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Determinants of Hypertension in Bangladesh: A Case Study of Rajshahi District

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Determinants of Hypertension in Bangladesh: A Case Study of Rajshahi District

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CERTIFICATE

This is to certify that the thesis entitled "Determinants of Hypertension in Bangladesh: A Case Study of Rajshahi District" is a record of original research work, for the degree of Doctor of Philosophy in Statistics, done by our research fellow Mr. Mazharul Islam, Department of Statistics, University of Rajshahi, Rajshahi-6205, Bangladesh. We further certify that the research work has not previously been submitted elsewhere for any other degree or diploma.

This thesis addressed age-specific hypertension patterns, alarming age for hypertension, and many determinants of hypertension in Bangladesh, e.g., feminine and nuptial determinants, socio-demographic determinants, health complication determinants, and body composition determinants. Most important determinants were selected using sophisticated statistical tools.

We wish him all successes.

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DECLARATION

I do hereby declare that the thesis entitled "Determinants of Hypertension in Bangladesh: A Case Study of Rajshahi Distric" submitted to the Department of Statistics, University of Rajshahi, Rajshahi-6205, Bangladesh for the partial fulfillment of the requirements of the Degree of Doctor of Philosophy (Ph. D) in Statistics. This is a record of original and independent research work done by me under the supervision of Md. Ayub Ali, Ph. D, Professor, Department of Statistics, University of Rajshahi, Bangladesh; Md. Nazrul Islam Mondal, Ph. D, Associate Professor, Department of Population Science and Human Resource Development, University of Rajshahi, Bangladesh and Md. Ayub Ali, MBBS, MD Assistant Professor, Cardiology Department, Rajshahi Medical College, Rajshahi, Bangladesh. It has not been submitted elsewhere for any other degree or diploma.

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In fine, I am alone responsible for the errors and shortcomings in this study, if there be any, I am sorry for that.

Mazharul Islam

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ABSTRACT

Hypertension is a silent killer of human life and the numbers of hypertensive patients are increasing globally and nationally. Therefore, the purpose of the study was to investigate age-specific hypertension patterns, alarming age for hypertension, and many determinants of hypertension in Bangladesh, e.g., feminine and nuptial determinants, socio-demographic determinants, health complication determinants, and body composition determinants. The data were collected from Rajshahi district using stratified multistage sampling with technique based on the scheduled questionnaire for this study. To identify the most important determinants, sophisticated statistical tools have been used such as percentage distribution, point bi-serial correlation, phi correlation, Pearson product-moment correlation, path analysis, boot strapping technique, binary backward logistic regression method including Likelihood ratio test, Hosmer-lemeshow test, Nagelkerke R^2, Sensitivity and specificity, receiver operating characteristics (ROC) curve etc. It was found that the number of systolic hypertensive patients (60.40%) were greater than diastolic hypertensive patients (47.90%) in old age group (≥61 years) where diastolic hypertensive patients (7.40%) were greater than systolic hypertensive patients (3.80%) in young age group (≤39 years) and in middle age group (40-60 years) both are same. Hence, young age (≤39 years) was risk period for occurring diastolic hypertension than systolic and old age (≥61years) was risk period for occurring systolic hypertension than diastolic when middle age (40-60 years) was also risk period for occurring both type of hypertension. The differences between two same percentiles of systolic and diastolic blood pressure were varying from 51 mmHg to 93 mmHg for hypertensive respondents where it is same for normotensive. Hence, the abnormality (>40 mmHg) of the differences is an indicator of hypertension or prehypertension.

From the view of proper critical analysis of impact of some key factors on hypertension, the study was divided into four aspects such as socio-demographic, feminine and nuptial, health complication and body composition aspects. About 28.10% hypertensive patients were due to socio-demographic aspect. Applying binary logistic regression model in the study of causal relationship, age was found as the most significant variable. i. e. age had positive significant impact on hypertension. Secondly, education had second most significant negative impact on hypertension and its odds ratio focus that for every increase of one year in education, the risk of hypertension increased 0.958 time. It was also found that sedentary life style, working hour (>8 hrs) per day, social stress, occupational stress and mental stress, hereditary hypertension, smoking, taking alcohol and taking excess salt had positive significant impact on raising hypertension where taking regular exercise had negative significant impact on hypertension. Hence, sedentary life style, working hour (>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 the age was found to be as the highest risk factor, but age increasing is out of human control.

In the health complication aspect, the adult hypertensive patients were 30.60%. In the analysis of causal relationship (applying binary backward logistic regression method) between hypertension and other health complication, kidney disease was found as a significant variable. i. e. kidney disease had positive significant impact on hypertension and its odds ratio 5.428 indicates that the respondents with kidney disease had 5.428 times risk to occur hypertension than the respondent without kidney disease. Also, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and overweight had the positive significant impact for occurring hypertension. After discussing the binary logistic regression it was further found that kidney disease, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and overweight might be considered as risk factors for raising high blood pressure or hypertension.

In selected feminine and nuptial aspect, the active married female hypertensive patients were 28.90%. In the study of causal relationship (applying backward binary logistic regression model) between hypertension and other feminine and nuptial characteristics, first menstruation age was found to be as significant variable. i. e. first menstruation age had negative significant impact on hypertension. Duration of couple life had significant positive significant impact on hypertension. Use of contraceptive method, menopause, pregnancy and miscarriage had positive significant impact for occurring hypertension compared with those who do not possesses the characteristics. Hence, first menstruation age, duration of couple life, use of contraceptive method, menopause, pregnancy and miscarriage might be considered as risk factors or determinants for raising high blood pressure or hypertension.

Using path analysis, the total effect of body mass index, abdominal circumference and ratio of waist to hip on systolic blood pressure were 0.207, 0.185 and 0.118 respectively in which their direct effect were respectively 0.146, 0.082 and 0.047. The total effect of body mass index, abdominal circumference and ratio of waist to hip on diastolic blood pressure were 0.289, 0.231 and 0.138 respectively in which their direct effect were respectively 0.231, 0.079 and 0.043.

CHAPTER 1
INTRODUCTION

1.1 Prelude

The study on hypertension is designed to make a broad analysis about the patterns of hypertension in Bangladesh and examine the risk factors of hypertension by in-depth assessment. Before beginning the study on hypertension it is important to know about hypertension. Hypertension is nothing but high blood pressure and high blood pressure is higher level of blood pressure. Also, blood pressure is the lateral pressure exerted on the walls of the arteries by blood flowing through the arteries. It reflects the rhythm of the heart beat and is a measure of the volume of blood pressure into the vessels by the heart. The pressure of blood within the arteries is highest whenever the heart contracts and is called systolic pressure. Between beats, when the ventricles are at rest, arterial pressure is at its lowest and is called diastolic pressure. The blood circulation system is shown below:

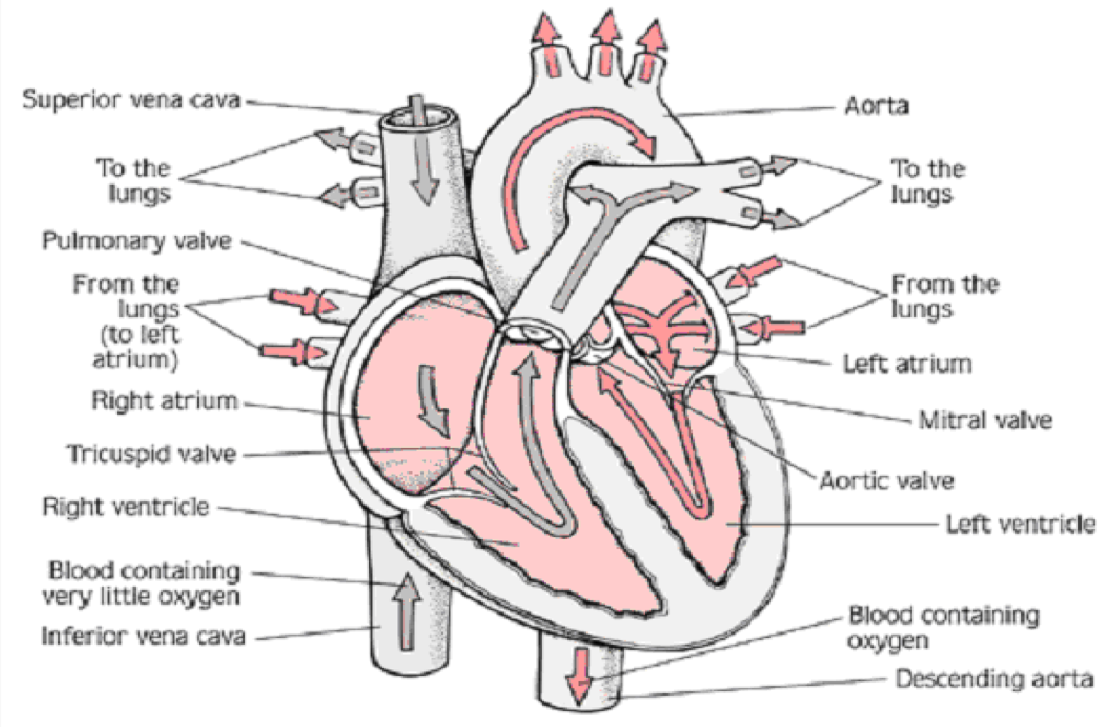


Figure 1.1: A picture of blood circulation in human heart

The table-1.1 gives the classifications of blood pressure as following:

Table 1.1: Classification of blood pressure for adults (18 years and above)

Category	**Systolic (mmHg)**	**Diastolic (mmHg)**
Hypotension or Low Blood Pressure	< 90	< 60
Normal	90–119	60–79
Prehypertension	120–139	80–89
High Blood Pressure or Hypertension		
Stage 1 Hypertension	140–159	90–99
Stage 2 Hypertension	160–179	100–109
Hypertensive Crisis	≥ 180	≥ 110

Source: AHA, 2011; MFMER, 2010

Health is wealth and sound health of Bangladeshi people's is the primary goal of all development plans. But the poor health of Bangladeshi people is an intractable problem as poverty. Poor health is occurred due to poverty, malnutrition, disease, lack of education, sex discrimination etc. Among the mentioned causes disease plays destructive role on health. There is no any disease (such as Arthritis, Asthma, AIDS, Beriberi, Bronchitis, Cancer, Coronary Heart Disease, Chickenpox, Cholera, Cowpox, Dengue, Eye Damage, Diabetes, Diphtheria, Gastroenteritis, Goiter, Gonorrhea, Heart Attack, Heart Failure, Hepatitis A, Hepatitis B, Hepatitis C, Hepatitis D, Hepatitis E, Hypertension, HIV, Hypothermia, Ischemic Heart Disease, Influenza, Kidney Disease, Lung Cancer, Malaria, Paralysis, Rheumatic Fever, Rheumatic Heart Disease, Stroke, Scabies, Smallpox, Stomach Ulcers, Syphilis, Thalassaemia, Tonsillitis, Tuberculosis, Typhoid etc.) which cannot lead the poor health. Among the leading diseases hypertension is one which may lead to heart attack, stroke, heart failure, paralysis, kidney disease, eye damage etc. (Chobanian, 2003). Hence, hypertension is a risk factor of premature death and a barrier of sound health. So, it is essential to formulate an appropriate strategy to control hypertension for healthy life.

1.2 Identification of the research problem

Discussing the literature reviews (Hoque et al., 2012; Islam et al., 2012; Islam et al., 2012; Rahim et al., 2012; ICDDR, B, 2011; Khanam et al., 2011; Kokiwar, 2011; Zaman et al., 2010; Midha et al., 2009; Agrawal et al., 2008; Chen et al., 2006a; Chen et al., 2006b; Saha et al., 2006; Alamgir et al., 2005; Chen, 2005; Sayeed et al., 2005; Zamudio et at., 2005; Cooper-Dehoff et al., 2004; Chobanian et al., 2003; Sayeed et al., 2003; Sayeed et al., 2002; Hannan et al., 2001; Moula et al., 2001; WHO, 2001; Bond et al., 2000; Rahaman et al., 1999; Zaman and Rouf, 1999;Chowdhury et al., 1998; Hoque et al., 1998; Sayeed et al., 1995; Sayeed 1994; Khandakar, 1993; Islam et al., 1983; Islam et al., 1979; Ullah, 1976;) mentioned in chapter 2, it is clear that many studies about hypertension in nationally and internationally have been conducted in biological aspect through a lot of researchers or institutions. But the mentioned knowledgeable sources (literature reviews) indicate that any expected research about the risk factors of hypertension in socio-demographic aspect, feminine and nuptial aspect, health complications aspect and body composition aspect has not yet been conducted. Hence, some questions may be asked as following:

i. Are there any age patterns as risk factors of hypertension?

ii. Are there any socio-demographic risk factors of hypertension?

iii. Are there any feminine and nuptial risk factors of hypertension?

iv. Are there any health complications risk factors of hypertension?

v. Are there any body composition risk factors of hypertension?

More than one reasons or risk factors are suspected for developing hypertension in the mentioned fields. The suspected risk factors are examined by this study.

1.3 Statement of the research problem

Indisposition is the universal fact and there is no such powerful and manifest problem in human life. So, every person expects that he/she is not to be ill. On the contrary, if it is occurred, it is to be remediable. Every indisposition is an effect of any of diseases or causes. From the beginning of human life till now, any of diseases continuously plays an inconsolable impact on human life such as Tuberculosis, Cholera, Typhoid, Malaria, Pox, Hypertension, Diabetes, Kidney disease and stroke etc. The prevalence of such kind of diseases is spreading day by day. As a result the mortality, cause specific deaths and burden of various diseases are increasing. WHO (2003) reveals that almost 57 million people died in 2002, 10.5 million (or nearly 20%) of whom were children aged under 5 years. Of these child deaths, 98% occurred in developing countries including Bangladesh and other countries. Overall 60% of deaths in developed countries occur beyond age 70, compared with about 30% in developing countries. A key point is the comparatively high number of deaths in developing countries at younger adult ages (15-59 years). Just over 30% of all deaths in developing countries occur at these ages, compared with 20% in richer regions. This vast premature adult mortality in developing countries is a major public health concern. From same report the disease burden information according to age and level of country development are shown in Table 1.2.

Table 1.2: Percentage distribution of disease burden by age and regions

Age groups (in years)	**Whole world**	**Developed regions**	**Low mortality developing regions**	**High mortality developing regions**
0-4	29	6	18	40
5-14	7	4	6	9
15-59	49	57	57	43
60+	15	33	19	8

Source: WHO, 2003

Man is mortal but the premature death is unexpected and maximum premature deaths are occurred by any of diseases or causes. Among leading disease which occur the premature death, hypertension is one of them. World wide prevalence estimates for hypertension may be as much as 1 billion individuals, and approximately 7.1 million deaths per year may be attributable to hypertension (WHO, 2002). This study also reports that systolic blood pressure (>115 mm Hg) is responsible for 62% of cerebrovascular disease and 49% of ischemic heart disease, with little variation by sex. In addition, suboptimal blood pressure is the number one attributable risk for death through-out the world (WHO, 2002). Since most blood pressure related deaths or non fatal events occur in middle age or the elderly, the loss of life years comprises a smaller proportion of the global total, but it is nonetheless substantial (64.3 million disease burden, or 4.4 % of the total) (WHO, 2002). An another report Chobanian (2003) shows that, in the people older than age 50, systolic blood pressure of greater than 140 mm Hg is a more important cardiovascular disease risk factor than diastolic blood pressure; beginning at 115/75 mm Hg, cardiovascular risk doubles for each increment of 20/10 mm Hg; those who are normotensive at 55 years of age will have a 90% lifetime risk of developing hypertension; prehypertensive individuals (systolic blood pressure 120-139 mm Hg or diastolic blood pressure 80-89 mm Hg) require health-promoting lifestyle modifications to prevent the progressive rise in blood pressure and cardiovascular diseases. According to WHO (2001), developing countries are thus likely to face an enormous burden of chronic non-communicable diseases in the near future. Of these diseases, hypertension is the most common of the Cardio-vascular diseases which is the leading cause of morbidity and mortality in the industrial world as well as becoming an increasing common disease in the developing countries (Saha, et al., 2006). The twenty leading causes of deaths in world wide and top ten causes of deaths by development of status and income groups' status of country are shown below (Table 1.3, Table 1.4 and Table 1.5):

Table 1.3: Worldwide top twenty leading causes of deaths

Causes of death	%	Causes of death	%
Ischemic heart disease	12.6	Diabetes mellitus	1.73
Cerebrovascular disease	9.7	Hypertensive heart disease	1.60
Lower respiratory infections	6.8	Suicide	1.53
HIV/AIDS	4.9	Stomach cancer	1.49
Chronic obstructive pulmonary disease	4.8	Cirrhosis of the liver	1.38
Diarrhoeal diseases	3.2	Nephritis/nephropathy	1.19
Tuberculosis	2.7	Colorectal cancer	1.09
Malaria	2.2	Liver cancer	1.08
Trachea/Lung cancers	2.2	Measles	1.07
Road traffic accidents	2.1	Violence	0.98

Source: WHO, 2004

Table 1.4: Top ten causes of deaths in developing and developed countries

Developing countries		Developed countries	
Causes	**Number of deaths**	**Causes**	**Number of deaths**
HIV/AIDS	2678000	Ischemic heart disease	3512000
Lower respiratory infections	2643000	Stroke	3346000
Ischemic heart disease	2484000	Chronic obstructive pulmonary disease	1829000
Diarrhoeal diseases	1793000	Lower respiratory infections	1180000
Cerebrovascular disease	1381000	Lung cancers	938000
Childhood disease	1217000	Car accidents	669000
Malaria	1103000	Stomach cancer	657000
Tuberculosis	1021000	High blood pressure	635000
Chronic obstructive pulmonary disease	748000	Tuberculosis	571000
Measles	674000	Suicide	499000

Source: WHO, 2004

Table 1.5: Top Ten causes of deaths of high, middle and low income countries

Causes of deaths	High income countries (%)	Middle income countries (%)	Low income countries (%)
Coronary heart disease	17.10	13.40	10.80
Stroke and other cerebrovascular disease	9.80	14.60	6.00
Trachea, bronchus, lung cancers	5.80		
Lower respiratory infections	4.30	3.30	10.00
Chronic obstructive pulmonary disease	3.90	7.60	3.10
Colon and rectum cancers	3.30		
Alzheimer and other dementias	2.70		
Diabetes mellitus	2.70		
Breast cancer	1.90		
Stomach cancer	1.80	2.80	
HIV/AIDS		3.00	7.50
Perinatal conditions		2.90	6.40
Hypertensive heart disease		2.60	
Trachea, bronchus, lung cancers		2.70	
Road traffic accidents		2.60	1.90
Diarrhoeal diseases			5.40
Malaria			4.40
Tuberculosis			3.80

Source: WHO, 2007; WB, 2007

Maternal death is an important factor which snatches away at least two life. The causes of maternal death vary by United Nations (UN) region. Hypertension is the first leading cause of maternal mortality in Latin America, accounting for 25.7% of maternal deaths, and also in Developed countries it is second leading cause of maternal health, where it accounts for 14.9% of maternal deaths (Khan, et al., 2006). In Asia and Africa, hypertensive disorders, causing 9.10% of maternal deaths. The most important cause of maternal death is "other direct causes" (21%), which includes largely complications during interventions such as those related to caesarean section and anesthesia, followed by hypertensive disorders and embolism (Khan, et al., 2006). The leading causes of maternal deaths according to regions are shown (Table 1.6).

Table 1.6: Causes of maternal deaths in Africa, Asia, Latin America and developed countries

Causes of Death	**Africa (%)**	**Asia (%)**	**Latin-america (%)**	**Developed countries (%)**
Haemorrhage	33.9	30.8	20.80	13.40
Other indirect causes of deaths	16.7	12.50	3.90	14.40
Sepsis	9.7	11.60	7.70	2.10
Hypertensive disorders	9.1	9.10	25.70	16.10
HIV/AIDS	6.2	0.00	0.00	0.00
Unclassified deaths	5.4	6.10	11.70	4.80
Other direct causes of deaths	4.9	1.60	3.80	21.30
Obstructed labor	4.1	9.40	13.40	-
Abortion	3.9	5.70	12.00	8.20
Anaemia	3.7	12.80	0.10	-
Embolism	2.0	0.40	0.60	14.90
Ectopic pregnancy	0.5	0.10	0.50	4.90

Source: Khan, et al., 2006

Also, deaths were occurred by blood pressure are greater in developed countries than developing countries for both sex and counting percentages of the deaths by development regions and sex are given (Table 1.7) (WHO, 2002).

Table 1.7: Deaths by blood pressure in developing and developed countries

Developing Countries				Developed Countries	
High Mortality		Low Mortality		Males (%)	Females (%)
Males (%)	Females (%)	Males (%)	Females (%)	20.1	23.9
7.4	7.5	12.7	15.1		

Source: WHO, 2002

From the world wide information discussed above, it is undoubtedly clear that high blood pressure, other diseases caused by hypertension and blood pressure related diseases plays a vulnerable impact on premature deaths of human life. Since the percentage is small with respect to total world population, but the amount is sustainable. Now, the major concentration of our study is about hypertension disease and risk factors of hypertension which lead to the development of hypertension in national context.

The people's Republic of Bangladesh located in the South Asia is the most densely populated country in the world having 14,23,19,000 people in a small area of 1,47,570 sq. km. (BBS, 2011b). The country emerged as an independent and sovereign country on 16th December, 1971 after long term domination and exploitation by the British and Pakistan rule. Due to long term domination, exploitation and massive destruction by liberation war, the national economy has resulted in fragile feature such as scanty natural resources, low per capita income (444 US$), illiteracy, large population, high mortality, massive malnutrition, 55/53 years healthy life expectancy for male/female respectively, total expenditure on health per capita 64 US$, and total expenditure on health as 3.1% of GDP (WHO, 2011a; GOB, 2001). Finally, our country is familiar as low income and developing country with high mortality (WB, 2007; WHO, 2002). The mortality rate is 9.23 per thousand and the healthy life expectancy in Bangladesh is 56 where the life expectancy/birth is 69.40 (WHO, 2010). A vast portion of total mortality rate is affected by premature deaths. Among the causes of premature or unexpected death hypertension is one which also leads to various diseases of premature deaths. Hypertension is one of top thirteen diseases of deaths in Bangladesh and causes 1.91% of total deaths (WHO, 2010). In the same report, hypertension related coronary heart disease (17.11%) and stroke (8.57%) are the first and third leading causes of total deaths (WHO, 2010). Another report reveals that hypertension related Ischemic heart disease is the first leading causes of deaths in Bangladesh, accounting for 12% of total deaths (WHO, 2006). An investigation represents that 27.40% of casus-specific deaths which caused by different causes have been occurred by hypertension related disease such as Ischemic heart disease, rheumatic heart disease, hypertensive heart disease, cerebrovascular diseases, inflammatory heart diseases etc. (WHO, 2011b). The death rates due to hypertension and hypertension related diseases are increasing day by day. The increasing deaths by high blood pressure and high blood pressure related disease are shown in Table 1.8.

Table 1.8: Deaths (%) by hypertension and hypertension related disease

Years ⟶	1987	1990	1992	1995	1997	1997-2001	2002	2004
Cardiovascular Diseases	2.1	4.8	6.5	6.6	10.0	15.4	10.51	25.3
Years ⟶	2002	2003	2004	2006	2010			
Hypertension, Heart Disease, Stroke	10.51	10.64	10.57	13.53	16.30			
Hypertension	-	-	-	-	2.6			

Source: BIDS, 2001; BBS, 2005; BBS, 2007a; BBS, 2007b; BBS, 2011; BBS, 2012

Also, 10.51% deaths have been occurred by blood pressure, heart disease as well as stroke and prevalence of morbidity by blood pressure is 6.20% (BBS, 2005; Begum, 1996). In another study, about 4% deaths were due to hypertensive complications in Bangladesh (BHSR, 1998).

The prevalence of hypertensive diabetic is increasing rapidly in Bangladesh (Hoque, et al., 2012). A report reveals that the overall prevalence rates of systolic and diastolic hypertension in the Bangladesh population were 14.40% and 9.10%, respectively (Sayeed, et al. 2002). The crude prevalence of systolic and diastolic hypertension in Bangladesh is 6.80% and 5.40%, respectively (Sayeed, et al., 2005). In an investigation, 11.30% adult people are affected by hypertension (Zaman and Rouf, 1999). Though the number of deaths by hypertension is little, deaths by hypertension related diseases is a major part of total deaths and increasing day by day. Also, the mentioned report proves that the large number of people of Bangladesh living with hypertension and it is increasing day by day.

Although a lot of development programs are being implemented all over the country, Bangladesh is still considered as high mortality and least developed countries in the world. To reduce the high mortality especially premature deaths the Bangladesh Government have taken various initiatives, some of these have been success and some are running. Also various international and non government institutes have taken necessary steps to reduce cause-specific deaths and to improve the health condition. It is apparent from the above discussion that the total health expenditure of government is a countable part and taken steps against diseases by government as well as non government and international institutes are valuable. But in spite of undertaken large health development programs after independence in 1971, the health development (by controlling the spread of various disease in timely) of Bangladeshi people has not been remarkably achieved. The prevalence of various disease including hypertension and related diseases are spreading uncontrollably. So, there may have some problems in the mode of health development strategy and also, may have the gap to establish the risk factor of various disease including hypertension. However, it is evident from the above features that some problem exists in hypertension disease control programs and in study to recognize the risk factors of hypertension in Bangladesh and also, a sufficient number of systematic and in-depth research work has not yet been conducted at grass root level in nationally and individually to explore nature, patterns, risk factors and impact of hypertension. Hence, the risk factors of hypertension ought to be evolved through critical analysis. From this view the researcher under took to carry out this research and present research work may point out the socio-demographic risk factors, feminine risk factors, health complications risk factors and body composition risk factors. Also, the research work provides some policy recommendations to obtain any significant progress.

1.4 Objectives of study

The ultimate objective of the present study is to help the policy makers providing evidence based information to take necessary steps for controlling hypertension and related diseases as well as to motivate public by the research findings in order to improve their consciousness. Also, the specific objectives of this study are the answers of the above research question which are to:

i. estimate the percentiles of age;
ii. compare the age-specific systolic and diastolic hypertension;
iii. compare the systolic and diastolic hypertension in hypertensive and normotensive respondents;
iv. investigate the socio-demographic risk factors of hypertension;
v. identify the health complication risk factors of hypertension;
vi. investigate the feminine and nuptial risk factors of hypertension;
vii. investigate the body compositions risk factors of hypertension.

