = 0.37$	0.01
	Educational Level	$r_{pbc} = -0.11$	0.01
Phi Correlation (r_{ϕ})	**Sedentary life Style**	$r_{\phi} = 0.23$	0.01
	Working Hour (> 8 hrs) Per Day	$r_{\phi} = 0.42$	0.01
	Taking Regular Exercise	$r_{\phi} = -0.05$	0.10
	Social Stress	$r_{\phi} = 0.31$	0.01
	Occupational Stress	$r_{\phi} = 0.48$	0.01
	Mental Stress	$r_{\phi} = 0.53$	0.01
	Hereditary Hypertension	$r_{\phi} = 0.28$	0.01
	Smoking	$r_{\phi} = 0.19$	0.01
	Taking Alcohol	$r_{\phi} = 0.21$	0.01
	Taking Excess Salt	$r_{\phi} = 0.45$	0.01

This table depicts that the relationships between hypertension and other variables such as age as well as educational level are highly significant at a 1% level of significance. These two relationships have been studied by point bi-serial correlation because two variables age and educational level are quantitative whereas hypertension is a qualitative variable. In the same table, we see another method for studying relations named phi-correlation which has been employed for all dichotomous variables. Thus, the relationships between hypertension and other variables such as sedentary lifestyle, working hours (>8 hrs) per day, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, and taking excess salt are highly significant at 1% level of significance except taking regular exercise which is significant at 10% level of significance.

After examining the existence of the relationship of socio-demographic variables with hypertension, it is important to analyze the causal relationship between hypertension and other socio-demographic variables. Hence, we have studied the causal relationship by applying the binary logistic regression model. The fitted model and requisite results are displayed in the following:

To study the causal relationship between hypertension and other socio-demographic variables, age is found as a significant variable. i.e. age has a positive significant impact on hypertension and its odds ratio of 1.028 indicates that for every increase of one year in age, the risk of occurring hypertension increases 1.028 times. Secondly, education has a significant negative impact on hypertension and its odds ratio focuses that every increase of one year in education, the risk of hypertension increases by 0.958 times. Thirdly, a sedentary lifestyle has a positive significant impact on hypertension and the odd ratio of 2.924 indicates that the respondents with a sedentary lifestyle have 2.958 times the odds or risk of occurring hypertension compared with those who do not have a sedentary lifestyle. Working hours (>8 hrs) per day has a significant impact on hypertension and the odds ratio indicates that the respondents who work regularly more than 8 hours have 5.019 times the risk for hypertension compared with those who do not work more than 8 hours. Again, regular exercise has a negative significant impact on hypertension and its odds ratio estimates that the respondents who take regular exercise have 0.604 times risk for hypertension compared with those who do not take. Also, social stress, occupational stress, and mental stress have a positive significant impact on hypertension, and odds ratios indicate that the respondents with social, occupational as well as mental stress have 4.727, 4.490 as well as 8.143 times risk respectively to occur hypertension compared with those who do not possess the characteristics. Hereditary hypertension has a positive significant impact on hypertension and a similar odds ratio refers to respondents who possess hereditary hypertension having a 6.047 times risk for occurring hypertension compared with those who do not. Finally, smoking, taking alcohol, and taking access salt also, have a positive significant impact on hypertension and the odds ratios indicate that the respondents who possess the characteristics of smoking, taking alcohol, and taking excess salt have 1.811, 2.924 as well as 14.835 times risk respectively to occur hypertension than who do not possess the characteristics.

Table 3: Results on Impact of Socio-demographic Determinants on Hypertension

Characteristics	Regressor Coefficient β	Standard Error of β	Wald Test	d. f	P - Value	Odds Ratio	95% Confidence Interval	
							Lower	Upper
Age	0.028	0.006	23.174	1	0.01	1.028	.922	.996
Educational Level	-0.043	0.020	4.772	1	0.02	0.958	1.017	1.040
Sedentary Life Style								

No (r)	-	-			-	-		
Yes	1.073	0.172	38.860	1	0.01	2.924	2.087	4.098
Working Hour (> 8 hrs) Per Day								
No (r)	-	-			-	-		
Yes	1.613	0.179	81.530	1	0.01	5.019	3.536	7.123
Taking Regular Exercise								
No (r)	-	-			-	-		
Yes	-0.504	0.228	4.877	1	0.02	0.604	.386	.945
Social Stress								
No (r)	-	-			-	-		
Yes	1.553	0.243	40.777	1	0.01	4.727	2.935	7.615
Occupational Stress								
No (r)	-	-			-	-		
Yes	1.502	0.188	64.145	1	0.01	4.490	3.109	6.484
Mental Stress								
No (r)	-	-			-	-		
Yes	2.097	0.167	157.468	1	0.01	8.143	5.868	11.299
Hereditary Hypertension								
No (r)	-	-			-	-		
Yes	1.800	0.183	96.482	1	0.01	6.047	4.223	8.660
Smoking								
No (r)	-	-			-	-		
Yes	0.594	0.202	8.645	1	0.01	1.811	1.219	2.691
Taking Alcohol								
No (r)	-	-			-	-		
Yes	1.073	0.535	4.017	1	0.04	2.924	1.024	8.350