1.5 Justification of the study

Health is the root of all happiness. But the disease is great challenge for sound public health. Among various diseases hypertension is a silent killer of human life. The numbers of patients affected by hypertension in Bangladesh are increasing day by day. The persistence of high blood pressure may lead to various health complications or diseases such as Cardiovascular disease, Cerebrovascular disease, Ischemic disease, Chest pain, Heart attack, Stroke, Paralysis, Heart failure, Renal failure, Blindness etc. So, the bad impacts of hypertension impede the normal activities of heart and snatch away peace as well as happiness and therefore, hypertension should be rooted out from society. Thus, there is an urgent need to develop strategies to detect and control the hypertension effectively. Nevertheless, the sufficient number of systematic and in-depth research work has not yet been conducted at grass root level to detect and control the hypertension. In the circumstances, where the problems of hypertension are persisting, therefore, the present study is undoubtedly an appropriate one and the researcher undertook to carry out this study.

In context of the people of Bangladesh, there is no in-depth research on hypertension from the view of socio-demographic background, nuptial and feminine concept, health complications and body composition to the best of our knowledge. Thus, an attempt is made to provide a real picture of hypertension in our society that may help the doctors and policy maker to estimate risk factors of hypertension. A few studies that deal with various aspects of the activities of hypertension are not sufficient to give the whole picture in analyzing the causes of hypertension and impact of hypertension on health. Since the study will attempt to give an elaborate analysis of the problems of hypertension in Bangladesh, the outcomes and suggestions from the present research may be helpful to the planners and policy makers to tackle these tremendous problems.

1.6 Utility of study

Expected utilizations of the study are following:

i. The present study will be able to explore epidemic conditions of hypertension of Bangladesh.

ii. The research work will provide some guidelines for the policy makers and planners to tackle different health complications including premature death arising from hypertension and the research findings will play an important role to create consciousness among public.

iii. The findings of the research will reduce the knowledge gaps which exist in this field.

iv. Teachers, researchers, students and development thinkers will be benefited to a great extent from this research work which will also contribute to compare among different study conducted indoor and outdoor of the country.

v. More over, this study will help as a secondary source for the next researchers.

1.7 Terminology

The operational definitions are discussed following:

1.7.1 Hypotension

Hypotension is another name of low blood pressure. The blood pressure < (90/60) mmHg is called low blood pressure.

1.7.2 Hypertensive

The respondent which is affected by hypertension disease is called hypertensive.

1.7.3 Normotensive

The respondent which is not affected by hypertension disease is called normotensive.

1.7.4 Health complication

The diseases or abnormalities of body compositions are defined as health complications.

1.7.5 Feminine

Feminine refers to only female oriented characteristics which are absent in male.

1.7.6 Nuptial

Nuptial refers to the marital characteristics.

1.8 Organization of study

The study has been organized into six chapters. This section contains an overview of the study. Chapter one is introduction which concentrates on statement of the study, objective of the study, importance of the study and organization of the study. Chapter two is literature review which contains information of earlier studies. Chapter three is study material which contains sample design, sample size, notes on data considered, and data collection methods, construction of schedule, variable selection and variable description and limitations of the study. Chapter four is methods of the study which contains a brief description of the correlation method, logistic regression method and goodness of fit statistic of the model. Chapter five is result and discussion which represents the findings or results and discussion of the findings. Chapter six is conclusion which express summary of the findings, conclusion and recommendations of the study. This chapter will also provide some suggestions for conducting further research in this filed.

CHAPTER 2
LITERATURE REVIEW

2.1 Prelude

Study on hypertension is not very old. Though different studies on hypertension have been done at international level but a few numbers of in-depth researches on hypertension have been studied at national level. The knowledge of such studies helps us to conduct the present study. Thus, various kinds of research on hypertension are discussed as following:

2.2 Review of literature

The different type literatures are reviewed as following:

Hoque et al. (2012) have investigated that among 406 respondents, 259 or 63.8% of the respondents can control hypertension (HTN) while 147 or 36.2% cannot control HTN. Among the patients who can controlled HTN almost 63% are males and 37.0% are females. The results of the chi-square test and the regression analysis show that the variables selected for the analysis are generally important predictors of HTN control among the diabetic patients.

Islam et al. (2012) have studied that hypertension (HTN) is an increasingly important medical and public health problem. In Bangladesh, approximately 20% of adult and 40-65% of elderly people suffer from HTN. High incidence of metabolic syndrome, and lifestyle-related factors like obesity, high salt intake, and less physical activity may play important role in the pathophysiology of HTN. The association of angiotensin-converting enzyme (ACE) gene polymorphism and low birth weight with blood pressure has been studied inadequately. Studies have found relationship between mass arsenic poisoning and HTN. Hypovitaminosis D presumably plays role in the aetiopathogenesis of HTN in Bangladeshi population. South Asians appear to respond to antihypertensive therapy in a similar manner to the Whites. The latest National Institute for Health and Clinical Excellence guideline advocates a calcium-channel blocker as step 1 antihypertensive treatment to people aged > 55 years and an ACE inhibitor or a low-cost angiotensin-II receptor blocker for the younger people. Calcium-channel blockers and beta-blockers have been found to be the most commonly prescribed antihypertensive drugs in Bangladesh. Non-adherence to the standard guidelines and irrational drug prescribing are likely to be important. On the other hand, non-adherence to antihypertensive treatment is quite high. At the advent of the new millennium, we are really unaware of our real situation. Large-scale, preferably, nation-wide survey and clinical research are needed to explore the different aspects of HTN in Bangladesh.

Islam et al. (2012) have studied that prevalence of hypertension was 6.6% (95% CI: 5.1–8.3). After adjustment for other factors, no excess risk of hypertension was observed for arsenic exposure >50μg/L or to that of arsenic exposure as quartiles or as duration. Arsenic concentration as quartiles and >50 μg/L did show a strong relationship with increased pulse pressure (adjusted OR: 3.54, 95% CI: 1.46–8.57), as did arsenic exposure for ≥10 years (adjusted OR: 5.25, 95% CI: 1.41–19.51).

Rahim et al. (2012) have studied that overall prevalence rate of hypertension was 30.64% (male 31.53% and female 29.36%). In the study, the blood pressure was measured in all study subjects. The mean blood pressure was higher in hypertensive participants than that of non hypertensive. The prevalence of hypertension (30.64%) observed in this study was higher than the previous study. In this study showed that with the increasing age more the prevalence of hypertension. The similar funding also observed in recent Indian study. Our study showed that the hypertension prevalence was high among people with high BMI and obesity, positive family history, smoking and less physical activity.

Khanam et al. (2011) have studied that the prevalence of hypertension was 12%, and it was higher among women (14.8%) than among men (8.9%). Fifty-eight percent of men (n=9,667) and 51.1% of women (n=20,293) were diagnosed by qualified care providers. Among the unqualified care providers, village doctors diagnosed 37% of the men and 42.7% of the women. Age, sex, education, wealth, and type of care provider were independently associated with non-adherence to anti-hypertensive medication. Significantly more men than women discontinued the treatment [odds ratio (OR)=1.74, 95% confidence interval (CI)= 1.48-2.04]. Non-adherence to medication was greater when hypertension was diagnosed by unqualified care providers (OR=1.52, 95% CI= 1.31-1.77). Hypertensive patients with older age and higher education were less likely to be non-adherent. Those who reported cardiovascular co-morbidity were also less likely to be non-adherent to anti-hypertensive medication (OR=0.79, 95% CI 0.64-0.97).

Kokiwar (2011) has studied that prevalence of hypertension was 19.04%. It was higher in females (23.4%) than males (14.4%). It was seen that prevalence of hypertension increased with age. Prevalence of Pre hypertension was high (18.8%). 4.3% had isolated systolic hypertension and 0.9% had isolated diastolic hypertension. Older age, increased body mass index and waist hip ratio were significantly higher among hypertensive compared to normotensive. Factors like upper social class, sedentary physical activity, tobacco use and diabetes were significantly associated with hypertension. Alcohol intake was not associated with hypertension. Conclusion: The prevalence of hypertension is high and is associated with socio-demographic factors. Hence there is need for primordial prevention efforts on large scale.

ICDDR, B (2011) has studied that hypertension, or high blood pressure, is a major risk factor for ischemic heart disease, stroke and kidney failure. It studied hypertension in rural and urban surveillance sites in Bangladesh. Hypertension was reported by 13% of the respondents (16% urban and 12% rural). There is very little information on diagnostic and management practices of hypertension in Bangladesh. In rural areas, unqualified providers (e.g., village doctors) played an important role in diagnoses of hypertension. People with more education, people with more money, and people over the age of 60 were more likely to be diagnosed as hypertensive by the doctors, both in rural and urban areas. To provide quality treatment for the majority of rural, poor populations, the care-giving capacity of the village doctors related to hypertension needs improvement.

Zaman et al. (2010) have studied that hypertension is a silent killer. Bangladeshis are racially predisposed to cardiovascular disease, and the increasing burden of hypertension has only added to the problem. Economic constraints and the allure of additional benefits without adverse effects have made lifestyle modifications an attractive proposition in developing and developed countries alike. Blood pressure is a continuum and any increase above optimum level confers additional independent risk of cardiovascular disease. They review screening, diagnosis and management using lifestyle measures and pharmacotherapy. They then discuss the barriers and challenges to implementing this approach and what can be done regarding prevention, screening, lifestyle modification and pharmacotherapy in our country. By adopting a comprehensive population based approach including policy level interventions directed at promoting lifestyle changes; a healthy diet (appropriate calories, low in saturated fats and salt and rich in fruits and vegetables), increased physical activity, and a smoking free society, properly balanced with a high risk approach of cost effective clinical care, Bangladesh can effectively control hypertension and improve public health.

Midha et al. (2009) have found that the prevalence of hypertension was 32.8% in the urban population and 14.5% in the rural population. The mean blood pressures were 128.4 ± 18.8 mmHg systolic and 82.6 ± 10.2 mmHg diastolic in urban area and 120.5 ± 16.1 mmHg systolic and 77.8±8.8 mmHg diastolic in rural area. A significant correlation of blood pressure with increasing age was seen. In urban area, hypertensives were less physically active, and more likely to smoke and consume alcohol. About 9.2% of the hypertensives had coexisting diabetes mellitus. Mean weight, BMI and waist circumference of hypertensives was significantly higher, whereas there was no significant difference between mean heights. In rural area, similar association was seen except alcoholism and diabetes. Multivariate logistic regression showed that regardless of area, age and gender, were significant risk factors of hypertension. In the urban population, diabetes (OR = 6.917) and BMI (OR = 1.195) and in the rural population, physical activity (OR = 0.483) and waist circumference (OR = l.094) were significantly associated.

Agrawal et al. (2008) have studied that prevalence of smoking and tobacco use was 16%, alcohol intake 9.4 %, daily salt intake (≥□5 gram) 34.2%, daily saturated fat intake (≥□10 % of daily energy intake) 47 .0 % and physical inactivity (work and leisure) as 18.5%. Body Mass Index (BMI) was ≥□25 in 18 % and ≥□30 in 3.2% men and women. Prevalence of truncal obesity (Waist Hip Ratio: men ≥□0.9; women ≥□0.8) was 8.5% with higher incidence in men. Prevalence of abdominal obesity (men ≥□102 cms; women ≥□88 cms) was found in 15.7 % with higher incidence in men. Differences in prevalence of risk factors between men and women were statistically significant in case of smoking, alcohol consumption and abdominal obesity. 18.5% men and women were suffering from systolic hypertension (≥□140 mg Hg) and 15 % from diastolic hypertension (≥□90 mg Hg). Prevalence of risk factors for hypertension was significantly more among subjects suffering from systolic and diastolic hypertension than normotensive subjects. Prevalence of systolic hypertension in rural community was 18.5 % and of diastolic hypertension 15% with higher prevalence in the age group of 60 years and above, in case of men and women. There was a significant linear trend in prevalence of systolic hypertension with respect to age group in men whereas it was not significant in case of women.

Chen et al. (2006a) have performed a cross-sectional analysis to evaluate the association between arsenic exposure from drinking water and blood pressure using baseline data of 10,910 participants in the Health Effect of Arsenic Longitudinal Study in Bangladesh (October 2000-May 2002). A time-weighted well arsenic concentration (TWA) based on current and past use of drinking wells was derived. Odds ratios for high pulse pressure ($\geq$55 mm Hg) by increasing TWA quintiles ($\leq$8, 8.1-40.8, 40.9-91.0, 91.1-176.0, and 176.1-864.0 μg/liter) were 1.00 (referent), 1.39 (95% confidence interval (CI): 1.14, 1.71), 1.21 (95% CI: 0.99, 1.49), 1.19 (95% CI: 0.97, 1.45), and 1.19 (95% CI: 0.97, 1.46). Among Participants with a lower than average dietary intake level of B vitamins and folate, the odds ratios for high pulse pressure by increasing TWA quintiles were 1.00 (referent), 1.84 (95% CI: 1.07, 3.16), 1.89 (95% CI: 1.11, 3.20), 1.83 (95% CI: 1.09, 3.07), and 1.89 (95% CI: 1.12, 3.20). The odds ratios for systolic hypertension suggest a similar but weaker association. No apparent associations were observed between TWA and general or diastolic hypertension. These findings indicate that the effect of low-level arsenic exposure on blood pressure is nonlinear and cardiovascular health. Future research is needed to evaluate the effect of low-level arsenic exposure on specific cardiovascular out comes.

Chen et al. (2006b) have found three major dietary patterns were identified by using principal component analysis: 1) the “balanced” pattern, which was characterized by rice, some meat, small fish, fruit, and vegetables; 2) the “animal protein” pattern, which was more heavily weighted on meat, milk, poultry, eggs, bread, large fish, and fruit; 3) the “gourd and root vegetable” pattern, which consisted largely of squashes and root and leafy vegetable. Adjusted prevalence odds ratios for general hypertension in increasing quintiles of balanced pattern scores ere 1.00 (reference), 0.81 (95% CI: 0.79, 0.97), 0.82 (0.68, 0.97), 0.79 (0.66, 0.94) and 0.71 (0.59, 0.85) (P for trend<0.01). Prevalence odds ratios for general hypertension in increasing quintiles of animal protein pattern scores were 1.00 (reference), 1.30 (1.01, 1.52), 1.20 (1.01, 1.47), 1.22 (1.00, 1.44), and 1.21 (1.03, 1.49) (P for trend<0.23). Markers of high socioeconomic status were positively associated with the animal protein pattern. These findings suggest the importance of dietary patterns in general hypertension in a low-income population undergoing the early stage of the epidemiologic transition.

Saha et al. (2006) have revealed that serum total cholesterol, triglyceride and LDL-cholesterol were significantly markedly raised ($p < 0.001$) whereas the level of HDL-cholesterol was significantly lower ($p < 0.001$) in hypertensive patients as compared to control subjects. No significant changes of serum lipid profile were found between male and female hypertensive patients, nut in control subjects, markedly higher levels of serum lipid profile was observed in male compared to that of female. It was concluded that hypercholesterolemia, hypertrigyceridaemia and low density lipoprotein are the main lipid abnormalities on the incidence of hypertension in the study area.

Sayeed et al. (2005) have found the overall prevalence (95% CI) of diabetes was 6.8% (1.88-9.32) and 8.2% (3.74-12.64) according to fasting blood glucose (FBG) and 2 hour blood glucose (2hBG), respectively. The crude prevalence of systolic and diastolic hypertension was 6.8 and 5.4% respectively. The median (interquartile range) values for age, BMI and FBG of the participants were 25.0 (21.0-30.0) years, 19.5 (18.2-21.2) and 3.9 (3.6-4.3) respectively. The history of abortion, neonatal death and stillbirth was found in 19.9, 11.4 and 9.6% respectively. The prevalence of gestational diabetes mellitus (GDM) was higher among those with history of stillbirth

(15.4 vs. 6.0%) and neonatal death (11.8 vs. 6.2%) than those without. The prevalence of GDM in rural Bangladesh is comparable with any other population with higher prevalence of GDM. Increased morbidity and mortality among mothers and newborns in Bangladesh may, in part, be because increase prevalence of GDM.

Zamudio et at. (2005) have shown that hypertensive complications of pregnancy are more common at high than low altitudes. Hypertension in pregnancy is associated with increased maternal and fetal morbidity and mortality; thus natural selection may be operating against women who develop the disorder and their infants. It has long been hypothesized that chronic hypoxia due to residence at high altitude predisposes women to develop hypertension during pregnancy. Prior studies indicate that maternal adaptation to pregnancy is altered by residence at high altitude such that some physiological characteristics of women pregnant at altitude resemble those of women who develop hypertension during pregnancy at low altitude.

Chen (2005) have suggested that 1) the validity of the food frequency questionnaire designed for the health effects of arsenic longitudinal study in measuring long term intakes of common foods and macronutrients was moderate; 2) the "balanced" diet, characterized by rice, some meat, small fish, fruits and vegetables, was associated with a reduced risk of hypertension, while the "root vegetable" diet was unrelated to risk of general hypertension and the "animal protein" diet, weighted more on higher intakes of meat, milk, poultry, eggs, some bread, large fish, and fruits, was related to an increased risk of hypertension; and 3) arsenic exposure was associated with higher systolic blood pressure and wider pulse pressure, and the associations were more pronounced in those with lower intakes of vitamin B_6, B_2, B_{12} and folate. However, we did not observe an association between arsenic exposure and risk of general hypertension.

Alamgir et al. (2005) have studied that prevalence of smoking tobacco was 13.8% (n=68) with total tobacco consumption of 25.76% (n=127). Only 7.4% of hypertensives did some sort of heavy exercise during any part of the week with mean value of 8.47 minute. Mean body weight of the whole study subject was 60.6 ± 11.2854 Kg while mean height was 161.5 cm ± 8.7393. Mean body mass index (BMI), Quetelet's Index, was 23.23. Mean Blood Pressure of the community was found to be 124/80 mmHg. Overall prevalence of hypertension was 27.60% according to 7th report of the Joint National Committee (JNC-7) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure and World Health Organization International society of hypertension guidelines criteria. Blood pressure was found to relate with increasing age (r_2=0.108). Blood pressure was found to rise with increment of body weight (for SBP r_2 = 0.021, p= 0.001 and for DBP r2 = 0.044, p <0.001). BMI and high blood pressure were related significantly ($c_2(2)$ = 29.926, p< 0.001). Quantity of tobacco intake affects blood pressure to rise (r2=0.022 for SBP and r2=0.042 for DBP, p< 0.001).

Cooper-Dehoff et al. (2004) found that an abnormal angiogram or documented myocardial infarction was observed more frequently in Caucasian patients (73%), while angina pectoris was more prevalent in Hispanic patients (87%). Diabetes and left ventricular hypertrophy were most common in black patients (33% and 29%, respectively), which hypercholesterolemia and prior revascularization (coronary artery bypass graft or angioplasty). More than 60% Hispanic and black patients were women – a unique characteristic for randomized coronary artery disease trials. Comparing race/ethnic groups were receiving antihypertensive therapy; however, only fewer than 25% had controlled blood pressure according to guidelines from the sixth report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. This high-risk population of hypertensive patients with coronary artery disease has been under treated and does not have well-controlled blood pressure race/ethnic differences were observed for clinical characteristics and medication use.

Chobanian et al. (2003) investigate in those older than age 50 years, systolic blood pressure of greater than 140 mm Hg is a more important cardiovascular disease risk factor than diastolic blood pressure; beginning at 115/75 mm Hg, cardiovascular disease risk doubles for each increment of 20/10 mm Hg; those who are normotensive at 55 years of age will have a 90% lifetime risk of developing hypertension; prehypertensive individuals (systolic blood pressure 120-139 mm Hg or diastolic blood pressure 80-89 mm Hg) require health-promoting lifestyle modifications to prevent the progressive rise in blood pressure and cardiovascular disease; for uncomplicated hypertension, thiazide diuretic should be used in drug treatment for most, either alone or combined with drugs from other classes; this report delineates specific high-risk conditions that are compelling indications for the use of other antihypertensive drug classes (angiotensin-converting enzyme inhibitors, angiotensin-receptor blockers, beta-blockers, calcium channel blockers); two or more antihypertensive medications will be required to achieved goal blood pressure (<140/90 mm Hg or <130/80 mm Hg) for patients with diabetes and chronic kidney disease; for patients whose blood pressure is more than 20 mm Hg above the systolic blood pressure goal or more than 10 mm Hg above the diastolic blood pressure goal, initiation of therapy using two agents, one of which usually will be a thiazide diuretic, should be considered; regardless of therapy or care, hypertension will be controlled only if patients are motivated to stay on their treatment plan.

Sayeed et al. (2003) have studied that body mass index (BMI) and waist-to-hip ratio (WHR) are widely used as obesity indices for diabetes and cardiovascular risks. Lower adult height was related to diabetes and stroke. Waist-girth was proved important for visceral obesity. Incorporating waist-girth and height as waist-to-height ratio (WHtR), we reported earlier “Waist-to-height ratio is an important predictor of hypertension and diabetes”. We readdressed this index in a larger sample with two-sample OGTT and lipid profiles. In a cluster sampling of 16,818 rural inhabitants, considering age>or=20 years, 5713 subjects were found eligible. Of them, 4923 (M/F=2321/2602) volunteered for height, weight, blood pressure, waist-girth and hip-girth, Fasting venous blood (5 ml) was drawn for plasma glucose, total cholesterol (T-chol), Triglycerides (TG) and high-density lipoprotein (HDL-c). Overall, 1565 participants were undertaken for OGTT, The mean (SD) values of BMI, WHR and WHtR for subjects with diabetes and hypertension were significantly higher in either sex. The level significance was highest for WHtR. The prevalence of diabetes and hypertension increased significantly with higher quintiles of BMI, WHR and WHtR (chi square values were largest in WHtR for both events). Partial correlation coefficients, controlling for age and sex, showed that BMI, WHR and WHtR significantly correlated with systolic and diastolic BP, FBG, T-chol and T. In the entire correlation matrix, the ‘r’ values were the highest for WHtR. Taking diabetes and hypertension as dependent variables, logistic regression also showed the highest odds ratio in higher WHtR than BMI and WHR. Concluded that WHtR was proved again a valuable obesity index for predicting diabetes, hypertension and lipidemia.

Sayeed et al. (2002) have studied that overall prevalence rates of systolic and diastolic hypertension in the study population were 14.4 and 9.10 percent respectively. The prevalence of systolic hypertension was significantly higher in rural than in urban participants ($p < 0.001$). Compared with the poor the rich class had significantly higher prevalence of both systolic ($p = 0.002$) and diastolic ($p = 0.041$) hypertension. With increase of age, body mass index (BMI) and blood glucose level were significantly related to hypertension ($P < 0.001$); whereas the trend for increasing waist-to-hip ratio (WHR), adjusting for social class, was not significant. Regression analysis showed that age, BMI, rural area and rich class were the strong predictors for hypertension.

Hannan et al. (2001) have contemplated a prospective study with 155 patients of acute stroke in the department of neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, from March 1996 to February 1997. The number of subjects during summer and winter were 121 and 34, respectively. In summer, out of 121 subjects, 87 (71.90%) were ischemic stroke and 34 (28.1%) hemorrhagic stroke, of which 32 were intracerebral haemorrhagic (ICH) and 2 subarachnoid haemorrhagic (SAH). There were 18 (52.9%) ischemic stroke and 16 (47.06%) haemorrhagic stroke (all ICH) among total 34 subjects during winter. The frequency of ischemic stroke during summer was significantly greater than that during winter ($p<0.05$). The frequency of haemorrhagic stroke ($p<0.1$). Hypertension was significantly more associated with haemorrhagic stroke than with ischemic stroke irrespective of season ($p<0.05$).

Moula et al. (2001) have studied that by November 2010, 17 (female 10, male 7) clubs of diabetic and hypertensive patients have been formed. Ninety-nine meetings of these clubs were held. Most meetings discussed about walking and lifestyle modification. All members (n=426) are checking their blood glucose and blood pressure at the meeting, consulting graduate physicians with mobile phones when needed; 46% of club members walk together with fellow members. In total, 3,350 people aged 40 years and above are listed; more than half participated in screening.

WHO (2001) has investigated that the over all prevalence of hypertension was 65% (95% confidence interval – 62%-67%). The prevalence was higher in urban than rural areas, but did not differ significantly between the sexes. Multiple logistic regression analyses identified a higher body mass index, Higher education status and prevalent diabetes mellitus as important correlates of the prevalence of hypertension. Physical activity, rural residence, and current smoking were inversely related to the prevalence of hypertension. Among study subjects who had hypertension, 45% were aware of their condition, 40% were taking antihypertensive medications, but only 10% achieved the level established by the US Sixth Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC)/WHO criteria. A visit to physician in the previous year higher educational attainment and being female emerged as important correlates of hypertension awareness. The study emphasize the need to implement effective and low cost management regimens based on absolute levels of cardiovascular risk appropriate for the economic context from a punlic health perspective, the only sustainable approach to the high prevalence of hypertension in the Indian subcontinent is through a strategy to reduce the average blood pressure in the population.

Bond et al. (2000) have studied hypertension is the leading health problem in African – American community and is associated with risk factors of stress, physical inactivity, and family history. Also found that subjects with a parental history of hypertension had significantly higher baseline systolic blood pressure and mean arterial blood pressure values than subjects with no parental history of hypertension. Among the group of parental history of hypertension subjects blood pressure reactivity to mental stress was as follows: the high aerobic fitness subgroup (peak oxygen uptake, VO2peak = 54.6 ± 1.2 ml/kg/min) (n=15) exhibited a 7.3 ± 2.0 mm Hg rise in SBP and a 3.2 ± 2.0 mm Hg rise in means arterial blood pressure, and the low aerobic fitness subgroup peak (oxygen uptake, VO2peak = 37.1 ± 0.7 ml/kg/min) (n=15) had a 15.8 ± 2.0 mm Hg rise in SBP and a 11.8 ± 2.0 mm Hg rise in means arterial blood pressure ($p<0.05$). Among the group of parental history of hypertension subject with high and low aerobic fitness (n-30, 15/group), no differences in blood pressure reactivity to mental stress were found. These results suggest that a lifestyle of physical activity associated with a high level of aerobic fitness may attenuate blood pressure reactivity to mental stress and reduce the risk of hypertension in African-American men.

Rahaman et al. (1999) have conducted the study of a prevalence comparison of hypertension among subjects with and those without arsenic exposure through drinking water in Bangladesh to confirm or refute an earlier observation of a relation in this respect. Well with and without present arsenic contamination were identified, and we interviewed and examined 1595 subjects who were depending on drinking water from these wells for living, all ≥ 30 years of age. The interview was based on a questionnaire, and arsenic exposure was estimated from the history of well-water consumption and current arsenic levels. Of the 1595 subjects studied, 1481 had a history of arsenic-contaminated drinking water, whereas 114 had not. Time-weighted mean arsenic levels (in milligrams per liter) and milligram-years per liter of arsenic exposure were estimated for each subject. Exposure categories were assessed as <0.5 mg/L, 0.5 to 1.0 mg/L, and >1.0 mg/L and alternatively as <1.0 mg-y/L, 1.0 to 5.0 mg-y/L, >5.0 but ≤ 10.0 mg-y/L, and >10.0 mg-y/L, respectively. Hypertension was defined as a systolic blood pressure of ≥ 140 mm Hg in combination with a diastolic blood pressure of ≥ 90 mm Hg. Corresponding to the exposure categories, and using "unexposed" as the reference, the prevalence ratios for hypertension adjusted for age, sex, and body mass index were 1.2, 2.2, 3.0, in relation to arsenic exposure in milligrams per liter and milligrams per liter and milligram-years per liter, respectively. The indicated dose-response relationships were significant (p<0.001) for both series of risk estimates. These results suggest that arsenic exposure may induce hypertension in humans.

Zaman and Rouf (1999) have reported that the pool estimates for the prevalence of hypertension in 13288 adults (urban 8172, rural 5166) is 11.30% (95% confidence interval 10.80% to 11.80%).

Chowdhury et al. (1998) have studied with fifty-one primary hypertensives and fifty-two normotensives were recruited from a hospital in Dhaka city of Bangladesh.

Height, weight and blood pressure were measured. Angiotensin converting enzyme (ACE) insertion/deletion (I/D) genotypes was established using polymerase chain reaction protocol. The genotype and allele frequencies did not differ significantly ($p>0.05$) between the groups. In logistic regression analysis, adjusted for age, sex and body mass index, the genotypes were not associated with hypertension (DD vs. II: Odds ratio = 2.6, p = 0.34; ID vs. II: 0.4, 0.23; ID + DD vs. II: 0.8, 0.69). In this hospital-based sample of Bangladeshi people, significant association of ACE I/D genotype with hypertension was not observed.

Hoque et al. (1998) have conducted a controlled clinical trial to determine whether combined exercise training and diet alone reduce blood pressure (BP), Body weight and body mass index (BMI) in three weeks. Twenty eight patients with diastolic BP$\leq$110 mm Hg were assigned to a hypertensive group and another 28 subjects with diastolic BP$\leq$90 mm Hg were subjected to the same intervention as control group (normotensive group). Exercise training and diet reduced diastolic BP by 24.7 mm Hg and systolic BP by 32.8 mm Hg in hypertensive group. There was a mean decreased of 5.3 mm Hg in the diastolic BP in the normotensive group ($p<0.001$). The systolic BP decreased only minimally. The weight loss ranged from 1 kg to 3 kg in hypertensive and 1 kg to 2 kg in the normotensive group. The mean weigh loss was 1.6 kg (0.7) in hypertensive and 1.5 kg (0.5) in the normotensive group. In both the groups the weight reduction was highly significant ($p<0.001$) and moderately positive correlation was also notes with the fall of BPs. The mean fall of BMI was 0.61 kg/m^2 (0.21) and 0.51 (0.2) kg/m^2 in the hypertensive and normotensive groups respectively. The findings indicated that a combined exercise training and dietary program could lower BP in patients with mild to moderate hypertension, but its long-term consequences on morbidity on morbidity and mortality remain to be determined.

Sayeed et al. (1995) have conducted a study in the context of Bangladesh population and estimated the crude prevalence of non-insulin-dependent diabetes mellitus (NIDDM) was 2.1% (men 3.1, women 1.3%) and impaired glucose tolerance (IGT) was 13.3% (men 14.4, women 12.4%). Age-adjusted (30-64 years of age) prevalence was 2.23% (95% CI 12.59-18.75) for IGT. Prevalence of hypertension with systolic blood pressure (sBP)>or=140 mm Hg was 10.5% and with diastolic blood pressure (dBP)>90 mm Hg was 9.0%. Increased age was the risk factor for NIDDM, IGT, and hypertension; whereas increased BMI showed inconsistent association with them. Relative risk for sBP with higher BMI (<22.0vs. >or=22.1) was 1.94 with CI 1.55-2.43 and for dBP it was 2.2 with CI 1.40-3.46. Correlation of sBP was significant with age, BMI, and 2hBG. Similar correlation was also observed with dBP. High prevalence of NIDDM, IGT, and hypertension were observed among rural subjects. Increased age was shown to be an important risk factor for all these disorders, whereas BMI-associated risk was significant with NIDDM and hypertension but not with IGT.

Sayeed (1994) has found that out of 1005 participants 106 subjects (10.50%) had systolic blood pressure more than 140 mm Hg and 9% of them had diastolic blood pressure more than 90 mm Hg. The prevalence of non-insulin-dependent diabetes mellitus was 2.1% and impaired glucose tolerance was 13.3%. The mean body mass index of men was 20.39 (standard deviation = 2.91) and that of women was 20.11 (standard deviation = 2.92), having no significant difference between them. Increased age (≥ 50 years), high body mass index (≥ 23.0) and hyperglycemia (2 –hPG > 7.8 mmol/L) were the risk factors for both systolic (>140 mm Hg) and diastolic (>90 mm Hg) hypertension. Likewise, increased age, high body mass index and hypertension showed significant association with glucose intolerance. Moreover, significant correlations were observed berween age and blood pressure (systolic blood pressure, r = 0.328 p < 0.001; diastolic blood pressure, r = 0.188 p < 0.001) body mass index and blood pressure (systolic blood pressure, r = 0.193 p < 0.001; diastolic blood pressure, r = 0.192 p < 0.001) and 2 – hPG and blood pressure (systolic blood pressure, r = 0.188 p < 0.001; diastolic blood pressure, r = 0.134 p < 0.001).

Khandakar (1993) has presented data obtained in Bangladesh, to elucidate the role of hypertension as a risk factor along with others such as smoking, cholesterol and diabetes mellitus as cofactors in ischemic heart disease (IHD), There was a series of 100 cases with IHD admitted within 12 hours after the onset of chest pain observed in this study. They all were diagnosed as IHD for the first time. Of them, 94 were male and 6 female, with an age range of 25-77 years (mean 50.16 +/- 14 years). On grouping of IHD, 21 angina pectoris and 79 acute myocardial infarction. 31% cased of IHD had hypertension. The blood pressure ranged between 168.54 +/- 24.85 and 106.29 +/- 16.80 mm Hg. 74 out of the 100 cases with IHD were smokers. The mean value of serum cholesterol in this series was 6.48+/- 1.66 mmol/L and that among 50 normal controls was 4.76 +/- 1.28 mmol/L (p<0.01). The serum triglyceride determinations between the 94 cased of IHD and 50 normal controls showed values with statistically significant difference. So, it was concluded that hypertension, smoking and hyperlipidemia are the most important risk factor of IHD in Bangladesh.

Islam et al. (1983) have found that a total of 5,026 persons constituting 75% of the total population of a village of Bangladesh were screened for elevated blood pressure. Three hundred thirty seven (6.7%) showed diastolic blood pressure of 90 mm Hg or above. Those with diastolic blood pressure of 95 or above constituted 2% of the population. 74% of the hypertensives were asymptomatic while 86.3% of the cases were undetected and therefore remained untreated. Our findings indicate the need for early detection and control of elevated blood pressure to prevent complications. It is recommended that a large scale community survey programme may be undertaken for detection and early treatment of hypertension which helps prevention of total complications.

Islam et al. (1979) have investigated that a total of 8172 persons constituting 98.6% of the total secretariat population of Bangladesh were screened for elevated blood pressure. One thousand and ninety cases (13.3%) showed diastolic blood pressure of 90 mm Hg or above. Those with diastolic blood pressure 95 or above constituted 3.7% of the population. More than two-thirds of the later group (71.6%) remained undetected indicating that vast majority of our hypertensive population remains undiagnosed and untreated. It is recommended that the misconception regarding symptomatic hypertension should be removed by adequate emphasis on the preventive value of the control of hypertension on cardiovascular and cerebrovascular complication. A plea has also been made for large-scale survey to determine the extent of the problem in Bangladesh.

Ullah (1976) has studied and found that about 2% of people examined were unaware that they had elevated blood pressure in Bangladesh. High incidence of hypertension was found in the age group of 40-50 years in the hospitalized patients.

CHAPTER 3
STUDY MATERIALS

3.1 Prelude

Study materials help to make concepts simple and easy. Materials are considered the best resource for study. The materials of the present study are discussed below under several sub-heading in their proper sequence.

3.2 Study area

The study is an empirical study in nature. It is known that primary data is mostly used in an empirical study. On the contrary, documents are usually used in a non-empirical study. To collect primary data, selection of study area is indispensable. There are six division and sixty four districts including six city corporation districts in Bangladesh. For field level data, considering practical constraints including time, resources and distance Rajshahi district has been selected purposively. The selection of the study area has been guided more by practical considerations than by methodological reasons. It is closely acquainted with the study area for a long period of time. So, the selected area was easily accessible and that is why it could manage to obtain precise information. The selected study area was serviceable for ensuring the quality of the data to be collected within the limited resources and time available to the researcher who had to make several follow-up visits to these areas to check the quality of the data as well as to get additional data for the purpose to updating the findings of the study. The characteristics of the selected study area have similarity with the rural as well as urban Bangladesh and therefore it is expected that the findings of the study would represent rural and urban Bangladesh. However, it was taken all possible care and steps in making sure the quality of the data to achieve the objectives of the study.

3.3 Study population

In general, Study population is that population on whom data is collected. Similarity may or may not remain between the study population and the source of data. For this research work some sources of data have been considered from the study population while some sources of data have not been considered. The study population of this study was the whole people aged 10 years above who were attacked or were not attacked by hypertension. From the above discussion it is clear that both types of people are considered as the study population in this research.

3.4 Sampling

Sampling is a scientific process of selecting a part from a statistical population and may also embrace the derivation of estimates and any inferences derived from them for that population.

3.4.1 Sample design

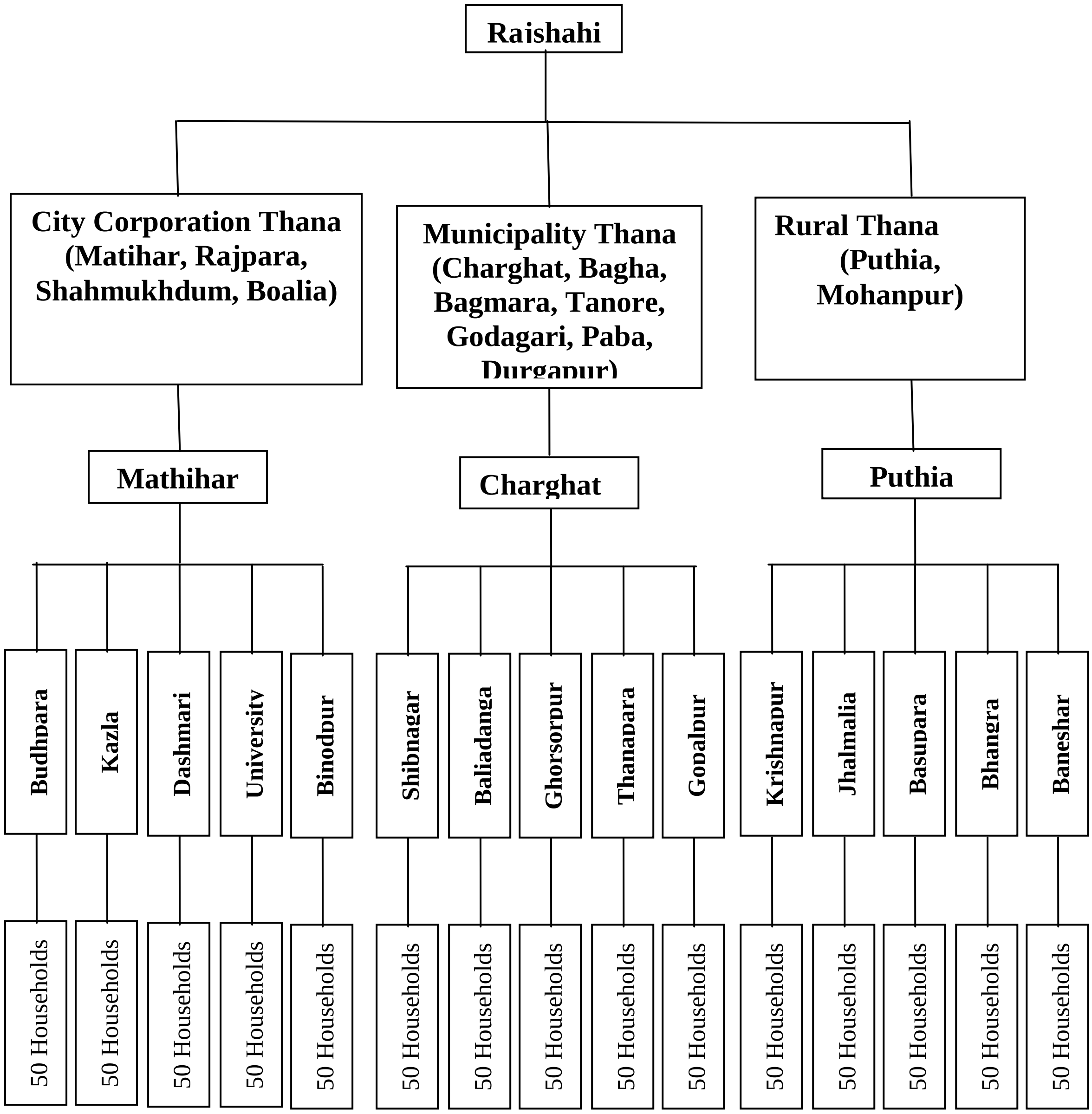
Sample design refers to the plans and methods to be followed in selecting sample from target population and the estimation technique vis-à-vis formula for computing the sample statistics. These statistics are the estimates used to infer the population parameters. The study has performed to observe the hypertensive patterns and risk factor of hypertension. For this stratified multistage sampling design has been applied. Sampling technique, sample size and sample spots have determined considering the following:

- The target population has been divided into three stratums by City Corporation thanas, Municipality thanas and rural thanas according to the information of population census 2001 (BBS, 2005).

- Considering budget constraint, time, labor and other barriers, from each stratum (subpopulation) only one thana has been selected by simple random sampling.
- Again using simple random sampling, from each selected thana 5 Mahallahs or Mouzas have been selected.
- From each selected Mahallahs or Mouzas 50 households have been selected using systematic random sampling.
- All members within a household (above 10 years) have been considered as a sample unit.

3.4.2 Sample diagram

The diagram of sample design is following.



3.4.3 Sample size

The size of the sample must be sufficient to accomplish the purpose of the study but should not be more than necessary or it becomes wasteful. The determination of sample size depends on:

- The confidence and precision desired;
- The variability of the characteristics in the target population if unknown (one must assume greater variability); and
- The size of the target population

Sample size determination also depends on time and resources. Because of time and fund constraint, sample size with precision level 2.5% or below can not be considered. The sample size needed to measure a given proposition with a given degree of accuracy at a given level of statistical significance by using the following formula,

$$n = \frac{Nz^2\, p(1-p)}{[d^2 (N-1) + z^2\, p(1-p)]} \times D$$ (Islam, 2008).

where,

n= Desire sample size, N= Size of the population,

z= Standard normal deviate, usually set at 1.96 at 5% level of significance which corresponds to 95% confidence level;

p= Target proportion of a particular characteristic. Since there is no reasonable estimate of p, we may consider p=50% (p=0.50), d= Precision level considered at 2.5% and D= Design effect= 1.5. Also, suppose 50% of the target people have Hypertension; z statistic is 1.96, which corresponds to the 95% confidence level, d is the level of accuracy that is considered 2.5% and design effect is 1.5.

The sample size, n= 2250.

3.4.4 Selection of mahallahs/mouzas

The number of mahallahs/mouzas and the number of respondents in each mahallah/mouza are calculated as following:

$$\text{Number of Mahallahs/Mouzas}, n_m = \frac{P(1-P)D(0.375)}{s^2 b(0.025)} \text{ (Bennett et al., 1991);}$$

$$= 14.42 = 15;$$

Where, b = Expected number of respondents of each mahallah
= average number of households per mahallah or mouza
= 253 (BBS, 2005).

$$s^2 = [\{P(1-P)\}/n] = 0.0001$$

$$\text{Number of respondent per mahallah} = \frac{\text{Total sample size (2250)}}{\text{Number of mahallah (15)}} = 150.$$

3.4.5 Selection of household

Household means the family place where the family members are lived together and the person who is lived during six month with this family considers him or her under this household. According to the Statistical Year Book 2005 the average member per household is 4.4 (BBS, 2005). We may consider 3 persons (above 10 years) per household. Then to collect data from 150 respondents in each mahallahs/mouzas 50 households are needed and we have taken 50 households on average. Also, a random number between 1 and 3 has been taken and every 3rd household has been drawn by systematic random sampling from each mahallah/mouza.

3.4.6 Selection of respondents

Respondents means from which the data are collected and a person under a household consider as a respondent if at least six month he or she lives and eats with this family. From each household whole family member aged above ten years old were considered as respondents in this present study.

3.5 Data

The raw material of statistics consists of numbers or observations usually obtained by some process of counting or measurement. These are referred to collectively call as data. According to the source, there are two types of data such as i) Primary data and ii) Secondary data. The data are collected from primary source is called primary data. The data are obtained from secondary source is called secondary data. In this present study, both types of data are used. According to measurement, the data are two types such as i) qualitative data and ii) quantitative data. In certain statistical investigations it is concerned only with the presence or absence of some characteristic in a set of objects or individuals. In this situation, it is only counted how many individuals do or do not possess the characteristics, is called qualitative data. A variable is a measurable quantity which can assume any of a prescribed set of values, called the domain of variables. When interest is concerned in a variable, data collectors either note or measure the actual magnitude of some character for each of the individuals or units under consideration is called quantitative data. In this present study, qualitative data and quantitative both types of data are used.

3.5.1 Data type

According to the source there are two types of data such as primary and secondary data. Also, according to the attributes there are two types of data such as qualitative and quantitative. In the present study all types of data mentioned have been used to analyze the problem and also to state the problem.

3.5.2 Data source

The sources of data are from where data is obtained. There is a difference between study population and source of data. The population about whom the data is collected is called study population. But the sources of data are from where or from whom the data is gathered. According to nature, the source of data can be two types as primary source and secondary source. When the data is collected from the specific person(s) or actual situation is called primary source. On the other hand, in a study, various types of documents are used as secondary source. In this present study, the population aged above ten years old was the primary source and official records, documents, publication of hypertension, publications of different government and non-government organizations of Bangladesh, individuals' research articles, books, periodicals, reports of various international organizations such as World Health Organization (WHO), International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDRB), World Bank (WB) etc. were the secondary sources. In this study, the respondents who are affected by hypertension and who are not affected by hypertension are both sources of data and study population.

3.5.3 Data collection tool or instrument

Depending on the nature of the data to be gathered, different instruments or tools are used to conduct the data collection session is called data collection tool or instrument. We have used some instruments in this study such as weight machine, length measurement tap, stethoscope, sphygmomanometer, automatic blood pressure machine, etc. and important instrument is interview schedule.

3.5.3.1 Weight machine

A weight machine is an exercise machine used for weight training that uses gravity as the primary source of resistance and a combination of simple machines to convey that resistance to the person using the machine. Each of the simple machines (pulley, lever, wheel, incline) changes the mechanical advantage of the overall machine relative to the weight. We have used analog weight machine to measure the weight.

3.5.3.2 Length measurement tape

A tape measure or measuring tape is a flexible form of ruler. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement markings. It is a common measuring tool. Its design allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners. Today it is ubiquitous, even appearing in miniature form as a keychain fob, or novelty item. Surveyors have used length measurement tape for measuring the length.

3.5.3.3 Stethoscope

The stethoscope is an acoustic medical device for auscultation, or listening to the internal sounds of an animal or human body. It is often used to listen to lung and heart sounds. It is also used to listen to intestines and blood flow in arteries and veins. In combination with a sphygmomanometer, it is commonly used for measurements of blood pressure. Less commonly, mechanic's stethoscopes are used to listen to internal sounds made by machines, such as diagnosing a malfunctioning automobile engine by listening to the sounds of its internal parts. Stethoscopes can also be used to check scientific vacuum chambers for leaks, and for various other small-scale acoustic monitoring tasks. Surveyors have used stethoscope for measuring the blood pressure.

3.5.3.4 Sphygmomanometer

A sphygmomanometer or blood pressure meter (also referred to as a sphygmometer) is a device used to measure blood pressure, composed of an inflatable cuff to restrict blood flow, and a mercury or mechanical manometer to measure the pressure. It is always used in conjunction with a means to determine at what pressure blood flow is just starting, and at what pressure it is unimpeded. Surveyors have used manual sphygmomanometers for measuring the blood pressure in conjunction with a stethoscope.

3.5.3.5 Automatic blood pressure machine

Automatic blood pressure machine or digital blood pressure machine is a medical device which is used to measure the blood pressure automatically. It is an alternative of analog machine.

3.5.3.6 Calculator

An electronic calculator is a small, portable, often inexpensive electronic device used to perform both basic and complex operations of arithmetic. We have used calculator during study to calculate some calculations.

3.5.3.7 Interview schedule

A schedule, also known as an interview schedule, is an instrument that is not given to the respondents but is filled in by interviewer himself who reads the questions to the respondents and records the answers as provided by the respondents. According to the goal of this research and data collection methods, a schedule was made. Data has been collected through individual interview schedule. The interview schedule has been designed considering the following characteristics:

- Number of questions in the interview schedule should be limited;
- A respondent should be assumed that his identity will not be against his interest;
- Avoid long and confusing questions and formulate simple and short questions;

- Start with easy questions then slowly put the difficult ones.

To avoid unnecessary trouble and hazardous situation, pre-testing of the schedule was done and modification of the contents of the schedule was made in the light of pre-testing. A draft schedule was first prepared and pre-testing of the same was completed. It was then finalized for field survey by eliminating the anomalous and inconsistencies present in the draft schedule. Questions are arranged in logical sequence and all questions relating to one aspect are grouped under one sub-head. Most of the questions were close-ended and also the answers chosen by the respondents were indicated by the tick mark. Some open-ended were included to find out the opinions of the respondents with having space provided for writing in answers. Also, the contingency questions have been used. Considering the difficulties of analysis of open-ended questions, we kept the number of open-ended to minimum. The set questions are perceptible to and worthy of arousing the respondents in order that accuracy and correctness of the respondents' answers are ensured. In certain situation local dialect of some terminology are used.

3.5.4 Data collection technique

All of the methods of data collection commonly employed have some limitations. Which of the methods of data collection will be preferred depend on the information that is required. The information comprises source of data, the time attribution and quality or quantity of data. The methods of collecting data may be classified in two parent types such as i) Quantitative method and ii) Qualitative method where the quantitative method may be classified in three types such as i) Personal interview, ii) Self-administered questionnaire and iii) Telephone interview and the qualitative method may classified in five types such as i) Unstructured method ii) Observation method iii) Focus group discussion iv) documents study and v) Content analysis (Islam, 2008). More than one method such as i) Personal interview and ii) Document study have been used in this present research. Keeping conformity with the objectives of this study, multiple methods of data collection have been employed. The required data have been obtained both from primary and secondary sources.

3.5.4.1 Personal interview

Personal interview is one that employs a standard structured questionnaire or interview schedule to ensure that all respondents are asked exactly the same set of questions in the same sequence. It is a two-way conversation initiated by an interviewer to obtain information from a respondent. The questions, the wording, and their sequence define the structure of the interview and the interview is conducted face-to-face. In this study, data have been obtained from the respondents by personal interview through interview schedule. To make sure reliability of data, the researcher himself with some students (male and female) of last semester of honors graduation have collected data by employing pre-tested interview schedule. Since many of the respondents were female and female members were reluctant to come before and unknown person or an outsider, the researcher have covered this situation by his wife is a female. Before starting interview, the researcher introduced him to the respondents, expounded the purpose of interview, gave assurance on confidentiality and sought their spontaneous co-operation. The data were collected by direct interview keeping in view the objectives of the study. The editing of the completed questionnaires helped in amending and recording errors or eliminating data that are obviously erroneous and inconsistent. All kinds of mistakes have been corrected where it was found in questionnaires and all answers be been observed carefully. As a result there was no irrelevant information. The tendency should not collect too many data, but the important one and some of which are never subsequently examined. Attention was given to record factual and true statement made by the respondents.

3.5.4.2 Document study

By document we mean any written materials that contain information about the phenomena we are interested to study. These documents are available generally in two forms: primary documents and secondary documents. The secondary documents which have been used to state or explain the problems and understanding the problem were collected by document study. These types of data have been collected from various reports of national and international organizations, different published and unpublished article and thesis papers on blood pressure.

3.5.5 Data collection time

Time specification for data collection is very important in a study. In this study, the researcher selected the favorable time of respondents so that no household work was disturbed and they can present in house. It was observed that the male respondents of the study area usually have presented at home from 7.30 Am to 9.30 Am and from 2.30 Pm to 5.00 Pm except service holder and maximum female respondents have presented at home all day long. In the maximum cases of male respondents, the researcher took interview from 7.30 Am to 9.30 Am and from 2.30 Pm to 5.00 Pm and for female respondents' interview has been taken during all day long. The time of interview was mainly fixed by the respondents. So, the researcher embarked on taking interview according to the convenient time of the respondents in order that no discomfort and disturbance took place. It is mentionable here that our field survey was conducted from the last quarter of 2008 to first quarter of 2009. This time was selected so that our survey work was not hampered due to rain or other environmental problems.

3.5.6 Data management

Objective(s) is ascertained before formal commencement of a work specially a research work. On the contrary, to achieve the predetermined objective(s), data management is very much needed. In this study, at the end of each interview session, the researcher minutely examined the gained information without delay in order that no needful information is missed. Data was input into computer as soon as possible. In this way, the researcher preserved all sorts of data. After the completion of data collection, all kinds of data were scrutinized and distinguished carefully and cautiously in order to avoid any kind of mistake.