Taking Excess Salt								
No (r)	-	-			-	-		
Yes	2.697	0.194	193.051	1	0.01	14.835	10.141	21.703
Constant	-6.218	0.419	220.058	1	0.01	0.002		

Note: r represents the reference category.

After discussing the binary logistics regression it is established that a sedentary lifestyle, working hours (>8) per day, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, taking excess salt may be considered as risk factors for raising high blood pressure or hypertension. Though age may be considered as a risk factor, but age increasing is out of human control.

We begin our discussion on the results of methods for assessing the fit of an estimated logistic regression model with the assumption that we are at least preliminarily satisfied with our efforts at the model-building stage. By this, we mean that, to the best of our knowledge, the model contains those variables that should be in the model, and that variables have been entered in the correct functional form. Now we would like to know how effectively the model we have describes the outcome variable by R square, Hosmer-Lemeshow, and classification table. Also, the results of the assessment are displayed in following table 4.

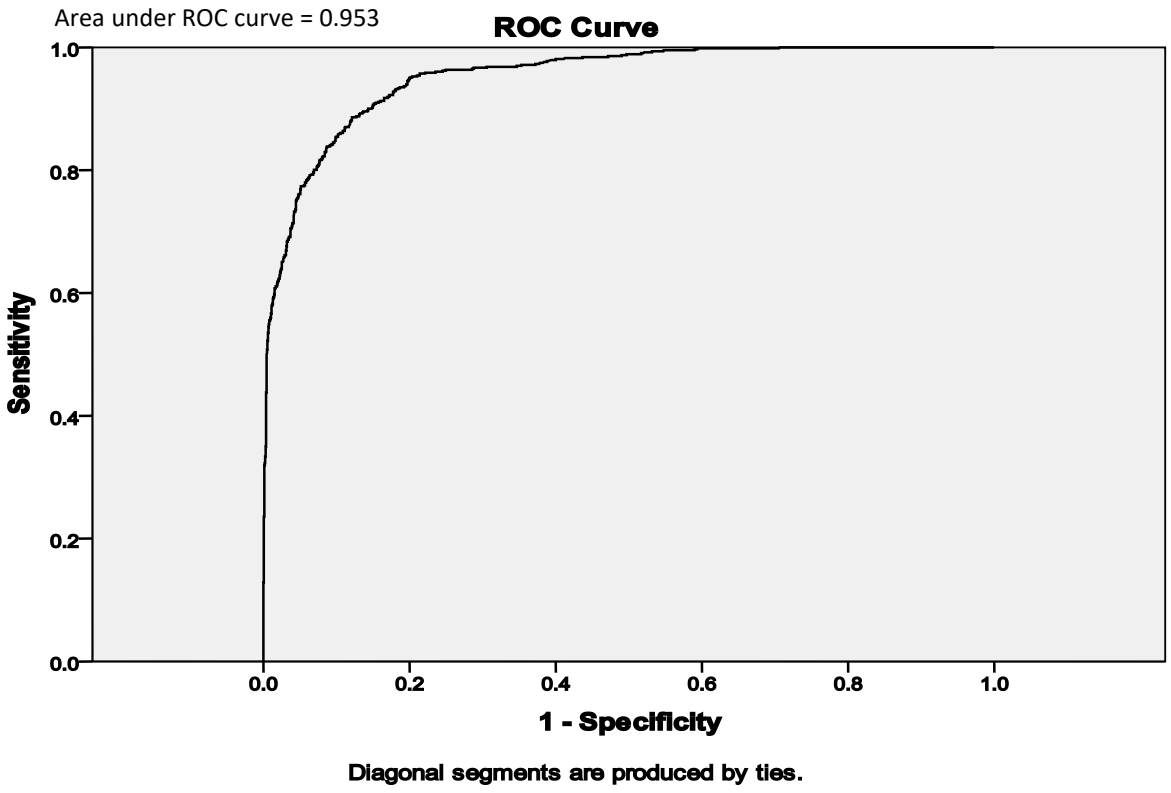
Table 4: Results of Assessment of Fitted Logistic Regression Model

-2 Log likelihood	**Cox & Snell R Square**	**Nagelkerke R Square**
1096.054	0.51	0.75