3.5.7 Problems of data collection

With keeping a great concentration on study objectives, data reliability, and consistency we have collected data. Thereafter we have faced some problems which are discussed following

i. A tendency has been observed for female respondents to hide their age and for male respondents to extent their age. In this situation we have taken help to minimize the error from other family member such as father, mother, husband, grand father and grand mother etc.

ii. We have faced some barriers to enter into some households and in case of some house holds we did not permit to enter. After convincing the household heads or honorable persons of the locality we have performed our interview and the households which were out of our convincing we have selected alternative households.

iii. Busy persons were not agreeing for interview and we have taken the interview for his/her leisure time.

iv. The respondents with thin arms were avoided because of unfitting the cuff with their arms.

v. We can not collect the body composition data properly from the respondents, who were bed patients, humpbacked person and affected by Gout. In this case the data were replaced by average values.

vi. Though we measured the hip circumference of female respondents' by female interviewer, we have faced problems for some female respondents during the measurement to open their cloths. We covered this situation by average values according to their age, height, weight and physical structure.

vii. Some respondents highly expressed their health complications to get medicine or any of medical service. But after confirming absence of medicine or any of medical service they discouraged others. In this situation we have to replace the respondents by others and some were agreed by convincing.

viii. To collect data about contraceptive methods some both types of male and female respondents avoid this question. We covered this problem by their close relatives or using alternative questions such as number of present children, number of expected children, willingly abortion, and tendency to take child at present etc.

ix. For some female respondents aged above 45 years with occurring menopause who have taken permanent contraceptive methods we hesitated to consider them as contraceptive users or not. We included them for both types questionnaire such as about menopause and contraceptive.

3.6 Description and measurement of selected variables

A characteristic which varies over time, place and individual is called variable. Variables used in an experiment or modeling can be divided into three types: outcome or dependent variable, independent or explanatory variable, or other. In the present study, we have discussed the variables and about the measurement of the variables. Measurement is the part and parcel of research. Stevens (1946) mentioned the four levels of measurements such as i) Nominal measurement ii) Ordinal measurement iii) Interval measurement and iv) Ratio measurement which are also known as measurement scale. In our study, we have used the interval scale for quantitative variables and nominal scale for qualitative variables. Thus, the measurement procedures for quantitative and qualitative variables which have been measured by interval and nominal scale are discussed as following:

3.6.1 Outcome variable

The outcome or dependent variable represents the output or effect, or is tested to see if it is the effect. The three variables hypertension, systolic blood pressure and diastolic blood pressure have been considered as dependent variable in this study. The outcome variables and their measurements are discussed following.

3.6.1.1 Hypertension

Hypertension is the persistent high blood pressure, in which the systolic is equal or more then 140 (millimeters of mercury) mmHg, and diastolic is equal or more then 90 (millimeters of mercury) mmHg which are measured in two or more consecutive days in a week. The dependent or outcome variable hypertension is measured by nominal scale where hypertension takes value 1 if the respondent has hypertension disease or 0 otherwise.

3.6.1.1.1 Symptoms of hypertension

The common symptoms of hypertension are given by confusion, vision changes, cyanosis, a condition in which the baby's skin has a bluish tint, even while they are receiving extra oxygen to breathe, dizziness, tiredness, swelling in the ankles or legs (edema), bluish lips and skin (cyanosis), angina-like chest pain (crushing chest pain), ear noise or buzzing, nausea and vomiting, respiratory distress, including signs such as flaring nostrils and grunting, headache, night sweating, hearing own heart sound, measurement of blood pressure above 140/90 mmHg, sleepiness, coma, nausea and vomiting.

3.6.1.1.2 Complications of hypertension

Over time, untreated high blood pressure can damage organs, such as the heart, kidneys, or eyes. This may lead to Chest Pain (Angina), Heart Attack, Heart Failure, Stroke, Kidney (renal) Failure, Peripheral Arterial Disease, Eye Damage (Retinopathy), Abnormal Heartbeat.

3.6.1.1.3 Types of hypertension

There are two major types of hypertension such as essential or primary hypertension and non essential or secondary hypertension. Essential hypertension or primary which accounts for 95% of hypertension, the cause of essential hypertension is multifactor, that is, there are several factors whose combined effects cause this. Non essential or secondary hypertension which accounts for 5% of hypertension, the high blood pressure is secondary to (caused by) a specific abnormality in one of the organs or systems of the body.

3.6.1.2 Systolic and diastolic blood pressure

Blood pressure is the lateral pressure exerted on the walls of the arteries by blood flowing through the arteries. It reflects the rhythm of the heart beat and is a measure of the volume of blood pressure into the vessels by the heart. The pressure of blood within the arteries is highest whenever the heart contracts and is called systolic pressure. Between beats, when the ventricles are at rest, arterial pressure is at its lowest and is called diastolic pressure. Blood pressure is measured in millimeters of mercury (mmHg). The top number, systolic is a measure of the pumping action of the heart muscle itself. The diastolic pressure indicates the ability of the arterial system to accept the pulse of blood that is forced in to the system by the contraction of the left ventricle. The most common site for taking blood pressure is the brachial artery of the upper arm, but arteries of the lower arm, thigh, and cuff may also be used. In the present study, the left upper arms of respondents have been used for blood pressure monitoring. At first, the respondents were sited or laid down and after taking 5-10 minutes rest (20 minutes rest have been taken after eating, smoking as well as exercising and stressful time avoided) we prepared them for blood pressure measurement. Then we formed a loop by passing the end of the cuff through the metal stirrup. The Velcro closer must be facing outwards. We have pushed the cuff over the left upper arm so that the tube points in the direction of the lower arm and laid the cuff on the arm. We made certain that the lower edge of the cuff laid approximately 2 to 3 cm above the elbow and that the rubber tube left the cuff on the inner side of the arm. About 3 cm long part of rubber tube was laid exactly over the artery which ran down the inner side of the arm and we have tightened the free end of the cuff and closed the cuff with the closer. There were no free space between the arm and the cuff and clothing did not restrict the arm. Any piece of clothing which does must be taken off. To secure the cuff with the Velcro closer in such a way that it was laid comfortably and was not too tight. The arm has been laid on the table so that the cuff was at the same height as the heart. Make sure that the tube is not kinked. During the measurement the respondent were speech less and still. We took three times of measurements with taking average value excluding the fractional part of the reading and successive measurements have been performed after at least 5-10 minutes. For blood pressure measurement we have used two types of machine such as i) Analog machine and ii) Automatic blood pressure monitor or digital machine.

Analog machine was used to measure blood pressure includes a sphygmomanometers, a cuff, and a stethoscope. The procedure begins by raising the silver column of mercury to 180-200 mmHg by inflating the cuff (Bernier, 1997). The pressure cuff was inflated rapidly to a pressure sufficient to stop the flow of blood and the air is gradually released. As the pressure in the cuff drops below the systolic blood pressure the turbulent flow of blood squirting through the artery causes sound vibrations that can be heard in the stethoscope. They are called korotkoff as k sounds (Cameron, 1978). This one set of k sounds indicates the systolic pressure level. As the pressure falls further, the k sounds become louder and then begin to fade. The point at which the k sounds die out or change indicates the diastolic pressure. For individuals experienced in this technique the reproducibility of the systolic blood pressure measurement is usually within 2 mmHg (Cameron, 1978). The reproducibility of the diastolic measurement is not as good automatic blood pressure machine or digital machine has been used to measure the blood pressure including a cuff and display monitor. After performing the all preparing condition as illustrated above we pressed the power button of the machine. At later of several seconds we have taken the systolic, diastolic value and pulse rate per minute from the display monitor. The top value shown in monitor was systolic and the middle as well as bottom values were diastolic blood pressure and pulse rate per minute.

3.6.2 Independent variable

The independent variables represent the inputs or causes, or are tested to see if they are the cause. In this study the independent variables have been classified into four aspects or types such as socio-demographic variable, health complication variables, feminine and nuptial variables and body composition variables.

3.6.2.1 Socio-demographic variable

The variables of socio-demographic aspect are considered as socio-demographic variables in this study. The socio-demographic variables and their measurements are discussed following:

3.6.2.1.1 Age

Age may refer to the effect of on persons. Age has been measured by interval scale in year. We have considered the round figure of age. The data have been obtained by direct individual question from the respondent.

3.6.2.1.2 Education

Education in its general sense is a form of learning in which knowledge, skills, and habits of a group of people are transferred from one generation to the next through teaching, training, research, or simply through auto didacticism. Generally, it occurs through any experience that has a formative effect on the way one thinks, feels, or acts. Education has been measured by interval scale in year which time the respondent involved with education according to educational level. The data have been obtained by direct individual question from the respondent.

3.6.2.1.3 Sedentary life style

Sedentary life style is a lack of sufficient physical activity to maintain a healthy balanced lifestyle i.e. the work of profession is sedentary style. Television and computers have become the major forces in the issue physical inactivity which is a growing problem in today's society. Sedentary life style has been measured by nominal scale. Sedentary life style is binary variable and takes value 1 if the work of profession is sedentary style or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.4 Working hour (>8 hrs) per day

Working hour means the time which is spent in occupation. The normal working hours per day are 8 hours. Working hour (>8hrs) per day was measured by nominal scale. Working hour (>8hrs) per day is a binary variable and takes value 1 if the respondent spend time more than 8 hours per day in his or her profession or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.5 Taking regular exercise

Physical exercise is any bodily activity that enhances or maintains physical fitness and overall health and wellness. It is performed for various reasons including strengthening muscles and the cardiovascular system, honing athletic skills, weight loss or maintenance, as well as for the purpose of enjoyment. Taking regular exercise has been measured by nominal scale. Taking regular exercise is a binary variable and takes value 1 if the respondent takes exercise or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.6 Social stress

Social stress is stress that stems from one's relationships with others and from the social environment in general. A person experiences stress when he or she does not have the ability or resources to cope when confronted with an external stimulus (stressor), or when they fear they do not have the ability or resources. Social stress has been measured by nominal scale. Social stress is a binary variable and takes value 1 if the respondent has social stress or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.7 Occupational stress

Occupational stress is stress involving work. Stress is defined in terms of its physical and physiological effects on a person, and can be a mental, physical or emotional strain. It can also be a tension or a situation or factor that can cause stress. Occupational stress can occur when there is a discrepancy between the demands of the environment/workplace and an individual's ability to carry out and complete these demands. Occupational stress has been measured by nominal scale. Occupational stress is a binary variable and takes value 1 if the respondent has occupational stress or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.8 Mental stress

Psychology a general term encompassing mental arousal and/or emotional stress; mental stress can be evoked by a number of mental tasks e.g., mental arithmetic, public speaking, mirror trace, type a structured interviews; mental stress evokes pathophysiologic responses e.g., myocardial ischemia measurable by radionuclide ventriculography of Physiological stress. Mental stress has been measured by nominal scale. Mental stress is a binary variable and takes value 1 if the respondent has mental stress or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.9 Hereditary hypertension

Heredity is the passing of traits to offspring (from its parent or ancestors). This is the process by which an offspring cell or organism acquires or becomes predisposed to the characteristics of its parent cell or organism. Through heredity, variations exhibited by individuals can accumulate and cause some species to evolve. The study of heredity in biology is called genetics, which includes the field of epigenetic. Hereditary hypertension has been measured by nominal scale. Hereditary hypertension is a binary variable and takes value 1 if the respondent has hereditary hypertension or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.10 Smoking

Smoking is a practice in which a substance, most commonly tobacco, is burned and the smoke is tasted or inhaled. Smoking has been measured by nominal scale. Smoking is a binary variable and takes value 1 if the respondent is smoker or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.11 Taking alcohol

In chemistry, an alcohol is an organic compound in which the hydroxyl functional group (-OH) is bound to a carbon atom. In particular, this carbon center should be saturated, having single bonds to three other atoms. Taking alcohol has been measured by nominal scale. Taking alcohol is a binary variable and takes value 1 if the respondent takes alcohol or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.1.12 Taking excess salt

Salt, also known as table salt or rock salt (halite), is a crystalline mineral that is composed primarily of sodium chloride (NaCl), a chemical compound belonging to the larger class of ionic salts. It is absolutely essential for animal life, but can be harmful to animals and plants in excess. Hence, taking access salt means takes salt out of curry. Taking access salt has been measured by nominal scale. Taking access salt is a binary variable and takes value 1 if the respondent takes salt out of curry or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.2 Health complication variable

The different types of diseases which affect human body have been considered health complications in this study. The various health complications are discussed following:

3.6.2.2.1 Kidney disease

Renal failure (also kidney failure or renal insufficiency) is a medical condition in which the kidneys fail to adequately filter waste products from the blood. The two main forms are acute kidney injury, which is often reversible with adequate treatment, and chronic kidney disease, which is often not reversible. Kidney disease has been measured by nominal scale. Kidney disease is a binary variable and takes value 1 if the respondent has kidney disease or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.2.2 Tumor

A tumor is commonly used as a synonym for a neoplasm (a solid or fluid-filled (cystic) lesion that may or may not be formed by an abnormal growth of neoplastic cells) that appears enlarged in size. Tumor is not synonymous with cancer. While cancer is by definition malignant, a tumor can be benign, pre-malignant, or malignant, or can represent a lesion without any cancerous potential whatsoever. Tumor has been measured by nominal scale. Tumor is binary variable and takes value 1 if the respondent has tumor or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.2.3 Diabetes

Diabetes mellitus, or simply diabetes, is a group of metabolic diseases in which a person has high blood sugar, either because the pancreas does not produce enough insulin, or because cells do not respond to the insulin that is produced. Diabetes has been measured by nominal scale Diabetes is binary variable and takes value 1 if the respondent is diabetic patients or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.2.4 Sleep apnea

In this condition, breathing repeatedly stops and starts during sleep. The repeated episodes of oxygen deprivation may damage the cellular lining of the blood vessel walls, which may deprive blood vessels of the elasticity they need to regulate blood pressure. Treating sleep apnea with a pressure mask, nasal devices, surgery, weight loss or other steps can help control the high blood pressure. Sleep apnea has been measured by nominal scale. Sleep apnea is a binary variable and takes value 1 if the respondent has sleep apnea disease or 0 otherwise. The data have been obtained by direct individual question about the symptoms of sleep apnea from the respondent.

3.6.2.2.5 Hypothyroidism

This condition occurs when the thyroid gland doesn't produce enough thyroid hormone, which can cause high blood pressure. Hypothyroidism may have various causes, including inflammation, surgery, radiation treatment, certain medications or pituitary problems. Treatment with synthetic thyroid hormones usually returns blood pressure to normal. Hypothyroidism has been measured by nominal scale. Hypothyroidism is a binary variable and takes value 1 if the respondent has hypothyroidism or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.2.6 Hyperthyroidism

This condition occurs when the thyroid gland produces too much thyroid hormone. This can increase the activity of epinephrine and nor epinephrine, which can increase blood pressure. Treatment may include medication, radioactive iodine therapy or surgery, all of which can restore normal blood pressure. Hyperthyroidism has been measured by nominal scale. Hyperthyroidism is a binary variable and takes value 1 if the respondent has hyperthyroidism or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.2.7 Tachycardia

Pulse rate is the number of times of heart beats per minute. Normal heart rate varies from person to person. The pulse rate per minutes has been measured by the number of times. When the blood was measured by digital machine, the average value of three pulse rate was taken excluding the fractional part. Otherwise, the pulse rate has been measured by stopwatch with soft press the nerve of left hand. A heart rate over 100 beats per minute is generally accepted as tachycardia. However, tachycardia can be dangerous depending on the speed and type of rhythm. Tachycardia has been measured by nominal scale. Tachycardia is binary variable and takes value 1 if the respondent has tachycardia disease or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.2.8 Over weight

The greater body mass, the more blood needs to supply oxygen and nutrients to tissues. As the volume of blood circulated through your blood vessels increases, so does the pressure on artery walls. A body mass index of 18.5 to 25 may indicate optimal weight; a body mass index lower than 18.5 suggest the person is underweight while a body mass index above 25 may indicate the person is overweight. Body mass index has been consiedered as health complication in this study and also, it has been measured by nominal scale. Body mass index is binary variable and takes value 1 if the respondent is over weighted or 0 otherwise. The data have been obtained by direct individual question and observation the medical report from the respondent.

3.6.2.3 Feminine and nuptial variable

The variables related with female and marital attitude have been considered as feminine and nuptial variable. The feminine and nuptial variables are discussed following with their measurement.

3.6.2.3.1 First menstruation age

Menstruation is the periodic shedding of the uterine lining (endometrium). It starts (menarche) at or before sexual maturity, maturation, in females of certain mammal species, and ceases at or near menopause (commonly considered the end of a female's reproductive life). The periodicity of menstruation gives rise to commonly used euphemisms like period and monthly. Age at first menstruation was measured by year at which the first menstruation was occurred and the age at last birth day was counted. The data was obtained by direct individual question from the respondent.

3.6.2.3.2 Duration couple life

Marriage (also called matrimony or wedlock) is a social union or legal contract between people called spouses that establish rights and obligations between the spouses, between the spouses and their children, and between the spouses and their in-laws. From the first marriage the respondent how many times lived with his/her couple partner was consider as duration of couple life. Duration of couple life has been measured by interval scale in year. The data was obtained by direct individual question from the respondent.

3.6.2.3.3 Use of contraceptive method

Contraceptive method, also known as contraception or Birth control or fertility control, refers to methods or devices used to prevent pregnancy. Planning and provision of birth control is called family planning. Use of contraceptive method was measured by nominal scale. Use of contraceptive is a binary variable and takes 1 if the respondent is contraceptive user or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.3.4 Menopause

Menopause literally means the end of monthly cycles. Menopause is an event that typically (but not always) occurs in women in midlife, during their late 40s or early 50s, and it signals the end of the fertile phase of a woman's life. Menopause has measured by nominal scale. Menopause is a binary variable and takes value 1 if the respondent possesses the menopause or 0 otherwise. The data have been collected by direct individual question from the respondent.

3.6.2.3.5 Pregnancy

Pregnancy is the fertilization and development of one or more offspring, known as an embryo or fetus, in a woman's uterus. In a pregnancy, there can be multiple gestations, as in the case of twins or triplets. Pregnancy has been measured by nominal scale. Pregnancy is a binary variable and takes value 1 if the respondent is pregnant or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.3.6 Miscarriage

Miscarriage or spontaneous abortion is the spontaneous end of a pregnancy at a stage where the embryo or fetus is incapable of surviving independently. Miscarriage is the most common complication of early pregnancy. Miscarriage has been measured by nominal scale. Miscarriage is a binary variable and takes value 1 if the respondent possesses the miscarriage or 0 otherwise. The data have been obtained by direct individual question from the respondent.

3.6.2.4 Body composition variable

Body composition is used to describe the percentages of fat, bone and muscle in human bodies. The body composition variables and their measurements are described following:

3.6.2.4.1 Height

Human height is the distance from the bottom of the feet to the top of the head in a human body, standing erect. Height is a major indicator of general body size and of bone length. It is important in screening for disease or malnutrition and in the interpretation of weight variations from the normal range can have social consequences, in addition to their associations with disease. We have taken height of the respondent measurement tape which was marking by cm as well as inch and we took in cm. The respondent who was not able to stand for them we took height by lying. By lying touched a scale with the top of the head and at the same time at the ending of the foot touching with another scale as a parallel way and measured the total distance between two scales. The respondent who was able to stand for them we have taken measurement between the distances from the highest point of the top of the head in the mid sagittal plan to the floor. Height has been measured by interval scale. Height is numerical variable. The data have been collected directly from the respondents.

3.6.2.4.2 Weight

Weight is a composite measure of total body size. It is important in screening for unusual growth, obesity and under nutrition. The weight was measured by weight in kilograms. The wearing cloths of all respondents are not possible to open in the time of taking weight. For this reason we subtracted on an average 1500 grams for the female, 1000 grams for male and 500 grams for children aged from ten to fifteen years from the actual weight with cloths. Height has been measured by interval scale. Weight is a numerical variable. The data have been collected directly from the respondents.

3.6.2.4.3 Body Mass Index (BMI)

Body mass index (BMI) is the indicator of body fitness that indicates under weight, normal weight, over weight and obesity. It is a number that shows body weight adjust for height. BMI is calculated by dividing a person’s weight in kg by the square of his/her height in meters as.

$$BMI = \frac{Weight(kg)}{Height^2(m)}$$

WHO (1997) assembles growth specification through BMI that can be exposed as follows:

Under weight	→	<18.5 BMI (kg/m^2)
Normal weight	→	18.5-24.9
Over weight	→	25-29.9
Obesity-1	→	30-34.9
Obesity-2	→	35-39.5
Extreme obesity	→	>40

3.6.2.4.4 Abdominal circumference

The abdominal circumference is the single most important measurement in assessing fetal size and growth. It is also a mandatory measurement. During measurement the respondent wore little clothing so that the tape may be correctly positioned. The measurement has not been made over clothing. The respondent stood with the arms by the sides and the feet together. The measurer faced the respondent and the tape was placed around the respondent at the level of the greatest anterior extension of the abdomen in a horizontal plane and took the reading in cm. Abdominal circumference has been measured by interval scale. Abdominal circumference is a numerical variable. The data have been collected directly from the respondents.

3.6.2.4.5 Waist circumference

The waist is the part of the abdomen between the rib cage and hip. On proportionate people, the waist is the narrowest part of the torso. During measurement the respondent wore little clothing so that the tape may be correctly positioned. The measurement was not made over clothing. The respondent stood erect with the abdomen relaxed, the arms at the sides and the feet together. The measurer faced the respondent and placed an inelastic tape around the respondent, in a horizontal plane, at the level of the natural waist and took the reading in cm. Waist circumference has been measured by interval scale. Waist circumference is a numerical variable. The data have been collected directly from the respondents.

3.6.2.4.6 Hip circumference

The hip region is located lateral to the gluteal region (i. e. the buttock), inferior to the iliac crest, and overlying the greater trochanter of the femur, or thigh bone. In adults, three of the bones of the pelvis have fused into the hip bone which forms part of the hip region. During the measurement the respondent wore only light smock over underwear. The respondent stood erect with arms at the sides and feet together. The measurer squats at the side of the subjects so that the level of maximum extension of the hip can be seen. Then an inelastic tape was placed around the hip in a horizontal plane at this level without compressing the skin and took the reading in cm. Hip circumference has been measured by interval scale. Hip circumference is a numerical variable. The data have been collected directly from the respondents.

3.6.2.4.7 Ratio of waist to hip circumference

Waist-to-hip ratio is an important risk factor of diabetes, hypertension and gallbladder. Waist-to-hip ratio is a number which has been calculated as dividing waist circumference by the hip circumference and measured in cm.

3.7 Assumption

Assumption is the statement of expected relation among variables which demand for testing or verifying. In fact, assumptions drive a research.

i. The age specific pattern of systolic and diastolic hypertension may exist.
ii. Socio-demographic characteristics may influence hypertension.
iii. Health complication characteristics may influence hypertension
iv. Feminine and other nuptial characteristics may influence hypertension
v. Abnormalities of body compositions may influence the high blood pressure.

3.8 Limitation of the study

In every study usually have some limitations. The present study also had a few limitations which are as follow:

i. The study was conducted in a specific area. But the disease hypertension is present everywhere and does not concentrate in a specific area.
ii. The sample size (total 2250 respondents) was larger in comparison with time and financial capability of the researcher.
iii. The researcher had to spend a long period of time for data collection. More over, it took a lot of time to collect process, tabulate, analyze and interpret the whole data. So, it was in fact very difficult for researcher to complete all the procedures in time.
iv. For the limitation of financial and administrative support we avoid the clinical test and measurements of body compositions.

CHAPTER 4
METHODS OF THE STUDY

4.1 Prelude

The existence of any science depends on its invented and employed methods. Physical and natural science has been qualified to achieve the scientific honors for the application of appropriate and logical procedure. In fact, these sciences are completely followed by scientific methods in its test and observation procedure. Some definite methods are used by social science in its discussion, consideration and making theory. But some one is not agree to support these methods as scientific methods or some tell these methods a procedure of theory making. For this consequence, many are reluctant to consider the social science as a proper science. Actually, the reality of research information from the physical and natural science is well ascertained but here social science is probability dependent. Thus, the present study is related to medical science which is the part of natural science but research procedures are social science dependent. This study fundamentally primary data based and attempts to obtain different types information of Bangladesh population about hypertension to know the hypertensive patterns and risk factors of hypertension through specified interview schedule. The methodology specified for this present study is discussed below under several sub-heading in their proper sequence.

4.2 Data analysis and presentation methods

Data analysis and presentation of the information gathered are an integral part of the study. In fact, data collected from field does not bring out much meaning if it is not condensed, analyzed and summed up. This kind of data is called information and exposition of information from raw data is analysis. In this study, data have been analyzed and presented illustratively as well as statistically as the situation permits. The applying methods to study the research problem are discussed following:

4.2.1 Percentage distribution

A frequency distribution in which the individual class frequencies are expressed as a percentage of the total frequency equated to 100. In this study, percentage distribution or dimensional table is adopted to just describe the background characteristics using percentages and percentiles.

4.2.2 Correlation method

The percentage distribution has made a concept about population based on sample by background characteristics. It can not make any idea about relationship between dependent and independent variables. Hence, to make an idea about the relationship, we have used the correlation method such as Pearson product-moment correlation, Point Bi-serial Correlation and Phi Correlation method. The methods are described following:

4.2.2.1 Pearson product-moment correlation

In statistics, the Pearson product-moment correlation coefficient is a measure of the correlation (linear dependence) between two quantitative variables X and Y, giving a value between +1 and −1 inclusive (Islam, 2008). It is widely used in the sciences as a measure of the strength of linear dependence between two variables. It was developed by Karl Pearson. It is denoted by r and defined as following:

$$r = \frac{\sum (X - \overline{X})(Y - \overline{Y})}{\sqrt{\sum (X - \overline{X})^2 \sum (Y - \overline{Y})^2}}; \text{ Where, } \overline{x} = \frac{\sum x}{n} \text{ and } \overline{y} = \frac{\sum y}{n}$$

4.2.2.2 Point bi-serial correlation

The Point bi-serial correlation coefficient is a measure of the correlation (Islam, 2008). To know the relationship between a binary variable hypertension (categorical) and other quantitative variables such as menstruation age as well as duration of couple lie, the point bi-serial correlation coefficient (r_{pbc}) has been employed. The method is described as following:

$$r_{pbc} = \frac{\bar{x}_p - \bar{x}_q}{s_x}\sqrt{pq}$$

where, $\bar{x}_p$ and $\bar{x}_q$ = means of continuous variable for those who affected by hypertension and not affected by hypertension respectively.

p and q = proportions of affected and non affected.

S_x= Standard deviation of continuous variable.

4.2.2.3 Phi-correlation coefficient

To examine the relationship between hypertension (categorical) and other binary or indicator variables such as use of contraceptive method, pregnancy, menopause as well as miscarriage; the phi correlation coefficient (r_φ) has been used (Islam, 2008). The method is described as following:

$$r_\phi = \frac{f_{11} f_{22} - f_{12} f_{21}}{f_{1+} \cdot f_{2+} \; f_{+1} \; f_{+2}}$$

Where, f_{11}= frequency of the first row and first column and so on.

f_{1+} and f_{+1}= Sum of first row and first column and so on.

4.2.3 Regression analysis

Correlation analysis gives us some idea about relationship between two variables such as existence, direction and intensity of relation but it does not give any idea about the rate of change. To study the rate of change of outcome variable with respect to change in explanatory variable and the statistical tool which is used is called regression analysis. In this study binary backward logistic regression analysis has been employed.

4.2.3.1 Binary backward logistic regression analysis

The binary backward logistic regression model[2] have been adopted to study the impact of some selected variables or characteristics or factors such as socio-demographic variables, health complications, feminine and nuptial variables (X_j's) on hypertension (Y). The model is as follows:

$$\pi(x) = E(Y_i = 1/X_j) = \frac{e^{\sum_j \beta_j X_j}}{1 + e^{\sum_j \beta_j X_j}}$$

$$\Rightarrow L_i = \log_e\left(\frac{\pi(x)}{1-\pi(x)}\right) = \sum_{j=1}^{k} \beta_j X_j$$

where, β_j is the j^{th} (j = 1, 2, 3, …, k) regressor coefficients and k is the number of explanatory variables.

4.2.3.2 Estimation method

To estimate the regression parameter, the maximum likelihood method have been used (Hosmer, 2000). By using the likelihood function we have estimated the maximum likelihood estimates. The likelihood function is given by

$$l(\beta) = \prod_{i=1}^{n} \pi(x_i)^{y_i}[1-\pi(x_i)]^{1-y_i}$$

Also, the log likelihood function is given by

$$L(\beta) = \ln[l(\beta)] = \sum_{i=1}^{n}[y_i \ln\{\pi(x_i)\} + (1-y_i)\ln\{1-\pi(x_i)\}]$$

To find the values of $\beta^{'s}$ that maximize L (β) we differentiate L (β) with respect to $\beta^{'s}$ and set the resulting expressions equal to zero.

4.2.4 Hypothesis testing methods

To test the significance of correlation coefficients and regression coefficients we have used t test, likelihood ratio test and Wald test. The test statistics are described following.

4.2.4.1 t test

The test statistic, t which follows t distribution is defined as following (Hosmer, 2000). It has been used to test the regression coefficients.

$$t = \frac{\hat{\beta}_j}{S\hat{E}(\hat{\beta}_j)}$$

; Where, $\hat{\beta}_j$ = Estimated coefficient of j^{th} variable.

$S\hat{E}(\hat{\beta}_j)$ = estimated standard error of j^{th} coefficient.

4.2.4.2 Likelihood ratio test

The likelihood ratio test statistic, G is following (Hosmer, 2000).

$$G = 2[\sum_{i=1}^{n}\{y_i \ln(\hat{\pi}_i) + (1-y_i)\ln(1-\hat{\pi}_i)\} - \{n_1 \ln(n_1) + n_0 \ln(n_0) - n\ln(n)\}]$$

Where, $n_0 = \sum(1-y_i)$; $n_1 = \sum y_i$ and n = Number of observation.

$$\hat{\pi}_i = \hat{\pi}(x_i) = \frac{e^{\sum \beta_j x_j}}{1+e^{\sum \beta_j x_j}}$$

4.2.4.3 Wald test

The Wald test statistic, W which follows standard normal distribution is following (Hosmer, 2000).

$$W = \frac{\hat{\beta}_j;}{S\hat{E}(\hat{\beta}_j)}$$

Where, $\hat{\beta}_j$ = Estimated coefficient of j^{th} variable.

$S\hat{E}(\hat{\beta}_j)$ = estimated standard error of j^{th} coefficient.

4.2.5 Goodness of fit test

To assess the goodness of fit of model, Hosmer-lemeshow test statistic H, Negelkerke R^2, Classification table (Sensitivity and specificity) and ROC curve have been studied as following:

4.2.5.1 Hosmer–Lemeshow test statistic

The Hosmer-Lemeshow Test Statistic is described as following (Hosmer, 2000).

$$H = \sum_{g=1}^{n} \frac{(O_g - E_g)}{N_g \pi_g (1 - \pi_g)}$$

Here O_g, E_g, N_g, and π_g denote the observed events, expected events, observations, predicted risk for the g^{th} risk decile group, and n is the number of groups. The test statistic asymptotically follows a χ^2 distribution with $n-2$ degrees of freedom.

4.2.5.2 Cox and Snell R-squared

Cox and Snell R-squared can be calculated as follows:

$$\mathbf{R}^2 = 1 - e^{\frac{-2(LL_m - LL_0)}{N}}$$ (Hosmer, 2000)

where, LL_m and LL_o are the log-likelihood of the model and intercept (the model without any explaining variable), respectively, and N is the sample size.

4.2.5.3 Nagelkerke R^2

One of the problems of Cox & Snell R-squared is that the theoretical maximum is not always 1, which is a little weird for R-square. Nagelkerke R-squared solves this problem. It can be calculated as follows:

$$R^2 = \frac{1 - e^{\frac{-2(LL_m - LL_0)}{N}}}{1 - e^{\frac{2LL_0)}{N}}}$$ (Hosmer, 2000)

where, LL_m and LL_o are the log-likelihood of the model and intercept (the model without any explaining variable), respectively, and N is the sample size.

4.2.5.4 Sensitivity and specificity

Sensitivity and specificity are statistical measures of the performance of a binary classification test, also known in statistics as classification function (Hosmer, 2000). Sensitivity (also called the true positive rate, or the recall rate in some fields) measures the proportion of actual positives which are correctly identified as such (e.g. the percentage of sick people who are correctly identified as having the condition). Specificity measures the proportion of negatives which are correctly identified as such (e.g. the percentage of healthy people who are correctly identified as not having the condition, sometimes called the true negative rate). These two measures are closely related to the concepts of type I and type II errors. A perfect predictor would be described as 100% sensitive (i.e. predicting all people from the sick group as sick) and 100% specific (i.e. not predicting anyone from the healthy group as sick).Sensitivity relates to the test's ability to identify positive results. The sensitivity of a test is the proportion of people that are known to have the disease who test positive for it. This can be written as:

$$\text{Sensitivity} = \frac{\text{Number of true positives}}{\text{Number of true positives} + \text{Number of false negatives}}$$

Specificity is the ability of test to identify negative results. Considering a example of medical test to identify a disease. The specificity of a test is defined as the proportion of patients that are known not to have the disease who will test negative for it. This can be written as:

$$\text{Specificity} = \frac{\text{Number of true negatives}}{\text{Number of true negatives} + \text{Number of false positives}}$$

4.2.5.5 Receiver operating characteristic (ROC) curve

In signal detection theory, a receiver operating characteristic (ROC) (Hosmer, 2000), or simply ROC curve, is a graphical plot which illustrates the performance of a binary classifier system as its discrimination threshold is varied. It is created by plotting the fraction of true positives out of the positives (TPR = true positive rate) vs. the fraction of false positives out of the negatives (FPR = false positive rate), at various threshold settings. TPR is also known as sensitivity (also called recall in some fields), and FPR is one minus the specificity or true negative rate. The graph at below shows three ROC curves representing excellent, good, and worthless tests plotted on the same graph. The accuracy of the test depends on how well the test separates the group being tested into those with and without the disease in question. Accuracy is measured by the area under the ROC curve. An area of 1 represents a perfect test; an area of .5 represents a worthless test. A rough guide for classifying the accuracy of a diagnostic test is the traditional academic point system:

- .90-1 = excellent (A)
- .80-.90 = good (B)
- .70-.80 = fair (C)
- .60-.70 = poor (D)
- .50-.60 = fail (F)

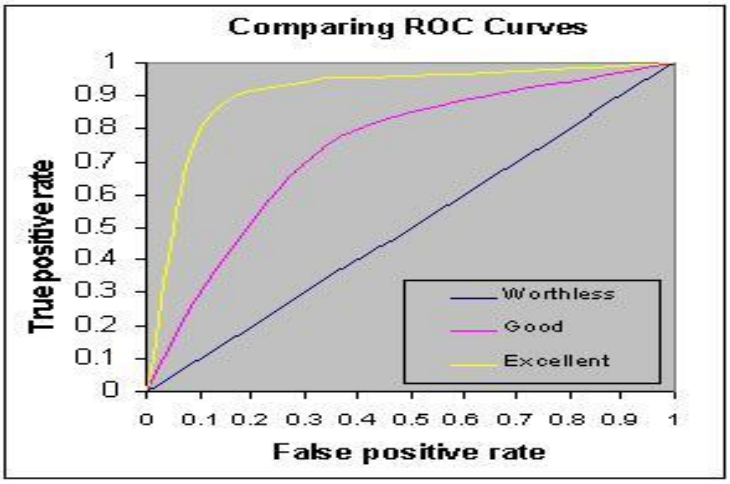


Figure 4.2.5.5: Graph of receiver operating characteristic (ROC) curve

4.2.6 Path analysis

The method of path coefficient analysis is essentially a device for analysis or decomposition of a correlation coefficient under a structure of casual relationships among linearly related variable (Varma, 1993). A correlation coefficient between two variables may consist of several factors corresponding to a certain step of link in the chain of relationship between two correlated variables. In path coefficient analysis the correlation coefficient between the criterion variable (effect) and a given predictor or independent variable (causal factor) is decomposed into a liner combination of the direct effect of the independent variable under consideration and its indirect effects through other independent variable(causal factors) with which the former is corrected. Path analysis is a straightforward extension of multiple regressions. Its aim is to provide estimates of the magnitude and significance of hypothesized causal connections between sets of variables. The path diagram is given below:

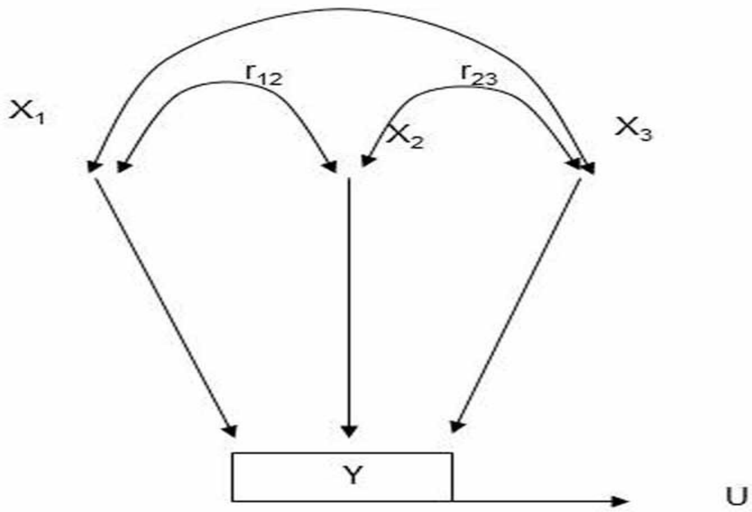


Figure 4.2.6: Graphical presentation of path analysis

4.2.7 Bootstrapping

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. It may also be used for constructing hypothesis tests. It is often used as a robust alternative to inference based on parametric assumptions when those assumptions are in doubt, or where parametric inference is impossible or requires very complicated formulas for the calculation of standard errors (Efron and Tibshirani, 1993).

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Prelude

The presentation and discussion of the results is the heart of the technical report. Many readers, of course, are interested only in obtaining the quick review of the work afforded by the summary and the concluding section. But readers who have reason to study the entire text of a report will normally spend most of their time on the Results and Discussion section. The first purpose of this section is a well-organized and objective presentation of the results. The second purpose of this section is a discussion of the results, together with their analysis, to show that the conclusions are warranted.

5.2 Hypertensive and normotensive patterns of blood pressure

This section is devoted to find out the nature and patterns of hypertension. So, the different types of percentiles of age are calculated and show in Table 5.2.1

Table 5.2.1: Distribution of percentiles of age of respondents

Percentiles	**5th**	**10th**	**25th**	**50th**	**60th**	**75th**	**90th**	**95th**	**99th**	**100th**
Age (in Year)	16	18	25	35	39	46	60	65	80	95
Percentiles	**1st - 60th**					**61th - 90th**		**91th - 100th**		
Age Interval (in Year)	≤39					40-60		≥61		

This table shows that 5% respondents are below-equal 16 years old, 25% are below-equal 25 years old, 50% are below-equal 35 years old, 60% are below-equal 39 years old, 75% are below-equal 46 years old, 90% are below-equal 60 years old, 95% are below-equal 65 years old, 99% are below-equal 80 years old and 100% are below-equal 95 years old. The same table presents that 60% respondents are less-equal 39 years old, 30% are contained between 40 to 60 years old when only 10% are above-equal 61 years old. The rate of systolic and diastolic hypertension and comparisons are displayed in Table 5.2.2

Table 5.2.2: Comparison between the rate of systolic and diastolic hypertension

	Percentiles	1^{st} - 60^{th}	61^{th} - 90^{th}	91^{th} - 100^{th}
	Age (Years) Intervals According to Percentiles	**≤39**	**40-60**	**≥61**
Systolic Hypertension (%)		3.80	34.00	60.40
Diastolic Hypertension (%)		7.40	34.10	47.90

which presents that systolic hypertensive patients (60.40%) are greater than diastolic hypertensive patients (47.90%) in oldest age group (≥61 years) where diastolic hypertensive patients (7.40%) are greater than systolic hypertensive patients (3.80%) in youngest age group (≤39 years) and in middle age group (40-60 years) both are same. Hence, young age (≤39 years) is risk period for occurring diastolic hypertension than systolic and old age (≥61years) is risk period for occurring systolic hypertension than diastolic when middle age (40-60 years) is also risk period for occurring both type of hypertension.

The different percentiles of systolic and diastolic blood pressure of hypertensive and normotensive respondents are displayed in Table 5.2.3 in which the differences between two same percentiles of systolic and diastolic blood pressure are almost same for normotensive respondents. Also, the constant difference is 40 mmHg. But the

Table 5.2.3: Comparison between percentiles of systolic and diastolic blood pressure

Percentiles	**5^{th}**	**10^{th}**	**25^{th}**	**50^{th}**	**60^{th}**	**75^{th}**	**90^{th}**	**95^{th}**	**99^{th}**	**100^{th}**
				Normotensive						
Systolic Blood Pressure (mm Hg)	103	105	110	114	115	117	118	119	119	119
Diastolic Blood Pressure (mm Hg)	63	65	70	74	75	76	78	79	79	79
Difference	40	40	40	40	40	41	40	40	40	40
				Hypertensive						
Systolic Blood Pressure (mm Hg)	141	142	145	152	157	164	178	187	217	244
Diastolic Blood Pressure (mm Hg)	90	91	92	96	98	102	110	118	132	151
Difference	51	51	53	56	59	62	68	69	85	93

differences between two same percentiles of systolic and diastolic blood pressure are varying from 51 mmHg to 93 mmHg for hypertensive respondents. Hence, the abnormality (>40 mmHg) of the differences is an indicator of hypertension or prehypertension.

5.3 Studies on different types of determinants of hypertension

From the view of proper critical analysis of impact of some key factors on hypertension, the study is divided into four aspects such as socio-demographic, feminine and nuptial, health complication and body composition aspects. So, the study on hypertension in different mentioned aspects is conducted following.

5.3.1 Socio-demographic determinants of hypertension

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. Hence, this sub section is devoted for socio-demographic aspect.

5.3.1.1 Socio-demographic background characteristics

In any research, it is important to study background characteristics of the respondents or target population or nature of the data. In order to study the background characteristics of different variables, the percentage distribution of the considered variables is conducted. This sub section is declared for socio-demographic background characteristics. This assessment leads to the interpretation of results and to examine any cause-effect relationship among the study variables.

The percentages of selected socio-demographic background characteristics displayed in Table 5.3.1.1. Among the total respondents 25.20% are in age group 26-35 years. Our study shows that 31.70% respondents are illiterate where 68.30% are literate by primary (21.60%), secondary (33.20%), higher secondary (7%) and graduate as well 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% respondents are habituated in sedentary life style. The well known and well established normal working hours per day is 8. But the same table shows that 23.80% respondents are working above 8 hours

Table 5.3.1.1: Percentage distribution of socio-demographic characteristics

Characteristics	**Percent (%)**	**Characteristics**	**Percent (%)**	**Characteristics**	**Percent (%)**
Age (based on percentiles) in Years		Working Hour (> 8 hrs) Per Day		Hereditary Hypertension	
10-16	5.70	No	76.20	No	77.60
17-18	5.00	Yes	23.80	Yes	22.40
19-25	17.20	Total	100.00	Total	100.00
26-35	25.20	Taking Regular Exercise		Smoking	
36-39	7.70	No	14.40	No	83.40
40-46	14.80	Yes	85.60	Yes	16.60
47-60	16.90	Total	100.00	Total	100.00
61-65	2.50	Social Stress		Taking Alcohol	
66-80	4.20	No	90.80	No	97.20
81-95	0.80	Yes	9.20	Yes	2.80
Total	100	Total	100.00	Total	100.00
Educational Level		Occupational Stress		Taking Excess Salt	
Illiterate	31.70	No	78.90	No	48.80
Primary	21.60	Yes	21.10	Yes	51.20
Secondary	33.20	Total	100.00	Total	100.00
Higher Secondary	7.00	Mental Stress		Hypertension	
Graduate and Above	6.50	No	67.30	No	71.90
Total	100.0	Yes	32.70	Yes	28.10
Sedentary Life Style		Total	100.00	Total	100.00
No	69.70				
Yes	30.30				
Total	100.00				

regularly in the study area. Here, regular exercise means physically normal movements not sedentary. 85.60% respondents take regular exercise. Social stress means pressure which is imposed by social environment, occupational stress means one kind of pressure is created by 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% are involve with the mentioned characteristics. Hereditary hypertension means hypertension is or was available in any family member. The hereditary hypertensions are 22.40%. In addition, 16.60% are smoker and 2.80% respondents take alcohol. Taking excess salt means taking salt out of curry and 51.20% respondents take access salt. Finally, 28.10% are hypertensive patients among the total respondents in our study area.

5.3.1.2 Association between hypertension and socio-demographic variables

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 find out the risk factors of hypertension it is important to verify the relationship between hypertension and other selected variables or characteristics. From this view researcher have employed some method (point bi-serial correlation and phi correlation method) to study the relationship between hypertension and other selected variables and results are represented in Table 5.3.1.2 This table depicts that the relationships between hypertension and other variables such as age as well as educational level are highly significant at 1% level of significance. These two relationships have been studied by point bi-serial correlation because two variables age and educational level have are quantitative where hypertension is qualitative variable. In the same table we see another method for studying relation named phi-correlation which has been employed for all dichotomous variables.

Table 5.3.1.2: 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

So that, the relationships between hypertension and other variables such as sedentary life style, working hour (>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.

5.3.1.3 Impact of Socio-demographic determinants on hypertension

After examining the existence of relation 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 applying binary logistic regression model. The fitted model and requisite results are displayed in following:

$$\pi(x)=\frac{e^{\left\{\begin{array}{l}-6.218+0.028\text{Age}-0.043\text{Educational Level}-1.073\text{Sedentary Life Style}\\+1.613\text{Working Hours}(>8\text{ hrs})\text{ Per Day}-0.504\text{Taking Regular Exercise}+1.553\text{Social Stress}\\+1.502\text{Occupational Stress}+2.0971\text{Mental Stress}+1.800\text{Hereditary Hypertension}+0.594\text{Smoking}\\+1.073\text{Taking Alcohol}+2.697\text{Taking Excess Salt.}\end{array}\right\}}}{1+e^{\left\{\begin{array}{l}-6.218+0.028\text{Age}-0.043\text{Educational Level}-1.073\text{Sedentary Life Style}\\+1.613\text{Working Hours}(>8\text{ hrs})\text{ Per Day}-0.504\text{Taking Regular Exercise}+1.553\text{Social Stress}\\+1.502\text{Occupational Stress}+2.0971\text{Mental Stress}+1.800\text{Hereditary Hypertension}+0.594\text{Smoking}\\+1.073\text{Taking Alcohol}+2.697\text{Taking Excess Salt.}\end{array}\right\}}}$$

To study the causal relationship between hypertension and other socio-demographic variables, age is found as a significant variable. i. e. age has positive significant impact on hypertension and its odds ration 1.028 indicates that for every increase of one year in age, the risk of occurring hypertension increases 1.028 times. Secondly, education has significant negative impact on hypertension and its odds ratio focus that every increase of one year in education, the risk of hypertension increase 0.958 time. Thirdly, sedentary life style has positive significant impact on hypertension and the odd ratio 2.924 indicates that the respondents with sedentary life style have 2.958 times odds or risk of occurring hypertension compared with those who do not have sedentary life style. Working hour (>8 hrs) per day has significant impact on hypertension and the odds ratio indicates that the respondents who works regularly more than 8 hours have 5.019 times risk for occurring hypertension compared with those who do not works more than 8 hours. Again, regular exercise has negative significant impact on hypertension and its odds ratio estimates that the respondents who takes regular exercise have 0.604 times risk for occurring hypertension compared with those who do not takes. Also, social stress, occupational stress and mental stress have 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 positive significant impact on hypertension and similar odds ratio refer to respondents who possess the

Table 5.3.1.3: Stepwise logistic regression of hypertension on socio-demographic factors

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.

hereditary hypertension have 6.047 times risk for occurring hypertension compared with those who do not. Finally, smoking, taking alcohol and taking access salt also, have positive significant impact on hypertension and the odds ratios indicate that the respondents who possess the characteristics 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. After discussing the binary logistics regression it is established that sedentary life style, working hour (>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 risk factor, but age increasing is out of human control.

5.3.1.4 Assessing the fit of the logistic regression model

We begin our discussion on 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.

5.3.1.4.1 Goodness-of-fit test

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 assessment are displayed in following Table 5.3.1.4.1.

Table 5.3.1.4.1: 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 5.3.1.4.1 depicts the value of Negelkerke R square is 0.75 which implies that all selected variables of logistic regression model have explained 75% of 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 degree of freedom which indicates that the model seems to fit quite well. The results of classifying the observations of hypertension using fitted logistic regression model are presented in 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.

5.3.1.4.2 Receiver operating characteristics curve for socio-demographic aspect

A more complete description of classification accuracy is given by the area under the receiver operating characteristics curve (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.

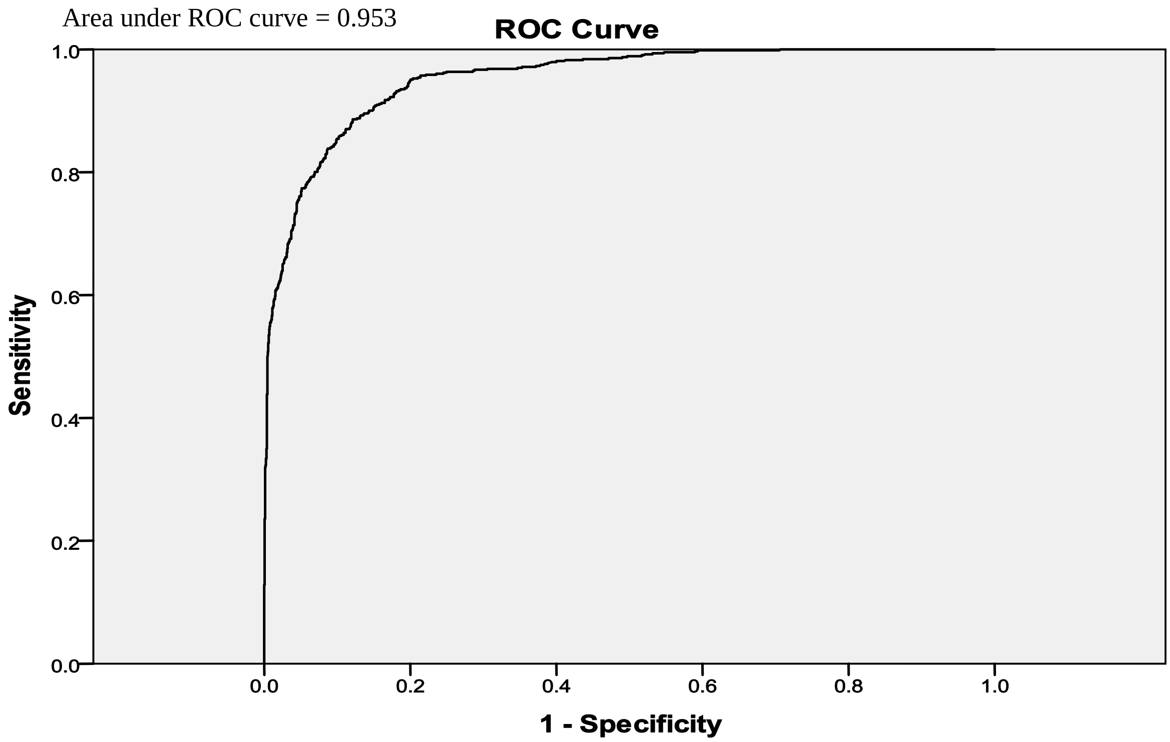


Figure 5.3.1.4.2: ROC curve for socio-demographic aspect

5.3.1.4.3 Logistic regression for socio-demographic aspect by bootstrapping

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 bootstrapping method, regression coefficients of socio-demographic factors have been found approximately same with comparing the logistic regression coefficients. The small amount of bias may be ignored. These results are shown the following Table 5.3.4.2.

Table 5.3.4.2: 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

5.3.2 Health Complication determinants of hypertension

In medicine, complication is an unfavorable evolution of a disease, a health condition or a therapy. Hence, this sub section is devoted for health complications aspect. In the context of health complication, the study is conducted on 2010 respondents of above

18 years old that are separated from total data 2250. For health complication aspects we consider the adult people who are above 18 years old. Because before 18 years old the people are known as child and the children are consider as immature in physically and mentally.