Hosmer and Lemeshow Statistic	**df**	**P - Value**
4.164	8	0.85

Classification Table		**Predicted Hypertension**		**%**
		No	**Yes**	
Observed Hypertension	**No**	1526	92	95 (specificity)
	Yes	141	491	78 (sensitivity)
				90
Area Under ROC Curve = 0.953				

The table 4 depicts the value of Negelkerke R square is 0.75 which implies that all selected variables of the logistic regression model have explained 75% of the outcome variable. Also, the value of the Hosmer-Lemeshow goodness-of-fit statistic is 4.164 and the corresponding p-value is 0.85 with 8 degrees of freedom which indicates that the model seems to fit quite well. The results of classifying the observations of hypertension using a fitted logistic regression model are presented in the same table. The overall rate of correct classification is estimated as 90% with 95% of the hypertension-free group (specificity) and only 78% of the hypertensive group (sensitivity) being correctly classified. A more complete description of classification accuracy is given by the area under the ROC curve which provides a measure of the model's ability to discriminate between those subjects who experience the outcome of interest versus those who do not. The area under the ROC curve in the present study for socio-demographic aspects is 0.953 which indicates that the model's ability is excellent to discriminate between those respondents who have hypertension than who do not have.



Bootstrapping is a re-sampling method for estimating the sampling distribution of an estimator by sampling with replacement from the original sample, most often with the

purpose of deriving robust estimates of standard errors and confidence intervals of a population parameter like a mean, median, proportion, odds ratio, correlation coefficient or regression coefficient. The bootstrapping method is used for logistic regression coefficients of socio-demographic factors. Using the bootstrapping method, regression coefficients of socio-demographic factors have been found approximately the same as comparing the logistic regression coefficients. The small amount of bias may be ignored. These results are shown the following Table 5.

Table 5: Logistic regression for socio-demographic aspect by bootstrapping

Bootstrap	Logistic Regressor Coefficient (β)	Bootstrapping Regressor Coefficient (β)	Bias	Standard Error of β	P-value	95% Confidence Interval	
						Lower	Upper
Educational Level	-.043	-.043	-.001	.019	.024	-.079	-.008
Age	.028	.028	.000	.006	.001	.016	.040
Sedentary Life Style	1.073	1.073	.007	.175	.001	.744	1.423
Working Hour (> 8 hrs) Per Day	1.613	1.613	.014	.187	.001	1.246	2.011
Taking Regular Exercise	-.504	-.504	-.007	.243	.035	-.964	-.024
Social Stress	1.553	1.553	.016	.284	.001	1.025	2.118
Occupational Stress	1.502	1.502	.023	.202	.001	1.115	1.930
Mental Stress	2.097	2.097	.029	.163	.001	1.816	2.461
Hereditary Hypertension	1.800	1.800	.017	.184	.001	1.471	2.210
Smoking	.594	.594	-.013	.229	.005	.124	1.032
Taking Alcohol	1.073	1.073	.039	.623	.065	-.028	2.415
Taking Excess Salt	2.697	2.697	.053	.207	.001	2.369	3.152
Constant	-6.218	-6.218	-.080	.431	.001	-7.184	-5.454

5. CONCLUSION

The study attempts to investigate the socio-demographic determinants of hypertension in Bangladesh using stratified multistage sampling. It has been revealed that 71.90% of respondents are normotensive and 28.10% are hypertensive. In the socio-demographic aspect, the highest 25.20% are in the age group 26-35 years among total respondents. 31.70% of respondents are illiterate and 68.30% are literate by primary (21.60%), secondary (33.20%), higher secondary (7%), and graduate as well above (6.5%). The percentages of sedentary lifestyle, working hours (>8hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, taking excess salt, and hypertension are 30.30%, 23.80%, 85.60%, 9.2%, 21.10%, 32.70%, 22.40%, 16.60%, 2.80%, 51.20% and 28.10% respectively.

Age, educational level, sedentary lifestyle, working hours (>8hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, taking excess salt are statistically highly related to hypertension at one percent level of significant except taking regular exercise. Also, a sedentary lifestyle, working hours (>8hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, and taking excess salt have a statistically high impact on hypertension. The socio-demographic variables sedentary lifestyle, working hours (>8hrs) per day, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, and taking excess salt may be considered as risk factors for raising high blood pressure or hypertension. Though age may be considered as a risk factor, but age increasing is out of human control.

The information stated above may help decision makers to reach better decisions and guide stakeholders to launch different medical programs such as awareness development programs, regular free health checkup programs, etc. It is an open problem to find out a medical reference chart (age-specific and occupational blood pressure chart) for measuring blood pressure in the context of the Bangladesh population. Due to different weaknesses, we cannot conduct medical chart-related research. After collecting this type of data our country may conduct the reference chart.

References

Begum, S. (1996). *Health dimensions of poverty in Bangladesh*. Bangladesh Institute of Development Studies (BIDS).

Bernier, D. R., Langan, J. K., & Wackers, F. J. T. (1997). *Nuclear medicine technology an techniques(4th ed.),* Mosby-Year Book Inc.

Bond, V., Franks, B., Coady, S., & Young, D. R. (2000). Blood pressure reactivity to mental stress and aerobic fitness in normotensive young adult African-American males with parental history of hypertension. *Stress Medicine, 16*(4), 219-227.

Bangladesh Bureau of Statistics (BBS). (2007). Statistical year book 2006. *Bangladesh Bureau of Statistics (BBS).*

Chobanian, A. V., Bakris, G. L., Black, H. R., Cushman, W. C., Green, L. A., Izzo, J. L., Jones, D. W., Materson, B. J., Oparil, S., Wright, J. T., & Roccella, E. J. (2003). Seventh report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure: The JNC 7 report. *Hypertension, 42*(6), 1206-1252. https://doi.org/10.1161/01.HYP.0000107251.49515.c2

Chen, Y., Islam, A., & Reza, M. (2006). Nutritional influence on risk of high blood pressure in Bangladesh: A population-based cross-sectional study. *American Journal of Clinical Nutrition,* 84*(5),* 1224-1232.

Dolea, C., AbouZahr, C., & Stein, C. (2003). Global burden of hypertensive disorders of pregnancy in the year 2000*. World Health Organization (WHO).*

Dehoff, C., Wilke, R., Cramer, M., & Kramer, P. (2004). Characteristics of contemporary patients with hypertension and coronary artery disease. *Clinical Cardiology, 27*(12), 571-576.

Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression* (2nd ed.). *John Wiley & Sons*.

Islam, N. M. (2008). An introduction to research methods*. Mullick & Brothers,* Newmarket, Dhaka-1205.

Islam, A. K. M. M., & Majumder, A. A. (2012). Hypertension in Bangladesh: A review. *Indian Heart Journal,* 64*(3),* 319-323.

Khanam, M. A., Khan, H., Kabir, I., & Islam, R. (2011). Hypertension: Adherence to treatment in rural Bangladesh—Findings from a population-based study. *13th ASCON, 08*(117). ICDDR,B.

Khan, K. S., Wojdyla, D., Say, L., Gülmezoglu, A. M., & Van Look, P. F. (2006). WHO analysis of causes of maternal death: A systematic review. *The Lancet, 367*(9516), 1066-1074. https://doi.org/10.1016/S0140-6736(06)68397-9

Moniruzzaman, M., Rahman, M., & Zaman, M. (2013). Prevalence of hypertension among the Bangladeshi adult population: A meta-analysis. *Regional Health Forum, 17*(1), 14-19.

Odell, C. D., & Amthor, R. F. (2006). Maternal hypertension as a risk factor for low birth weight infants: Comparison of Haitian and African-American women. *Maternal and Child Health Journal*, 10(1), 1-8.

Syeed, M. A., Islam, M. N., & Rahman, M. A. (1994). Blood pressure and glycemic status in relation to body mass index in rural population of Bangladesh. *Bangladesh Medical Research Council Bulletin, 20*(2), 27-35.

Saha, M. S., Saifuddin, M., & Haque, M. (2006). Serum lipid profile of hypertensive patients in the northern region of Bangladesh. *Journal of Bio-Science*, 14(1), 93-96.

Tosell, S., Baker, P. T., & Little, M. A. (2001). Body size, composition, and blood pressure of high-altitude Quechua from the Peruvian Central Andes. *American Journal of Human Biology*, 13(4), 539-547. https://doi.org/10.1002/ajhb.1077

Ullah, W. (1976). Hypertension in a mixed community. *Bangladesh Medical Research Council Bulletin*, 2(2), 95-98.

World Health Organization (WHO). (1978). *Report of WHO scientific group: Classification of hypertension* (Technical Report Series-657). World Health Organization (WHO).

World Health Organization (WHO). (2001). Prevalence, awareness, treatment, and control of hypertension among the elderly in Bangladesh and India: A multicentre study. *Bulletin of the World Health Organization, 79*(6), 490-500.

World Health Organization (WHO). (2002a). World Health Report 2002: Reducing risk promoting healthy life. *World Health Organization (WHO).*

World Health Organization (WHO). (2002b). *Mortality country fact sheet 2006. World Health Organization (WHO).* http://www.worldmapper.org/display_extra.php?selected=455

Zaman, M. S. M., Karim, M. N., & Rahman, M. (2010). Management of hypertension: A Bangladeshi perspective. *Bangladesh Medical Journal*, 39(1), 1-5.