5.3.2.1 Health complication related background characteristics

To develop any basic concept about the study, background characteristics of the respondents or target population or nature of the data have to study. In order to study the background characteristics of different variables, the percentage distribution of the considered variables is conducted. This sub section is declared for health complication related background characteristics. This assessment leads to the interpretation of results and to examine any cause-effect relationship among the study variables. The percentages of selected health complication related background characteristics among the adult people (above and 18 years old) are displayed in Table 5.3.2.1. Among adult total respondents 4.8% are patients with kidney disease. Our study shows that 13.60% respondents have tumor when 8.2% are diabetic patients. Sleep apnea disease affect 25.10% respondent. The percentages of hypothyroidism and hyperthyroidism disease are 32.40% and 31.70% respectively. The pulse rate per minute above 100 times is known as tachycardia disease and the people affected by tachycardia disease are 5.60%. Among the adult respondents 24.3% are fatty. Finally, the adult hypertensive patients are 30.60%.

Table 5.3.2.1: Percentage distribution of health complication characteristics

Characteristics	**Percent (%)**	**Characteristics**	**Percent (%)**	**Characteristics**	**Percent (%)**
Kidney Disease		Sleep Apnea		Tachycardia	
No	95.2	No	74.9	No	94.4
Yes	4.8	Yes	25.1	Yes	5.6
Total	100	Total	100.0	Total	100.0
Tumor		Hypothyroidism		Over Weight	
No	86.4	No	67.60	No	75.7
Yes	13.6	Yes	32.4	Yes	24.3
Total	100	Total	100.0	Total	100.0
Diabetes		Hyperthyroidism		Hypertension	
No	91.8	No	68.3	No	69.4
Yes	8.2	Yes	31.7	Yes	30.6
Total	100	Total	100.0	Total	100.0

5.3.2.2 Association between hypertension and health complications

To study the relationship between two binary variables, phi correlation technique is more appropriate to proper investigate the relation. Hence, before find out the risk factors of hypertension it is important to verify the relationship between hypertension and other health complications. Also, the results are represented in Table 5.3.2.2. This table depicts that the relationships between hypertension and other variables such as kidney disease, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and overweight are highly significant at 1% level of significance. These relationships have been studied by phi correlation because all variables are binary.

Table 5.3.2.2: Association between hypertension and health complications

Hypertension		Correlation Coefficient	P-Value
Phi Correlation (r_φ)	Kidney Disease	$r_\phi = 0.22$	0.01
	Tumor	$r_\phi = 0.36$	0.01
	Diabetes	$r_\phi = 0.26$	0.01
	Sleep Apnea	$r_\phi = 0.73$	0.01
	Hypothyroidism	$r_\phi = 0.60$	0.01
	Hyperthyroidism	$r_\phi = 0.63$	0.01
	Tachycardia	$r_\phi = 0.08$	0.01
	Over Weight	$r_\phi = 0.20$	0.01

5.3.2.3 Impact of health complication determinants on hypertension

Ensuring the existence of relationship between hypertension and other selected health complications, it is important to analyze the causal relationship between hypertension and other selected health complication variables. Hence, we have studied the causal relationship applying binary backward logistic regression method. The fitted model and requisite results are displayed in following:

$$\pi(x) = \frac{e^{\left\{\begin{array}{l}-3.266+1.692\text{KidneyDisease}+0.496\text{Tumor}+1.239\text{Diabetes}+2.760\text{Sleep Apnea}\\+0.508\text{Hypothyrodism}+2.091\text{Hyperthiraodism}+0.572\text{Tachycardia}+0.939\text{Overweight}\end{array}\right\}}}{1+e^{\left\{\begin{array}{l}-3.266+1.692\text{KidneyDisease}+0.496\text{Tumor}+1.239\text{Diabetes}+2.760\text{Sleep Apnea}\\+0.508\text{Hypothyrodism}+2.091\text{Hyperthiraodism}+0.572\text{Tachycardia}+0.939\text{Overweight}\end{array}\right\}}}$$

To study the causal relationship between hypertension and other health complication, kidney disease is found as a significant variable. i. e. kidney disease has positive significant impact on hypertension and its odds ratio 5.428 indicates that the respondents with kidney disease have 5.428 times risk to occur hypertension than the respondent without kidney disease. Secondly, tumor has positive significant impact on hypertension and the odd ratio 1.643 indicates that the respondents with tumor have 1.643 times odds or risk of occurring hypertension compared with those who do not have tumor. Thirdly, diabetes has positive significant impact on hypertension and its odd ratio indicates that the respondents with diabetes have 3.452 times odds or risk of occurring hypertension compared with those who do not have diabetes disease. Sleep apnea has positive significant impact on hypertension and the odds ratio indicates that the respondents who possess the sleep apnea have 15.795 times risk for occurring hypertension compared with those who do not possess. Also, hypothyroidism, hyperthyroidism and tachycardia disease have positive significant impact on hypertension and the odds ratios estimate that the respondents who possess hypothyroidism, hyperthyroidism and tachycardia disease have 1.662, 8.096 and

1.771 times risk respectively for occurring hypertension compared with those who do not possess. Finally, over weighted or fatty respondents are in risk of 2.558 times

Table 5.3.2.3: Stepwise logistic regression of hypertension on health complications

Characteristics	Regressor Coefficient (β)	Standar d Error of β	Wald Test	d. f	P - Value	Odds Ratio	95% Confidence Interval	
							Lower	Upper
Kidney Disease								
No (r)	-	-			-	-		
Yes	1.692	.376	20.236	1	.000	5.428	2.597	11.342
Tumor								
No (r)	-	-			-	-		
Yes	.496	.273	3.315	1	.069	1.643	.963	2.803
Diabetes								
No (r)	-	-			-	-		
Yes	1.239	.285	18.845	1	.000	3.452	1.973	6.039
Sleep Apnea								
No (r)	-	-			-	-		
Yes	2.760	.191	207.804	1	.000	15.795	10.853	22.986
Hypothyroidism								
No (r)	-	-			-	-		
Yes	.508	.184	7.658	1	.006	1.662	1.160	2.382
Hyperthyroidism								
No (r)	-	-			-	-		
Yes	2.091	.172	147.608	1	.000	8.096	5.778	11.345
Tachycardia								
No (r)	-	-			-	-		
Yes	.572	.314	3.322	1	.068	1.771	.958	3.275
Over Weight								
No (r)	-	-			-	-		
Yes	.939	.169	30.782	1	.000	2.558	1.836	3.564
Constant	-3.266	.141	535.066	1	.000	.038		

Note: r represents the reference category.

for occurring hypertension than normal normal respondents. After discussing the binary logistics regression it is established that kidney disease, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and over weight may be considered as risk factors for raising high blood pressure or hypertension.

5.3.2.4 Assessing the fit of the logistic regression model

We begin our discussion on 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.

5.3.2.4.1 Goodness-of-fit test

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 assessment are displayed in following Table 5.3.2.4.1.

Table 5.3.2.4.1: Results of assessment of fitted logistic regression model

-2 Log likelihood		**Cox & Snell R Square**		**Nagelkerke R Square**
1134.885		0.487		0.70
Hosmer and Lemeshow Statistic		**df**		**P - Value**
2.985		5		0.71
Classification Table		**Predicted Hypertension**		**%**
		No	**Yes**	
Observed Hypertension	**No**	1327	68	95 (specificity)
	Yes	148	467	76 (sensitivity)
				90
Area Under ROC Curve = 0.93				

The Table 5.3.2.4.1 depicts the value of Negelkerke R square is 0.70 which implies that all selected variables of logistic regression model have explained 70% of outcome variable. Also, the value of the Hosmer-Lemeshow goodness-of-fit statistic is 2.985 and the corresponding p-value is 0.75 with 5 degree of freedom which indicates that the model seems to fit quite well. The results of classifying the observations of hypertension using fitted logistic regression model are presented in same table. The overall rate of correct classification is estimated as 90% with 95% of the hypertension free group (specificity) and only 75% of the hypertensive group (sensitivity) being correctly classified.

5.3.2.4.2 Receiver operating characteristics curve for health complication factors

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 0.93 which indicates that the model's ability is excellent to discriminate between those respondents who have hypertension than who do not have.

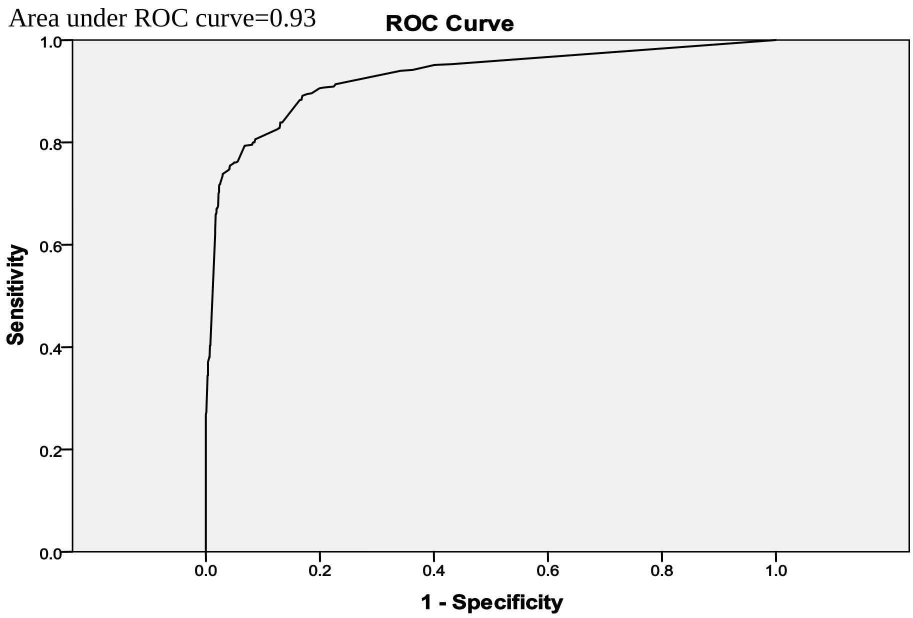


Figure 5.3.2.4.2: ROC curve for health complications

5.3.2.4.3 Logistic regression for health complications by bootstrapping

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 health complications factors. Using bootstrapping method, regression coefficients of health complications factors have been found approximately same with comparing the logistic regression coefficients. The small amount of bias may be ignored. These results are shown the following Table 5.3.2.4.3.

Table 5.3.2.4.3: Logistic regression for health complications by bootstrapping

Bootstrap	Logistic Regressor Coefficient (β)	Bootstrapping Regressor Coefficient (β)	Bias	Standard Error of β	P-value	95% Confidence Interval	
						Lower	Upper
Kidney Disease	1.692	1.695	.000	.464	.001	.694	2.625
Tumor	.496	.504	.009	.262	.056	.002	1.046
Diabetes	1.239	1.244	.023	.300	.001	.688	1.885
Sleep Apnea	2.760	2.760	.024	.195	.001	2.402	3.168
Hypothyroidism	.508	.510	-.005	.204	.009	.091	.889
Hyperthyroidism	2.091	2.091	.028	.193	.001	1.742	2.495
Tachycardia	.572	.570	-.005	.316	.065	-.114	1.138
Over Weight	.939	.940	.015	.173	.001	.592	1.277
Constant	-3.266	-3.259	-.024	.141	.001	-3.585	-3.021

5.3.3 Feminine and nuptial determinants on hypertension

Feminine is a set of attributes, behaviors, and roles generally associated with women. Feminine is socially constructed, but made up of both socially-defined and biologically-created factors. Also, nuptial is a set of attributes, behaviors and roles generally associated with marriage.

5.3.3.1 Feminine and nuptial background characteristics

To know the basement of the feminine and nuptial aspect of the study, background characteristics of the respondents or target population or nature of the data have to study. In order to study the background characteristics of different variables, the percentage distribution of the considered variables is conducted. This sub section is declared for feminine and nuptial background characteristics. This assessment leads to the interpretation of results and to examine any cause-effect relationship among the study variables. The percentages of selected feminine and nuptial characteristics among the active married female are displayed in Table 5.3.3.1(a). Among total active married females 53.90% are contraceptive users in the mean time 5.90% are pregnant. In this study, the rate of miscarriage in active married female is 21.40%. Also, the rate of menopause or unproductive females is 14.70%. Finally, the active married female hypertensive patients are 28.90%.

Table 5.3.3.1(a): Distribution of background characteristics of respondents

Characteristics	**Percent (%)**	**Characteristics**	**Percent (%)**	**Characteristics**	**Percent (%)**
Use Contraceptive Methods		Miscarriage		Hypertension	
No	46.10	No	78.60	No	71.10
Yes	53.90	Yes	21.40	Yes	28.90
Total	100	100	100	Total	100
Pregnancy		Menopause			
No	94.10	No	85.30		
Yes	5.90	Yes	14.70		
Total		Total	100		

The percentiles of age at first menstruation and duration of couple life are displayed in Table 5.3.3.1(b). In our present study, among 25% female the first menstruation has been started at 12 years old where among 95% the age is 15 years old and among 99% the age is 17 years old. In the same table it is found that 95% females have completed 44 years of their total couple life where 50% have completed 18 years.

Table 5.3.3.1(b): Percentiles of first menstruation age and duration of couple life

Percentiles	**5^{th}**	**10^{th}**	**25^{th}**	**50^{th}**	**60^{th}**	**75^{th}**	**90^{th}**	**95^{th}**	**99^{th}**	**100^{th}**
First Menstruation Age (in Year)	11	11	12	13	13	14	15	15	17	17
Duration of Couple Life	3	4	10	18	22	28	38	44	56	72

5.3.3.2 Association of hypertension with feminine and nuptial factors

To study the relationship between two binary variables, phi correlation technique is more appropriate to proper investigate the relation. Also, to study the relationship between quantitative and binary variable, point bi-serial correlation method is more appropriate to find out the amount of relationship. Hence, before find out the risk factors of hypertension, it is important to verify the relationship between hypertension and other feminine and nuptial characteristics. Also, the results are represented in Table 5.3.3.2. This table depicts that the negative relationship between hypertension and first menstruation age is significant at 5% level of significance. Another positive relationship between hypertension and duration of couple life is highly significant at 1% level of significance. The mentioned two relationships have studied by point bi-serial correlation method because between the two related variables one is quantitative and another is binary variable. Also, the relationships between hypertension and other selected feminine as well as nuptial characteristics such as use of contraceptive method, pregnancy, menopause and miscarriage are significant at 10%, 3%, 1% and 1% level of significance. These relationships have been studied by phi correlation because all variables are binary.

Table 5.3.3.2: Association of hypertension with feminine and nuptial factors

	Hypertension	Correlation Coefficients	P-Value
Point Bi-serial Correlation (r_{pbc})	First Menstruation Age	$r_{pbc} = -0.06$	0.05
	Duration of Couple Life	$r_{pbc} = 0.34$	0.01
Phi Correlation (r_{φ})	Use of Contraceptive Method	$r_{\phi} = 0.08$	0.10
	Menopause	$r_{\phi} = 0.24$	0.01
	Pregnancy	$r_{\phi} = 0.07$	0.03
	Miscarriage	$r_{\phi} = 0.14$	0.01

5.3.3.3 Impact of feminine and nuptial determinants on hypertension

After examining the existence of relation between hypertension and other selected feminine and nuptial characteristics, it is important to analyze the causal relationship between hypertension and other selected feminine and nuptial characteristics. Hence, we have studied the causal relationship applying backward binary logistic regression model. The fitted model and requisite results are displayed in following:

$$\pi(x) = \frac{e^{\left\{ \begin{array}{l} -3.119 - 0.089\text{First Menstruation Age} + 0.070\text{Duration of Couple Life} \\ -2.086\text{Use of Contraceptive Method} + 1.661\text{Menopause} + 2.676\text{Pregnancy} + 0.576\text{Miscarriage.} \end{array} \right\}}}{1 + e^{\left\{ \begin{array}{l} -3.119 - 0.089\text{First Menstruation Age} + 0.070\text{Duration of Couple Life} \\ -2.086\text{Use of Contraceptive Method} + 1.661\text{Menopause} + 2.676\text{Pregnancy} + 0.576\text{Miscarriage.} \end{array} \right\}}}$$

To study the causal relationship between hypertension and other feminine and nuptial characteristics, first menstruation age is found as a significant variable. i. e. first menstruation age has negative significant impact on hypertension and its odds ration 0.914 indicates that for every increase of one year in first menstruation age up to 17 years, the risk of occurring hypertension increases 0.914 times. Secondly, duration of couple life has significant positive significant impact on hypertension and its odds ratio focus that every increase of one year in duration of couple life, the risk of hypertension increase 1.073 times. Thirdly, use of contraceptive method has positive significant impact on hypertension and the odd ratio indicates that the respondents who use contraceptive method have 8.054 times odds or risk of occurring hypertension compared with those who do not use. Also, menopause, pregnancy and miscarriage have positive significant impact on hypertension and the odds ratios indicate that the respondents who possess the mentioned characteristics have 5.265, 14.530 and 1.779 times risk for occurring hypertension compared with those who do not possess.

Table 5.3.3.3: Stepwise logistic regression of hypertension on feminine and nuptial factors

Characteristics	Regressor Coefficient (β)	Standard Error of β	Wald Test	d. f	P - Value	Odds Ratio	95% Confidence Interval	
							Lower	Upper
First Menstruation Age	-.089	.052	2.992	1	.084	.914	.828	1.016
Duration of Couple Life	.070	.007	89.738	1	.000	1.073	1.057	1.089
Use of Contraceptive Method								
No (r)	-	-			-	-		
Yes	2.086	.245	72.461	1	.000	8.054	4.863	12.768
Menopause								
No (r)	-	-			-	-		
Yes	1.661	.279	35.555	1	.000	5.265	3.008	8.964
Pregnancy								
No (r)	-	-			-	-		
Yes	2.676	.358	55.991	1	.000	14.530	7.235	30.335
Miscarriage								
No (r)	-	-			-	-		
Yes	.576	.166	12.056	1	.001	1.779	1.295	2.488
Constant	-3.119	.716	18.992	1	.000	.044		

Note: r represents the reference category.

After discussing the backward binary logistics regression it is established that first menstruation age, duration of couple life, use of contraceptive method, menopause, pregnancy and miscarriage may be considered as risk factors or determinants for raising high blood pressure or hypertension.

5.3.3.4 Assessing the fit of the logistic regression model

We begin our discussion on 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.

5.3.3.4.1 Goodness-of-fit test

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 assessment are displayed in following Table 5.3.3.4.1.

Table 5.3.3.4.1: Results of assessment of fitted logistic regression model

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1143.401	0.21	0.30

Hosmer and Lemeshow Statistic	df	P - Value
6.354	8	0.61

Classification Table		Predicted Hypertension		%
		No	Yes	
Observed Hypertension	No	769	68	92 (specificity)
	Yes	210	130	40 (sensitivity)
				77
Area Under ROC Curve = 0.80				

The Table 5.3.1.4.1 depicts the value of Negelkerke R square is 0.30 which implies that all selected variables of logistic regression model have explained 30% of outcome variable. Also, the value of the Hosmer-Lemeshow goodness-of-fit statistic is 6.354 and the corresponding p-value is 0.61 with 8 degree of freedom which indicates that the model seems to fit quite well. The results of classifying the observations of hypertension using fitted logistic regression model are presented in same table. The overall rate of correct classification is estimated as 77% with 92% of the hypertension free group (specificity) and only 40% of the hypertensive group (sensitivity) being correctly classified.

5.3.3.4.2 Receiver operating characteristic curve for feminine and nuptial factors

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 feminine and nuptial aspects is 0.80 which indicates that the model's ability is well to discriminate between those respondents who have hypertension than who do not have.

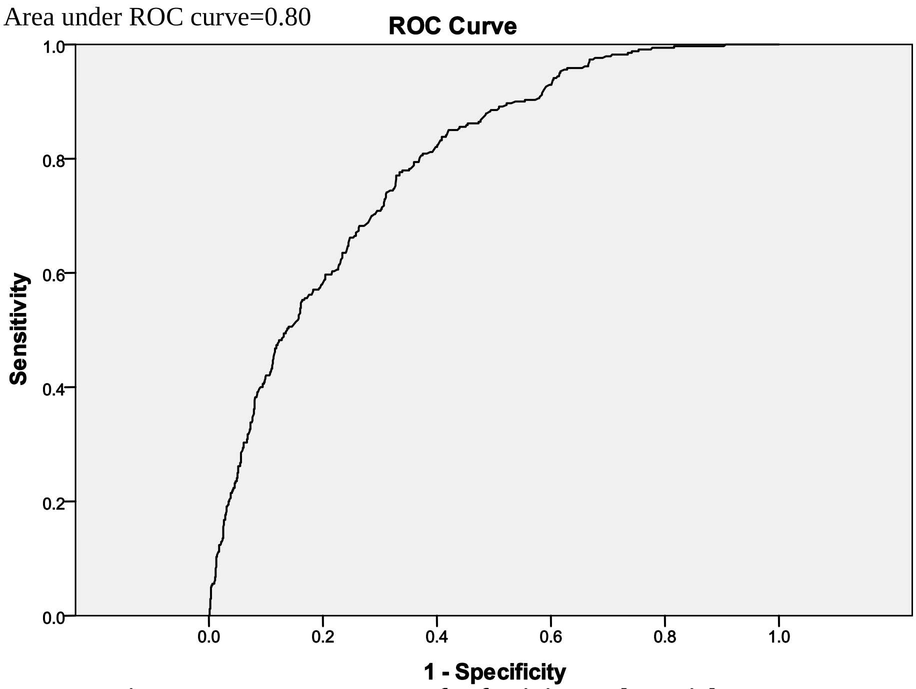


Figure 5.3.3.4.2: ROC curve for feminine and nuptial aspect

5.3.3.4.3 Logistic regression for feminine and nuptial aspect by bootstrapping

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 feminine and nuptial factors. Using bootstrapping method, regression coefficients of feminine and nuptial factors have been found approximately same with comparing the logistic regression coefficients. The small amount of bias may be ignored. These results are shown the following Table 5.3.3.4.3.

Table 5.3.3.4.3: Logistic regression for feminine and nuptial factors by bootstrapping

Bootstrap	Logistic Regressor Coefficient (β)	Bootstrapping Regressor Coefficient (β)	Bias	Standard Error of β	P-value	95% Confidence Interval	
						Lower	Upper
Menstruation Age	-.089	-.089	.001	.054	.095	-.187	.020
Duration of Couple Life	.070	.070	.001	.008	.001	.056	.086
Use of Contraceptive Method	2.086	2.086	.024	.245	.001	1.661	2.629
Menopause	1.661	1.661	.028	.301	.001	1.098	2.277
Pregnancy	2.676	2.676	.022	.385	.001	1.894	3.446
Miscarriage	.576	.576	.011	.165	.003	.263	.915
Constant	-3.119	-3.119	-.051	.733	.001	-4.679	-1.815

5.3.4 Body composition determinants of high blood pressure

Body composition is the body's relative amount of fat to fat-free mass. Those with optimal body composition are typically healthier, move more easily and efficiently, and in general, feel better than those with less-than-ideal body composition. Achieving a more optimal body composition goes a long way toward improving your quality of life and overall wellness. Among 2250 respondents in this study 1623 respondents with above 25 years old are separated for studying the body composition factors of hypertension. We have taken only above 25 years old because the bone of human being does not increase after 25 years old generally. The subsection is conducted for discussing the body composition aspect of hypertension.

5.3.4.1 Body composition background characteristics

In any research, it is important to study background characteristics of the respondents or target population or nature of the data. In order to study the background characteristics of different variables, the percentiles distribution of the considered variables is conducted. This sub section is declared for body composition background characteristics. This assessment leads to the interpretation of results and to examine any cause-effect relationship among the study variables. So, the different types of percentiles of body mass index, abdominal circumference and ratio of waist to hip are calculated and show in Table 5.3.4.1.

Table 5.3.4.1: Distribution of percentiles of age of respondents

Percentiles	**5th**	**10th**	**15th**	**25th**	**50th**	**75th**	**90th**	**95th**	**99th**	**100th**
Body Mass Index	16.87	17.79	18.44	19.56	22.21	25.11	27.44	29.47	32.45	41.14
Abdominal Circumference	61	65	68	72	80	88	95	99	107	125
Ratio of Waist to Hip	0.75	0.77	0.78	0.81	0.86	0.91	0.95	0.98	1.06	1.71

This table shows that among the respondents who are above 25 years old, about 15% are under weight when 25% are over weight and, 60% are normal. The same table presents that the abdominal circumference of 95% respondents is 99 cm, where the ratio of waist to hip of 95% respondents is 0.90.

5.3.4.2 Correlation between blood pressure and body compositions

To study the relationship between two quantitative variables, Pearson's correlation technique is more appropriate to proper investigate the relation. Hence, before find out the direct and indirect effect of risk factors on blood pressure (systolic and diastolic), it is important to verify the relationship between blood pressure and other body compositions. Also, the results are represented in Table 5.3.4.2. This table depicts that the relationships between blood pressure and other body composition such as body mass index, abdominal circumference and the ratio of waist to hip. The correlation between body mass index and abdominal circumference, the correlation between body mass index and ratio of waist to hip, the correlation between body mass index and systolic blood pressure, the correlation between body mass index and diastolic blood pressure are positive and highly significant at 1% level of significance. Also, the correlation between abdominal circumference and ratio of waist to hip, the correlation between abdominal circumference and systolic blood pressure, the correlation between abdominal circumference and diastolic blood pressure are positive and highly significant at 1% level of significance. Finally, the correlation between ratio of waist to hip and systolic blood pressure, the correlation between ratio of waist to hip and diastolic blood pressure are positive and highly significant at 1% level of significance.

Table 5.3.4.2: Correlation between blood pressure and body compositions

	Abdominal Circumference	**Ratio of Waist to Hip Circumference**	**Systolic Blood Pressure**	**Diastolic Blood Pressure**
Body Mass Index	0.593 (0.01)*	0.286 (0.01)*	0.208 (0.01)	0.290 (0.01)*
Abdominal Circumference		0.378 (0.01)*	0.187 (0.01)*	0.232 (0.01)*
Ratio of Waist to Hip Circumference			0.120 (0.01)*	0.139 (0.01)*

Note: * Level of significance.

5.3.4.3 Direct and indirect effect of body compositions on blood pressure

Ensuring the existence of relationship between blood pressure (systolic and diastolic) and other selected body compositions, it is important to measure the direct and indirect effect of body composition on blood pressure. Hence, we have measured the direct and indirect effect of body composition on blood pressure (systolic and diastolic) by path analysis. The requisite results are displayed in following:

Table 5.3.4.3: Direct and indirect effect of body compositions on blood pressure

Dependent variables	Independent variables	Direct effect	Indirect effect via			Non-causal effect	Total effect	Total association
			Body Mass Index	Abdominal Circumference	Ratio of Waist to Hip Circumference			
Systolic blood pressure	Body Mass Index	0.146	-	0.048	0.013	0.001	0.207	0.208
	Abdominal Circumference	0.082	0.086	-	0.017	0.002	0.185	0.187
	Ratio of Waist to Hip Circumference	0.047	0.041	0.030	-	0.002	0.118	0.120
Diastolic blood pressure	Body Mass Index	0.231	-	0.046	0.012	0.001	0.289	0.290
	Abdominal Circumference	0.079	0.136	-	0.016	0.001	0.231	0.232
	Ratio of Waist to Hip Circumference	0.043	0.066	0.029	-	0.001	0.038	0.139

The Table 5.3.4.3 shows that the direct effect of body mass index on systolic blood pressure is 0.146. Also, the indirect effect of body mass index trough abdominal circumference is 0.048 and through another path ratio of waist to hip on systolic blood pressure is 0.013. So, the total effect of body mass index on systolic blood pressure is 0.207. The amount of direct effect of another characteristic abdominal circumference on systolic blood pressure is 0.082. The indirect effect of abdominal circumference through body mass index is 0.086 and through another path ratio of waist to hip on systolic blood pressure is 0.017. The total effect of abdominal circumference on systolic blood pressure is 0.185. The direct effect of ratio of waist to hip on systolic blood pressure is 0.047. The indirect effect of ratio of waist to hip through abdominal circumference is 0.030 and through another path body mass index on systolic blood pressure is 0.041. The total effect of the ratio of waist to hip on systolic blood pressure is 0.118. In the same table, the direct effect of body mass index on diastolic blood pressure is 0.231. Also, the indirect effect of body mass index trough abdominal circumference is 0.046 and trough another path ratio of waist to hip on diastolic blood pressure is 0.012. So, the total effect of body mass index on diastolic blood pressure is 0.289. The amount of direct effect of another characteristic abdominal circumference on diastolic blood pressure is 0.079. The indirect effect of abdominal circumference through body mass index is 0.136 and through another path ratio of waist to hip on systolic blood pressure is 0.016. The total effect of abdominal circumference on diastolic blood pressure is 0.231. The direct effect of ratio of waist to hip on diastolic blood pressure is 0.043. The indirect effect of ratio of waist to hip through abdominal circumference is 0.029 and through another path body mass index on diastolic blood pressure is 0.066. The total effect of the ratio of waist to hip on diastolic blood pressure is 0.138.

5.3.4.4 Path Diagram for body composition factors

The graphical representation of path of direct, indirect and total effects of selected body compositions on systolic and diastolic blood pressure are shown by the following path diagram. The quantity between two arrows represents the amount of correlation coefficient and one arrow represents the direct effect that means amount of standardized regressor coefficient.

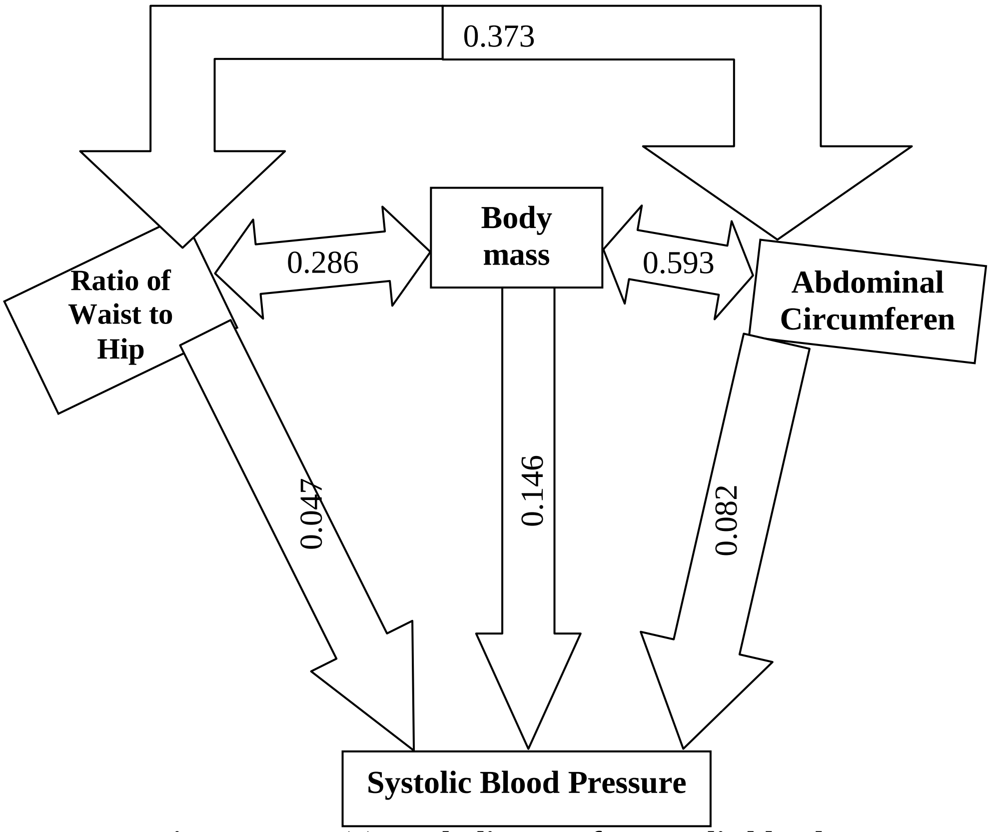


Figure5.3.4.4 (a): Path diagram for systolic blood pressure

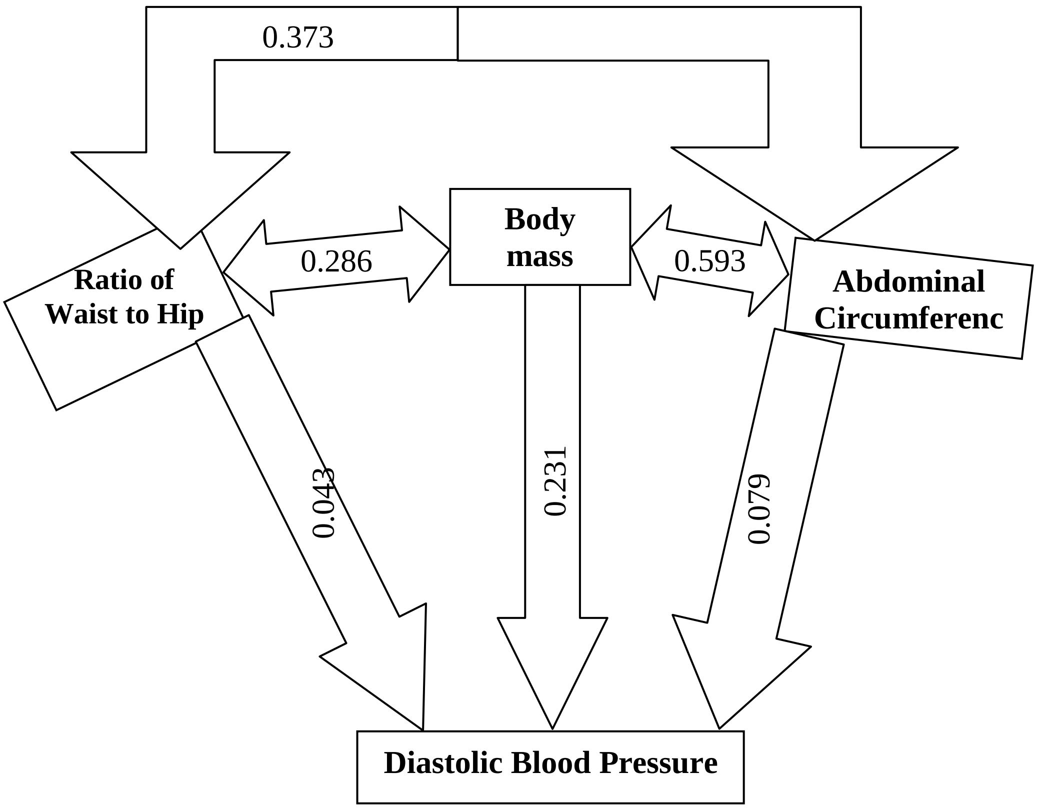


Figure5.3.4.4 (b): Path diagram for diastolic blood pressure

CHAPTER 6
CONCLUSION

6.1 Prelude

Writing a conclusion is an important part of any piece of writing. It is often possible to get a good picture of an assignment by looking briefly at the conclusion. However, writing a conclusion can be quite difficult. This is because it can often be hard to find something interesting or useful to say in the conclusion. A small attempt for conducting conclusion of this present study is displayed in following.

6.2 Overall Findings

The rate of diastolic hypertension is higher than systolic hypertension in age group <40years and less than systolic hypertension in age group >60years. But the rate of both systolic and diastolic hypertension is near about same in age group 40-60years. Though with increasing age the rate of both type hypertension is increasing but young age (<40years) is more risk period for occurring diastolic hypertension than systolic and old age (>60years) is more risk period for occurring systolic hypertension than diastolic when middle age (40-60 years) is also risk period for occurring both type of hypertension. The differences between two same percentiles of systolic and diastolic blood pressure are increasing with increasing percentiles cut-offs for hypertensive respondents and the differences are almost same with increasing percentiles for normotensive.

In socio-demographic aspect, the highest 25.20% are in age group 26-35years among total respondents. 31.70% 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 hour (>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 hour (>8hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, taking excess salt are statistically highly related with hypertension at one percent level of significant except taking regular exercise. Also, sedentary lifestyle, working hour (>8hrs) per day, taking regular exercise, social stress, occupational stress, mental stress, hereditary hypertension, smoking, taking alcohol, taking excess salt have statistically highly impact on hypertension. The socio-demographic variables sedentary life style, working hour (>8hrs) 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 risk factor, but age increasing is out of human control.

In health complications context, the percentages of kidney disease, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and overweight are 4.8%, 13.60%, 8.2%, 25.10%, 32.40%, 31.70%, 5.60% and 24.3% respectively. Finally, the adult hypertensive patients are 30.60%. Health complications kidney disease, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and overweight are statistically highly related with hypertension at one percent level of significance. Kidney disease, tumor, diabetes, sleep apnea, hypothyroidism, hyperthyroidism, tachycardia and overweight have statistically highly significant impact on hypertension. Health complications such as: kidney disease, diabetes, tumor, sleep apnea, hyperthyroidism, hypothyroidism, tachycardia and over weight may be considered significant determinants of hypertension.

In feminine and nuptial context, the percentages of use of contraceptive method, pregnancy, miscarriage, and menopause are 53.90%, 5.90%, 21.40%, 14.70%. Finally, the active married female hypertensive patients are 28.90%. 95% females have completed their first menstruation at 15years old. First menstruation age, duration of couple life, use of contraceptive method, pregnancy, miscarriage, and menopause are statistically highly related with hypertension at five percent level of significance except use of contraceptive method. The feminine and nuptial variables first menstruation age, duration of couple life, use of contraceptive method, pregnancy, miscarriage, and menopause have significant impact on hypertension. First menstruation age, duration of couple life, use of contraceptive method, pregnancy, miscarriage, and menopause may considered as feminine and nuptial risk factors of hypertension.

In body composition context, among >25years old, about 15% are under weight, 25% are over weight and, 60% are normal. The abdominal circumference of 95% respondents is 99 cm and ratio of waist to hip of 95% respondents is 0.90. Body mass index, abdominal circumference and ratio of waist to hip are statistically highly correlated with systolic and diastolic blood pressure at one percent level of significance. Body mass index, abdominal circumference and ratio of waist to hip have statistically significant effect (direct and indirect) on hypertension.

6.3 Recommendations

The possible recommendations are as follows:

- We should measure blood pressure and health checkup regularly.
- Public should take necessary initiatives individually to tackle health impact of sedentary life style, working hour (>8hrs) per day, occupational stress, mental stress and social stress.
- To tackle or to get rid of hypertension we should control or remove kidney disease, diabetes, sleep apnea, hyperthyroidism, and hypothyroidism.
- There are no alternatives of pregnancy, menopause and couple life. Hence, women are advised to maintain their daily life smoothly.
- Government and public should take initiatives to avoid the practice of miscarriage.
- Government should find out the alternative way of existing contraceptive method.
- Public should take necessary steps individually to control body composition factors.
- Government should take necessary steps to increase the awareness among people about risk of hypertension.

6.4 Scope for Further Research

It is an open problem to find out a medical reference chart. Blood pressure chart can be constructed for Bangladeshi people for different age groups and occupations.

BIBLIOGRAPHY

Alamgir, A. K. M. et al. (2005). Hypertension Prevalence and Related Factors in an Urban Affluent Community in Bangladesh. *Bang J Med Sci*, **01**(11), 22-25.

AHA (2011). *Understanding-Blood Pressure Readings*. American Heart Association (AHA), USA. (Available at http://www.heart.org/HEARTORG/Conditions/HighBlood Pressure/AboutHighBloodPressure/Understanding-Blood Pressure-Readings_UCM_301764. Access on: 20 April 2011).

Agrawal, V. K. et al. (2008). Prevalence and Determinants of Hypertension in a Rural Community. *MJAFI*, **64**, 21-25.

Bond, V. et al. (2000). Blood Pressure Reactivity to Mental Stress and Aerobic Fitness in Normotensive Young Adult African-American Males with Parental History of Hypertension. *Stress Med.*, **16**, 219-227. (Available at http://www3. interscience.wiley.com/cgi-bin/fulltext/72510212/PDFSTART. Access on: 20 April 2011)

Bennett, et al. (1991). *A Simplified General Method for Cluster-sample Surveys of Heath in Developing Countries*. pp. Trimest. Statist. Sanit. Mond. 44.

BIDS (2001). *Fighting Poverty Bangladesh Human Development Report 2000*. Bangladesh Institute of Development Studies (BIDS), Dhaka, Bangladesh.

BBS (2005). *Population Census – 2001; Community Series, Zila: Rajshahi*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

BBS (2005). *Statistical Year Book of Bangladesh - 2004*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

BBS (2005). *Statistical Year Book 2005*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

BBS (2007a). *Statistical Year Book of Bangladesh - 2005*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

==

BBS (2007b). *Statistical Year Book of Bangladesh - 2006*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

BBS (2011a). *Statistical Year Book of Bangladesh - 2010*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

BBS (2011b). *Population & Housing Census 2011: Preliminary Results*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh. (Available at 203.112.218.65/WebTest Application/userfiles/Image/BBS/PHC2011PreliminaryResult.pdf. Access on 23 May 2013.)

BBS (2012). *Statistical Year Book of Bangladesh - 2011*. Bangladesh Bureau of Statistics (BBS), Dhaka, Bangladesh.

Begum, S. (1996). *Health Dimensions of Poverty in Bangladesh*. Bangladesh Institute of Development Studies (BIDS), Dhaka, Bangladesh.

BHSR (1998). *Cause of death and morbidity profile.* Bangladesh Health Service Report (BHSR), Government of Bangladesh, Dhaka, Bangladesh.

Bernier, et al. (1997). *Nuclear Medicine Technology and Techniques*. 4th edition. Mosby-Year Book Inc., ISBN: 0-8151-1991-7, P-230. 2.

Cameron, et al. (1978). *Medical physics*. Jhon wiley & sons, Inc., New York, P-162.

Chen, Y. et al. (2006a). Arsenic Exposure from Drinking Water, Dietary Intakes of Vitamins and Folate, and Risk of High Blood Pressure in Bangladesh: A Population-based, Cross-sectional Study. *American Journal of Epidemiology*, **165** (5), 540-552.

Chen, Y. et al. (2006b). Nutritional Influence on Risk of High Blood Pressure in Bangladesh: a Population-Based Cross-Sectional Study. *The American Journal of Clinical Nutrition*, **84**, 1224-1232. (Available at www. ajcn.org. Access on: 1st March 2012)

Chen, Y. (2005). *Dietary Factors, Arsenic Exposure, and Risk of High Blood Pressure* *in Bangladesh*. Columbia University, New York.

Chobanian, A. V. et al. (2003). *Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report*. Hypertension, **42**, 1206-1252. (Available at http://www.hypertensionaha.org. Access on: 18 April 2011)

Cooper-Dehoff, R. M. et al. (2004). Characteristics of Contemporary Patients with Hypertension and Coronary Artery Disease. *Clin Cardiol*, **27**, 571-576. (Available at http://www3. interscience.wiley.com/cgi-bin/fulltext/113493717 /PDFSTART. Access on: 20 April 2011)

Chowdhury, A. H. et al. (1998). Association of Angiotensin Converting Enzyme (ACE) Gene Polymorphism with Hypertension in a Bangladeshi Population..*Bangladesh Med Res Counc Bull.*, **27** (2), 69 - 78.

Chowdhury, A. K. M. N. et al. (1981). Dasherkandi Project Studies: Demography, morbidity and mortality in a rural community of Bangladesh. *Bangladesh Med Res Council Bull*, 22–39.

GOB (2004). *Bangladesh Economic Review 2004*. Government of Bangladesh (GOB) Finance Division, Ministry of Finance, Dhaka.

Efron, B. and Tibshirani, R. (1993). *An Introduction to the Bootstrap*. Boca Raton, FL: Chapman & Hall/CRC. ISBN 0-412-04231-2.

Hoque, M. N. et al. (2012). Determinants of Blood Pressure Control in Hypertensive Diabetic Patients in Rajshahi District of Bangladesh. *J Biomet Biostat*, ISSN: 2155-6180, S7.

Hoque, M. S. et al. (1998). An Exercise Training Combined with Dietary Program for patients with Hypertension. Bangladesh *Med Res Counc Bull.*, **24** (1), 14-19.

Hannan, M. A. et al. (2001). Stroke: Seasonal Variation and Association with Hypertension. *Bangladesh Med Res Counc Bull.*, **27** (2), 69 - 78.

Hansson, L. et al. (1998). *Effects of intensive blood-pressure lowering and low-dose aspirin in patients with hypertension: principal results of the hypertension optimal treatment (HOT) randomized trial*. Lancet, **351**, 1755-62.

ICDDR, B (2011). Determinants of qualified hypertension diagnosis in surveillance sites of Bangladesh: findings from a cross-sectional study. *Health and Science Bulletin*, 9(4), International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDRB), Dhaka, Bangladesh.

Islam, A. K. et al. (2012). Hypertension in Bangladesh: a review. *Indian Heart J*. **64**(3):319-23.

Islam, M. R. et al. (2012). Association between Hypertension and Chronic Arsenic Exposure in Drinking Water: A Cross-Sectional Study in Bangladesh. *Int. J. Environ. Res. Public Health*, **9**(12), 4522-4536.

Islam, N. M. (2008). *An Introduction to Research Methods*. Mullick & Brothers, New Market, Dhaka.

Islam, N. et al. (1983). Hypertension in the rural population of Bangladesh—a preliminary survey. *Bangladesh Med Res Council Bull*, **ix**: 11–14.

Islam, N. et al. (1979). Hypertension in Secretariate Population of Bangladesh. *Bangladesh Med Res Counc Bull.*, **5** (1), 19-24.

Kokiwar, P. R. (2011). Prevalence of hypertension in a rural community of central India. *Int J Biol Med Res*, **2**(4), 950 – 953.

Khan, K. S. et al. (2006). *WHO Analysis of Causes of Maternal Death: A Systematic Review*. Lancer, 367, 1066-1074.

Khanam, M. A. et al. (2011). *Hypertension: Adherence to Treatment in Rural Bangladesh—Findings from a Population-based Study*. International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), GPO Box 128, Dhaka 1000, Bangladesh.

Khandakar, R. K. (1993). Evaluation of Hypertension and Other Risk Factors in Ischemic Heart Disease. *Chin Med J (Engl).*, **106** (5), 290-292.

Kearney, P. M. et al. (2005). *Global burden of hypertension: analysis of worldwide data*. Lancet, **365**, 217-23.

Khan, N. A. et al. (2005). The 2005 Canadian Hypertension Education Program (CHEP) recommendations for the management of hypertension: part 2 - therapy. *Can J Cardiol*, **21**, 657-72.

Lloyd-Jones, D. M. et al (2004). Framingham risk score and prediction of lifetime risk for coronary heart disease. *Am J Cardiol*, **94**, 20-24.

Menotti, A. et al. (2001). Cardiovascular risk factors as determinants of 25- year all-cause mortality in the seven countries study. *Eur J Epidemiol*, **17**, 337-46.

MFMER (2010). *Low blood pressure (hypotension) causes*. Mayo Foundation for Medical Education and Research (MFMER), MayoClinic.com. *(*Available at *http://www.mayoclinic.com/health/low-blood-pressure/DS00590/DSECTION=causes.* Access on: 20 April 2011*).*

Moula, A. et al. (2001). *Helping to Form Club of Diabetic and Hypertensive Patients for Engaging in Walking and Changing Lifestyle: An Experience from Chakaria*. International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), GPO Box 128, Dhaka 1000, Bangladesh

Murray, C. J. L. et al. (2000). *A Critical Examination of Summary Measures of Population Health*. Bulletin of the World Health Organization' **78**, 981-994.

Murray, C. J. L. et al. (2002). *Health Gaps: An Overview and Critical Appraisal*.

World Health Organization (WHO), Geneva, Switzerland. (Available at *http:// www.who.int/ pub/smph/en/index.html)*

Malik, A. (1976). Congenital and acquired heart diseases (a survey of 7062 persons). *Bangladesh Med Res Council Bull.*, **II**: 115–119.

Midha, T. et al. (2009). Prevalence and Determinants of Hypertension in the Urban and Rural Population of a North Indian District. *East Afr J Public Health*, **6**(3), 268-73.

NHBPEPCC (1997). The sixth report of the joint national committee on prevention, detection, valuation, and treatment of high blood pressure. National High Blood Pressure Education Program Coordinating Committee (NHBPEPCV), *Arch Intern Med*, **157**: 2413–2446

Neuhauser, H. K. et al. (1998). A comparison of Framingham and SCORE-based cardiovascular risk estimates in participants of the German National Health Interview and Examination Survey. *Eur J Cardiovasc Prev Rehabil*, **12**, 442-50.

Rahaman, M. et al. (1999). Hypertension and Arsenic Exposure in Bangladesh. *American Heart Association*, **33**, 74-78.

Rahim, M. A. et al. (2012). The Prevalence rate of Hypertension in Rural Population of Bangladesh. *Journal of Dhaka National Medical College & Hospital*, 18(1).

Sayeed, M. A. et al. (2002). Prevalence of Hypertension in Bangladesh: Effect of Socioeconomic Risk Factor on Difference between Rural and Urban Community. *Bangladesh Med Res Counc Bull.*, **28** (1), 7-18.

Stevens, S. S. (1946). *On the Theory of Scales of Measurement. Science*. No. 103 Fuilford. J. P. 1971. Psychometric Methods. New York: MEGrw-Hill.

Saha, M. S. et al. (2006). Serum Lipid Profile of Hypertensive Patients in the

Northern Region of Bangladesh. *J. bio-sci*., **14**, 93-98.

Sayeed, M. A. (1994). Blood Pressure and Glycemic Status in Relation to Body Mass Index in a Rural Population of Bangladesh. Bangladesh *Med Res Counc Bull*., **20** (2), 27-35.

Sayeed, M. A. et al. (2005). Diabetes and Hypertension in Pregnancy in a Rural Community of Bangladesh: a population-Based Study. *Diabet Med.*, **22** (9), 1267-1271.

Sayeed, M. A. et al. (1995). Prevalence of Diabetes and Hypertension in a Rural Population of Bangladesh. *Diabetes Care*, **18** (4), 555-558.

Sayeed, M. A. et al. (2003). Waist-to-Height ratio is a Better Obesity Index than Body Mass Index and Waist-to-hip Ratio for Predicting Diabetes, Hypertension and Lipidemia. *Bangladesh Med Res Counc Bull.*, **29** (1), 01 - 10.

Sayeed, M. A. et al. (1994). Blood pressure and glycemic status in relation to body mass index in a rural population of Bangladesh. *Bangladesh Med Res Council Bull* 1994; **20**: 27–35.

Touyz, R.M. et al. (2004). The 2004 Canadian recommendation for the management of hypertension: part III -lifestyle modification to prevent and control hypertension. *Can J Cardiol*, **20**, 55-59.

Ullah, W. (1976). Hypertension in Mixed Community. *Bangladesh Med Res Counc Bull.*, **2**, 95-99.

WHO (2011a). *Country Profile: Bangladesh*. World Health Organization(WHO), Geneva, Switzerland. *(Available at http:// www.who.int/countries/ bgd/en/, access on 22 May 2013)*

WHO (2011b). *Data and Statistics*. World Health Organization (WHO), Geneva, Switzerland. *(Available at http:// www.who.int/research/en , access on 22 May 2013)*

WHO (2006). *Mortality Country Fact Sheet 2006*. World Health Organization (WHO), Geneva, Switzerland.

WHO (2010). *World Life Expectancy: Live Longer Live Better*. World Health Organization (WHO), Geneva, Switzerland.

WHO (2003). *World Health Report 2003: Shaping in Future*. World Health Organization (WHO), Geneva, Switzerland.

WHO (2002). *World Health Report 2002: Reducing Risk Promoting Healthy Life*. World Health Organization (WHO), Geneva, Switzerland.

WHO (2001a). *Prevalence, Awareness, Treatment and Control of Hypertension among the Elderly in Bangladesh and India: a Multicentre Study.* World Health Organization (WHO), 79 (6), 490-500.

WHO (2001b). *The world health report 2001- Mental Health: New Understanding, New Hope*. World Health Organization (WHO), Geneva, Switzerland.

WHO (2004). *World Health Report 2004: Changing History*. World Health Organization (WHO), Geneva, Switzerland.

WHO (2007). *The top 10 Causes of Death*. World Health Organization (WHO), Fact Sheet No. 310, Geneva, Switzerland.

WHO (1997). *Preventing and Managing the Global Epidemic of Obesity: Report of the World Health Organization Consultation of Obesity*. World Health Organization (WHO), Geneva, Switzerland.

WB (2007) World Development Indicators Database. World Bank (WB), Washington, U. S. A.

WHO (2005). *Preventing chronic disease: a vital investment: WHO global report.* World Health Organization (WHO), Geneva, Switzerland. (Available at http://www.who.int/chp/chronic_disease_report/en/ index.)

Zaman, S. M. M. et al. (2010). Management of Hypertension: A Bangladeshi Perspective. *Bangladesh Medical Journal*, **39**(1).

Zamudio, S. et al. (1995). High Altitude and Hypertension during Pregnancy. *Willey Inter-science Journal*. (Available at http://www3.interscience.wiley.com/cgi-bin/abstract/110504400/ABSTRACT)

Zaman, M. M. and Rouf, M. A. (1999). Prevalence of Hypertension in a Bangladesh Adult Population. *Journal of Human Hypertension*, **13**, 547-549.

APPENDIX 1

Questionnaire on
Determinants of Hypertensive in Bangladesh: A Case Study of Rajshahi District

Department of Statistics, University of Rajshahi, Rajshahi-6205.

Case No. **Name and Address:**

1. Sex-Male/ Female
2. Religion- Islam/Hindu/Christian/Buddha
3. Education (in years)-………………..
4. Age (in years)-………………………
5. Family Type-……………………….
6. Number of Family Member-…………
7. Marital Status- Unmarried/Married/Widow
8. Age at First Marriage (in years)-…………
9. Duration of Couple Life (in years)-……….
10. First Menstruation Age (in years)-……….
11. Use of Contraceptive Method- Yes/No
12. Menopause- Yes/No
13. Pregnancy- Yes/No
14. Miscarriage- Yes/No
15. Occupation- Education/Service/Business/Housewife/Day Labor
16. Life Style- Sedentary/Medium/Heavy
17. Working Hour (>8hrs) Per day- Yes/No
18. Occupational Stress- Yes/No
19. Taking Regular Exercise- Yes/No
20. Loan- Yes/No
21. Social Stress- Yes/No
22. Political Involvement- Yes/No
23. Migration in Last 5 Years- Yes/No
24. Mental Stress- Yes/No
25. Tumor- Yes/No
26. Kidney Disease- Yes/No
27. Mumps- Yes/No
28. Anemia- Yes/No
29. Diabetes- Yes/No
30. Fat Belly- Yes/No
31. Joint Pain- Yes/No
32. Metabolic Syndrome- Yes/No
33. Taking Antihypertensive Drug- Yes/No
34. Hereditary Hypertension- Yes/No
35. Symptoms of Hypertension- Yes/No
If yes- * Severe Headache * Fatigue or confusion or nervousness * Vision problems * Chest pain * Sweating * Difficulty breathing * Pounding in your chest, neck, or ears *Irregular Heartbeat * Body Inflation or weight gain
36. Regular Medical Checkup- Yes/No
37. Asthma- Yes/No
38. Any Operation- Yes/No
39. Arsenic Disease- Yes/No
40. Sleep Apnea- Yes/No
41. Allergy- Yes/No
42. Symptoms of Hypothyroidism- Yes/No
If yes- * sensitivity to cold * Body Inflation or weight gain * Dry, thick and rough skin * Constipation * weakness * Unwillingness to work
43. Symptoms of Hyperthyroidism- Yes/No
If yes- * sensitivity to warm * Sweating * sudden weight loss * Diarrhoea * Hand tremor
44. Any following disease- Yes/No
If yes- * Coronary artery disease * Congenital hear disease * Valvular heart disease * Heart failure * Stroke * Peripheral arterial disease and claudication * Arrtythmias
45. Body color- White/Black
46. Systolic blood pressure (mmHg)-…………….
47. Diastolic blood pressure (mmHg)-…………….
48. Pulse pressure (mmHg)-…………
49. Means of mean arterial pressure-…………
50. Weight (in Kg.)-………………..
51. Height (in cm)-………………….
52. Body mass index-……………….
53. Abdominal circumference (in cm)-…………
54. Hip circumference (in cm)-………………
55. Waist circumference (in cm)-……………
56. Ratio of waist-to-hip circumference-…………..
57. Smoking- Yes/No
58. Taking alcohol- Yes/No
59. Taking access salt- Yes/No

APPENDIX 2

Logistic Regression on Socio-demographic Aspect

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	2250	100.0
	Missing Cases	0	.0
	Total	2250	100.0
Unselected Cases		0	.0
Total		2250	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Independent Variable Encoding

Variable Name	Label
V3	Education
V4	Age
V26in2cat(1)	Sedentary Life Style
V27in2cat(1)	Working Hour (>8) Per Day
V31in2cat(1)	Taking Regular Exercise
V36(1)	Social Stress
V37(1)	Occupational Stress
V38(1)	Mental Stress
V55(1)	Hereditary Hypertension
V92in2cat(1)	Smoking
V93(1)	Taking Alcohol
V94in2cat(1)	Taking Access Salt

Categorical Variables Codings

		Frequency	Parameter coding (1)
Taking Access Salt	No	1098	.000
	Yes	1152	1.000
Working Hour (> 8 hrs) Per Day	No	1715	.000
	Yes	535	1.000
Taking Regular Exercise	No	323	.000
	Yes	1927	1.000
Social Stress	No	2044	.000
	Yes	206	1.000
Occupational Stress	No	1776	.000
	Yes	474	1.000
Mental Stress	No	1514	.000
	Yes	736	1.000
Taking Alcohol	No	2188	.000
	Yes	62	1.000
Smoking	No	1877	.000
	Yes	373	1.000
Hereditary Hypertension	No	1747	.000
	Yes	503	1.000
Sedentary Life Style	No	1569	.000
	Yes	681	1.000

Block 0: Beginning Block

Classification Table[a,b]

	Observed		Predicted: Hypertension Overall No	Predicted: Hypertension Overall Yes	Percentage Correct
Step 0	Hypertension Overall	No	1618	0	100.0
		Yes	632	0	.0
	Overall Percentage				71.9

a. Constant is included in the model.
b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.940	.047	401.625	1	.000	.391

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	V3	23.279	1	.000
		V4	282.865	1	.000
		V26in2cat(1)	118.722	1	.000
		V27in2cat(1)	383.467	1	.000
		V31in2cat(1)	2.696	1	.101
		V36(1)	210.193	1	.000
		V37(1)	518.013	1	.000
		V38(1)	626.111	1	.000
		V55(1)	169.728	1	.000
		V92in2cat(1)	76.251	1	.000
		V93(1)	98.217	1	.000
		V94in2cat(1)	451.452	1	.000
	Overall Statistics		1.273E3	12	.000

Block 1: Method = Backward Stepwise (Likelihood Ratio)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	1576.005	12	.000
	Block	1576.005	12	.000
	Model	1576.005	12	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1096.054[a]	.504	.725

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.164	8	.842

Contingency Table for Hosmer and Lemeshow Test

		Hypertension Overall = No		Hypertension Overall = Yes		
		Observed	Expected	Observed	Expected	Total
Step 1	1	226	225.636	0	.364	226
	2	225	224.258	0	.742	225
	3	222	223.094	3	1.906	225
	4	218	219.790	7	5.210	225
	5	215	214.159	10	10.841	225
	6	204	201.129	21	23.871	225
	7	164	169.291	61	55.709	225
	8	103	103.190	122	121.810	225
	9	36	31.903	189	193.097	225
	10	5	5.552	219	218.448	224

Classification Table[a]					
			Predicted		
			Hypertension Overall		Percentage Correct
	Observed		No	Yes	
Step 1	Hypertension Overall	No	1526	92	94.3
		Yes	141	491	77.7
	Overall Percentage				89.6

a. The cut value is .500

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	V3	-.043	.020	4.772	1	.029	.958
	V4	.028	.006	23.174	1	.000	1.028
	V26in2cat(1)	1.073	.172	38.860	1	.000	2.924
	V27in2cat(1)	1.613	.179	81.530	1	.000	5.019
	V31in2cat(1)	-.504	.228	4.877	1	.027	.604
	V36(1)	1.553	.243	40.777	1	.000	4.727
	V37(1)	1.502	.188	64.145	1	.000	4.490
	V38(1)	2.097	.167	157.468	1	.000	8.143
	V55(1)	1.800	.183	96.482	1	.000	6.047
	V92in2cat(1)	.594	.202	8.645	1	.003	1.811
	V93(1)	1.073	.535	4.017	1	.045	2.924
	V94in2cat(1)	2.697	.194	193.051	1	.000	14.835
	Constant	-6.218	.419	220.058	1	.000	.002

a. Variable(s) entered on step 1: V3, V4, V26in2cat, V27in2cat, V31in2cat, V36, V37, V38, V55, V92in2cat, V93, V94in2cat.

Model if Term Removed					
Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	V3	-550.429	4.804	1	.028
	V4	-559.805	23.555	1	.000
	V26in2cat	-567.895	39.735	1	.000
	V27in2cat	-590.449	84.844	1	.000
	V31in2cat	-550.434	4.814	1	.028
	V36	-569.895	43.736	1	.000
	V37	-581.422	66.790	1	.000
	V38	-634.979	173.905	1	.000
	V55	-600.550	105.047	1	.000
	V92in2cat	-552.322	8.590	1	.003
	V93	-550.179	4.304	1	.038
	V94in2cat	-680.328	264.603	1	.000

APPENDIX 3

Logistic Regression on Health Complication Aspect

Case Processing Summary			
Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	2010	89.3
	Missing Cases	0	.0
	Total	2010	89.3
Unselected Cases		240	10.7
Total		2250	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding	
Original Value	Internal Value
No	0
Yes	1

Independent Variable Encoding	
Variable Name	Label
V45(1)	Kidney Disease
V47(1)	Tumor
V50(1)	Diabetes
V59(1)	Operation
V61(1)	Sleep Apnea
V63(1)	Hypothyroidism
V64(1)	Hyperthyroidism
V69in2cat(1)	Tachycardia
V73in2cat(1)	Over Weight

Categorical Variables Codings			
		Frequency	Parameter coding (1)
Body Mass Index in Two Category	Otherwise	1522	.000
	Over Weight	488	1.000
Tumor	No	1736	.000
	Yes	274	1.000
Diabetes	No	1845	.000
	Yes	165	1.000
Operation	No	1620	.000
	Yes	390	1.000
Sleep Apnea	No	1505	.000
	Yes	505	1.000
Hypothyroidism	No	1358	.000
	Yes	652	1.000
Pulse Rate in Two Category (Tachycardia Disease)	No	1897	.000
	Yes	113	1.000
Hyperthyroidism	No	1372	.000
	Yes	638	1.000
Kidney Disease	No	1914	.000
	Yes	96	1.000

Block 0: Beginning Block

Classification Table[c,d]

	Observed		Predicted					
			Selected Cases[a]			Unselected Cases[b]		
			Hypertension Overall		Percentage Correct	Hypertension Overall		Percentage Correct
			No	Yes		No	Yes	
Step 0	Hypertension Overall	No	1395	0	100.0	223	0	100.0
		Yes	615	0	.0	17	0	.0
	Overall Percentage				69.4			92.9

a. Selected cases For Health Complications Analysis EQ 1

b. Unselected cases For Health Complications Analysis NE 1

c. Constant is included in the model.

d. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.819	.048	286.319	1	.000	.441

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	V45(1)	89.263	1	.000
		V47(1)	259.357	1	.000
		V50(1)	133.456	1	.000
		V59(1)	12.316	1	.000
		V61(1)	1.044E3	1	.000
		V63(1)	697.909	1	.000
		V64(1)	798.793	1	.000
		V69in2cat(1)	11.913	1	.001
		V73in2cat(1)	74.945	1	.000
	Overall Statistics		1.217E3	9	.000

Block 1: Method = Backward Stepwise (Likelihood Ratio)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	1340.828	9	.000
	Block	1340.828	9	.000
	Model	1340.828	9	.000
Step 2[a]	Step	-.043	1	.836
	Block	1340.785	8	.000
	Model	1340.785	8	.000

a. A negative Chi-squares value indicates that the Chi-squares value has decreased from the previous step.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1134.842[a]	.487	.687
2	1134.885[a]	.487	.687

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.907	6	.556
2	2.985	5	.702

Contingency Table for Hosmer and Lemeshow Test						
		Hypertension Overall = No		Hypertension Overall = Yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	113	111.874	3	4.126	116
	2	681	680.837	26	26.163	707
	3	152	153.294	12	10.706	164
	4	176	175.011	18	18.989	194
	5	151	158.057	60	52.943	211
	6	99	90.395	108	116.605	207
	7	21	20.760	185	185.240	206
	8	2	4.773	203	200.227	205
Step 2	1	794	792.736	29	30.264	823
	2	125	124.978	8	8.022	133
	3	187	187.811	20	19.189	207
	4	167	173.554	62	55.446	229
	5	99	90.390	108	116.610	207
	6	19	20.219	176	174.781	195
	7	4	5.312	212	210.688	216

===

Classification Table[c]								
Observed			Predicted					
			Selected Cases[a]			Unselected Cases[b]		
			Hypertension Overall		Percentage Correct	Hypertension Overall		Percentage Correct
			No	Yes		No	Yes	
Step 1	Hypertension Overall	No	1329	66	95.3	220	3	98.7
		Yes	149	466	75.8	4	13	76.5
	Overall Percentage				89.3			97.1
Step 2	Hypertension Overall	No	1327	68	95.1	220	3	98.7
		Yes	148	467	75.9	4	13	76.5
	Overall Percentage				89.3			97.1

a. Selected cases For Health Complications Analysis EQ 1

b. Unselected cases For Health Complications Analysis NE 1

c. The cut value is .500

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	V45(1)	1.695	.377	20.245	1	.000	5.449
	V47(1)	.504	.275	3.350	1	.067	1.656
	V50(1)	1.244	.287	18.846	1	.000	3.470
	V59(1)	-.041	.198	.043	1	.836	.960
	V61(1)	2.760	.191	207.705	1	.000	15.796
	V63(1)	.510	.184	7.689	1	.006	1.665
	V64(1)	2.091	.172	147.423	1	.000	8.090
	V69in2cat(1)	.570	.314	3.309	1	.069	1.769
	V73in2cat(1)	.940	.169	30.814	1	.000	2.560
	Constant	-3.259	.145	508.497	1	.000	.038
Step 2[a]	V45(1)	1.692	.376	20.236	1	.000	5.428
	V47(1)	.496	.273	3.315	1	.069	1.643
	V50(1)	1.239	.285	18.845	1	.000	3.452
	V61(1)	2.760	.191	207.804	1	.000	15.795
	V63(1)	.508	.184	7.658	1	.006	1.662
	V64(1)	2.091	.172	147.608	1	.000	8.096
	V69in2cat(1)	.572	.314	3.322	1	.068	1.771
	V73in2cat(1)	.939	.169	30.782	1	.000	2.558
	Constant	-3.266	.141	535.066	1	.000	.038

a. Variable(s) entered on step 1: V45, V47, V50, V59, V61, V63, V64, V69in2cat, V73in2cat.

Model if Term Removed					
Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	V45	-577.166	19.489	1	.000
	V47	-569.079	3.315	1	.069
	V50	-576.783	18.725	1	.000
	V59	-567.442	.043	1	.836
	V61	-684.481	234.120	1	.000
	V63	-571.149	7.456	1	.006
	V64	-641.025	147.208	1	.000
	V69in2cat	-569.017	3.193	1	.074
	V73in2cat	-582.683	30.525	1	.000
Step 2	V45	-577.168	19.451	1	.000
	V47	-569.079	3.273	1	.070
	V50	-576.797	18.709	1	.000
	V61	-684.535	234.186	1	.000
	V63	-571.155	7.426	1	.006
	V64	-641.142	147.399	1	.000
	V69in2cat	-569.045	3.204	1	.073
	V73in2cat	-582.687	30.489	1	.000

Variables not in the Equation					
			Score	df	Sig.
Step 2[a]	Variables	V59(1)	.043	1	.836
	Overall Statistics		.043	1	.836
a. Variable(s) removed on step 2: V59.					

APPENDIX 4

Logistic Regression on Feminine and Nuptial Aspect

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	1177	52.3
	Missing Cases	0	.0
	Total	1177	52.3
Unselected Cases		1073	47.7
Total		2250	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Independent Variable Encoding

Variable Name	Label
V15	Age at First Marriage
V17	Duration of Couple Life
V18(1)	Use of Contraceptive Methods
V21(1)	Menopause
V22(1)	Pregnancy
V23and24(1)	Miscarriage Overall

Categorical Variables Codings			
		Frequency	Parameter coding (1)
Miscarriage Overall	No	925	.000
	Yes	252	1.000
Menopause	No	1004	.000
	Yes	173	1.000
Pregnancy	No	1107	.000
	Yes	70	1.000
Use of Contraceptive Methods	No	543	.000
	Yes	634	1.000

Block 0: Beginning Block

Classification Table[d,e]

Observed			Predicted					
			Selected Cases[a]			Unselected Cases[b]		
			Hypertension Overall		Percentage Correct	Hypertension Overall		Percentage Correct
			No	Yes		No	Yes	
Step 0	Hypertension Overall	No	837	0	100.0	225	0	100.0
		Yes	340	0	.0	111	0	.0
	Overall Percentage				71.1			67.0

a. Selected cases Marital Status Feminine Analysis EQ 1

b. Unselected cases Marital Status Feminine Analysis NE 1

d. Constant is included in the model.

e. The cut value is .500

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.901	.064	196.228	1	.000	.406

Variables not in the Equation					
			Score	df	Sig.
Step 0	Variables	V15	2.857	1	.091
		V17	132.062	1	.000
		V18(1)	6.562	1	.010
		V21(1)	66.875	1	.000
		V22(1)	4.474	1	.034
		V23and24(1)	22.425	1	.000
	Overall Statistics		234.598	6	.000

Block 1: Method = Backward Stepwise (Likelihood Ratio)

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	271.676	6	.000
	Block	271.676	6	.000
	Model	271.676	6	.000

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1143.401[a]	.206	.295

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	6.354	8	.608

Contingency Table for Hosmer and Lemeshow Test						
		Hypertension Overall = No		Hypertension Overall = Yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	116	114.630	1	2.370	117
	2	114	111.915	5	7.085	119
	3	102	102.452	15	14.548	117
	4	98	97.507	20	20.493	118
	5	93	91.544	25	26.456	118
	6	80	86.413	40	33.587	120
	7	78	77.064	40	40.936	118
	8	67	68.385	51	49.615	118
	9	51	55.999	67	62.001	118
	10	38	31.091	76	82.909	114

Classification Table[d]

Observed			Predicted					
			Selected Cases[a]			Unselected Cases[b]		
			Hypertension Overall		Percentage Correct	Hypertension Overall		Percentage Correct
			No	Yes		No	Yes	
Step 1	Hypertension Overall	No	769	68	91.9	203	22	90.2
		Yes	210	130	38.2	74	37	33.3
	Overall Percentage				76.4			71.4

a. Selected cases Marrital Status Faminine Analysis EQ 1
b. Unselected cases Marrital Status Faminine Analysis NE 1
d. The cut value is .500

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	V15	-.089	.052	2.992	1	.084	.914
	V17	.070	.007	89.738	1	.000	1.073
	V18(1)	2.086	.245	72.461	1	.000	8.054
	V21(1)	1.661	.279	35.555	1	.000	5.265
	V22(1)	2.676	.358	55.991	1	.000	14.530
	V23and24(1)	.576	.166	12.056	1	.001	1.779
	Constant	-3.119	.716	18.992	1	.000	.044

a. Variable(s) entered on step 1: V15, V17, V18, V21, V22, V23and24.

Model if Term Removed

Variable		Model Log Likelihood	Change in -2 Log Likelihood	df	Sig. of the Change
Step 1	V15	-573.206	3.012	1	.083
	V17	-622.864	102.328	1	.000
	V18	-622.420	101.439	1	.000
	V21	-591.124	38.847	1	.000
	V22	-600.282	57.163	1	.000
	V23and24	-577.659	11.917	1	.001

APPENDIX 5
PATH ANALYSIS

Introduction

The method of path coefficient analysis[3] is essentially a device for analysis or decomposition of a correlation coefficient under a structure of casual relationships among linearly related variable. A correlation coefficient between two variables may consist of several factors corresponding to a certain step of link in the chain of relationship between two correlated variables. In path coefficient analysis the correlation coefficient between the criterion variable (effect) and a given predictor or independent variable (causal factor) is decomposed into a liner combination of the direct effect of the independent variable under consideration and its indirect effects through other independent variable(causal factors) with which the former is corrected. Path analysis is a straightforward extension of multiple regressions. Its aim is to provide estimates of the magnitude and significance of hypothesized causal connections between sets of variables. The path diagram is given below:

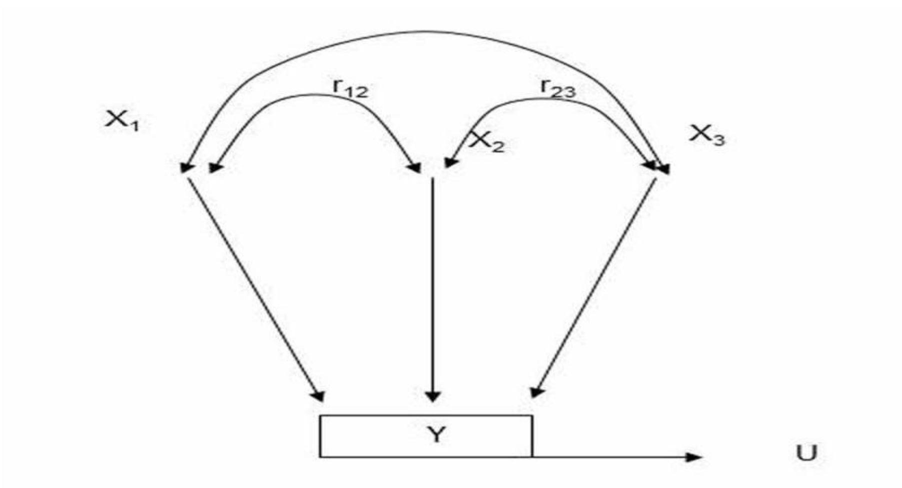


Figure 1: Path Diagram

Method of path analysis

Let X_1, X_2, . . . ,X_k are k known causal factors (Predictors) and Y is the effect (criterion variable) of these casual factors where U is the residual set including the disturbance variable. The casual factors are assumed to be independent of the residual factor. In fig 1 single arrows indicate the direction of influence and a double arrowed line indicates correlation and also, P_1, P_2, P_3 are measures of the direct effect of X_1, X_2, X_3 respectively on the criterion variable (effect) Y and called paths through which X_1, X_2 and X_3 affect Y directly. The path coefficient P_1, the direct path from the casual factor X_1 to Y is defined as the ratio of the standard deviation σ_{x1} to the standard deviation σ_{y1} when X_2 and X_3 are held constant. Intuitively, the ratio may be viewed as a measure of the influence of X_1 on Y since its square measures the fraction of the variance in Y attributable to variation in X_1. Besides the direct effects of X_1 on Y there are indirect effect of X_1 on Y, there are indirect effects of X_1 on Y via X_2 and X_3 by virtue of its inter correlation with X_2 and X_3. Any change in X_2 will bring a concomitant change in X_1depanding upon the correlation between X_1 and X_2 (r_{12}) which in turn, will affect Y. Since P_2 is the direct effect of X_2 on Y, this change is only partial and is proportional to r_{12}. That is, this indirect effect of X_1 via X_2 is measured as a fraction $r_{12}P_2$ of the direct effect of X_2 on Y. Thus, the correlation coefficient r_{1y} between X_1 and Y is conceived of as the sum total of the direct effect of X_1(i.e. P_1) and its indirect effects via X_2 (i.e. r_{12} P_2) and X_3 (i.e. r_{13} .P_3): $r1y = P_1 + r_{12}P_2 + r_{13}P_3$. Similarly, the correlation coefficients between Y and X_2 (i.e. r_{2y}) and between Y and X_3 (i.e. r_{3y}) and so on may be decomposed as sum of direct and indirect effects.

==

Derivation of path analysis

Let us consider $X_1, X_2, \ldots, X_k$ be measurement on k factors supposed to influence the effect measured by Y. let the effect Y be sum total of these causal factor $X_1, X_2, \ldots, X_k$ and a residual U. That is $Y = X_1 + X_2 + \cdots + X_k + U$

Then the correlation coefficient r_{1y} between X_1 and Y is defined as

$$r = \frac{\mathrm{Cov}(X_1, Y)}{\sigma_{x_1}\sigma_y} = \frac{\mathrm{Cov}(X1, X1 + X2 + \cdots + Xk + U)}{\sigma_{x_1}\sigma_y} = \frac{[\mathrm{Cov}(X_1, X_1) + \mathrm{Cov}(X_1, X_2) + \cdots + \mathrm{Cov}(X_1, X_k)}{\sigma_{x_1}\sigma_y}$$

$\mathrm{cov}(X_1, U) = 0$ since u is assumed to be independent of $X_1, X_2, \ldots, X_k$. That is

$$r_{1y} = \frac{\sigma_{x_1}{}^2 + r_{12}\sigma_{X_1}\sigma_{X_2} + \cdots + r_{1k}\sigma_{X_1}\sigma_{X_k}}{\sigma_{x_1}\sigma_y}$$

$$= \frac{\sigma_{x_1}}{\sigma_y} + r_{12}\frac{\sigma_{X_2}}{\sigma_y} + \ldots + r_{1k}\frac{\sigma_{X_k}}{\sigma_y} = P_1 + r_{12}P_2 + \cdots + r_{1k}P_k$$

where, $P_j = \dfrac{\sigma_{X_1}}{\sigma_y}$; for $j = 1, 2, \ldots, k$

A similar result could be shown for r2y,r3y,…, rky In matrix notation, we thus have $(\rho_{cv}{}^2 \times 100)\%$

$$\begin{pmatrix} r_{1y} \\ r_{2y} \\ r_{3y} \\ . \\ . \\ . \\ r_{ky} \end{pmatrix} = \begin{pmatrix} 1 & r_{12} & r_{13} & . & . & . & r_{1k} \\ r_{21} & 1 & r_{23} & . & . & . & r_{2k} \\ r_{31} & r_{32} & 1 & . & . & . & r_{3k} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ r_{k1} & r_{k2} & r_{k3} & . & . & . & r_{kk} \end{pmatrix} \begin{pmatrix} P_1 \\ P_2 \\ P_3 \\ . \\ . \\ . \\ P_k \end{pmatrix}$$

i. e. $r_y = RP$

Then solving for P

$P = R^{-1} r_y$

Thus, the direct effects, $p_1, p_2, \ldots, p_k$ could be estimated from the sample correlation matrix(R) among the causal factors and the effect. Once, the direct effects are estimated, and then the indirect effect could easily be computed. Thus, for the casual factor X_i (i=1,2,3, . . . ,k) then direct effect on y is p_i and indirect effect via X_j $(i \neq j)$ is

$r_{ij}\,p_j$ (j=1,2,3, . . . , k). The magnitudes $r_{ij}.p_j$ will then reflect the influence of via the path

X_j, the totality of such indirect will then be $\sum_{\substack{i=j \\ i \neq j}} r_{ij} p_j = r_{iy} - p_i$