EVALUATION OF BEHAVIOURAL RISK REDUCTION ON STAGE–I HYPERTENSION

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A dissertation submitted to the University of Dhaka for the partial fulfillment of the degree of Doctor of Philosophy

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Dedication

I dedicate this dissertation to my parents, my wife and my children for being there for me and making me the person I am today.

Declaration

I do hereby declare that this thesis entitled "EVALUATION OF BEHAVIOURAL RISK REDUCTION ON STAGE-I HYPERTENSION" is based on the basic research work carried out by me during the session 2006-2007 to 2008-2009. This dissertation is submitted to the Faculty of Postgraduate Medical Science & Research for the partial fulfillment of the requirement for the degree of Doctor of Philosophy under the University of Dhaka. No part of it has been presented previously for any higher degree. This research work was carried out at the auspices of the Faculty of Postgraduate Medical Science & Research, University of Dhaka, under the supervision of Prof. Dr. Shah Mohammad Keramat Ali, MBBS, DPH, MCommH, PhD, Professor, Clinical Nutrition (now retired), Institute of Nutrition and Food Science University of Dhaka, Bangladesh and Prof. Dr. KMHS Sirajul Haque, MBBS, FCPS, FCPS, FRCP (Edin), FACC, Professor and Chairman, Dept. of Cardiology, and the Dean, Faculty of Medicine, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

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Declaration by the Supervisors

The undersigned certify and recommend to the Faculty of Postgraduate Medical Science and Research, University of Dhaka for acceptance of the thesis entitled ***Evaluation of Behavioural Risk Reduction on Stage–I Hypertension*** submitted by Dr. AKM Alamgir for the award of the Doctor of Philosophy (PhD) degree. This is an independent research work done by him. The study has been carried out under the auspices of the University with our supervision. and has not been used as the basis of any other higher degree or fellowship.

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List of Abbreviation

Abbreviation	Elaboration
ACE	Angiotensin-Converting Enzyme
AGT	Angiotensin
AHA	American Heart Association
Ang-I	Angiotensin-I
Ang-II	Angiotensin-II
ANF	Atrial Natriuretic Factor
BMI	Body Mass Index
BMRC	Bangladesh Medical Research Council
BP	Blood Pressure
CHD	Coronary Heart Disease
CHF	Congestive Heart Failure
CVD	Cardiovascular Diseases
DASH	Dietary Approaches to Stop Hypertension
DBP	Diastolic Blood Pressure
ECE	Endothelin Converting Enzyme
ET	Endothelin
GHQ	General Health Questionnaire
HADS	Hospital Anxiety and Depression Scale
HDL	High Density Lipoprotein
HTN, HT	Hypertension
IHD	Ischaemic heart disease
ISH	Indian Society of Hypertension
JNC-7	The seventh report of the Joint National Committee (JNC-7) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
LDL	Low Density Lipoprotein
MI	Myocardial Infarction
mmHg	Millimetre of Mercury (Unit for measuring BP)

MONICA	Monitoring of Trends and Determinants of Cardiovascular Diseases
NICVD	National Institute of Cardiovascular Diseases
NCD	Non-communicable Diseases
NGO	Nongovernmental organization
PGI_2	Prostaglandin I_2
PHQ	Patient Health Questionnaire
RAS	Renin-Angiotensin system
SBP	Systolic Blood Pressure
SF-36	The Short Form Health Survey
WHO	World Health Organization
WHO-ISH	World Health Organization International Society of Hypertension
VLDL	Very Low Density Lipoprotein
TG	Triglyceride

Abstract

Background

Prevalence of hypertension is on rise silently and slowly in Bangladesh. This quasi-experimental community trial was conducted aiming at evaluating reversal of blood pressure through reduction of bodyweight in overweight or obese peoples, cessation of table salt intake, increment of physical activity and cessation of smoking in an urban community. The study also aimed at finding out the socio-economic and demographic profile for hypertension and evaluating outcome of behavioural risk reduction contributing to maintenance of reversal of hypertension.

Materials and Methods

This intervention study was conducted among 4,930 respondents out of 7,474 population aged 18 years or above in Mohammadpur area of Dhaka city. The response rate was 65.96%. This survey was carried out at household level, during the period August 2005 to February 2009 including an intervention period of 18 months. Cluster randomized sampling was used to collect 282 respondents with stage-I hypertension who were not aware about their hypertension. The respondents had neither any complication nor any co-morbidity. The intervention was given person-to-person after the respondents signed the informed consent form. Intervention included physical activity enhancement, dietary advice, avoidance of extra table salt and smoking cessation. Global standard tools were used to collect data through person-to-person interview and clinical assessment. Follow-up on pre-determined parameters were done after 6, 12, and 18 month of intervention. Data analysis and interpretation were done through SPSS.

Results

Mean Systolic Blood Pressure of the respondents was found to be 121.4 ± 15.9 mmHg and mean diastolic Blood Pressure of the respondents was found to be 78.2 ± 9.6 mmHg. Normal blood pressure was found among 45.6% respondents and pre-hypertension in 34.3%. Overall prevalence of hypertension was 20.1% according to the JNC-7 criteria (12.8% stage-I hypertension and 7.3% either stage-II hypertension or hypertension under treatment).

This study included 196 (69.5%) male and 86 (30.5%) female above 18 years. Peak age group for untreated stage-I hypertension was 25-44 year. Blood pressure was found to have linear correlation with increasing age (for sBP r^2 =0.258 with F = 3.568, df 38 p< 0.001 and for dBP r^2=0.342, F= 3.318, df 38 p<0.001). Married respondents comprised 74.5% while 25.5% were unmarried. Positive history of hypertension among first-degree family members was found in 63.1%. Illiterate respondents were 8.6% but 47.8% had graduate and university level of education. Sixty six percent respondents had expenditure of about Tk-75,000.00 to Tk-300,000.00 per anum. Important occupations of respondents were service (48.2%), house wives (18.5%), businessmen (14.2%), students (9.9%) and others (9.2%).

Mean height and weight of the respondents were found to be160.1 ± 7.4cm and 63.2 ± 8.1 Kg respectively. Mean BMI was found 20 kg/m.^{2} Significant correlation of both systolic and diastolic blood pressure was found with increment of body weight (for sBP r^2=0.421, F=2.739, p<0.001 and for dBP r^2=0.451, F=3.094, p<0.001).

After 18 month intervention mean change of systolic blood pressure was -9.1 ± 5.7 mmHg and mean change of diastolic blood pressure was -8.4 ± 4.6 mmHg. Percent reduction for systolic blood pressure from baseline BP was -7.0% and for diastolic BP from baseline BP was -9.9% after 18m behavioural risk reduction intervention.

Blood pressure of 56.7% respondents with stage-I hypertension reversed to lower level (normal 7.8% and prehypertension level 48.9%). In 17.7% cases blood pressure remained at stage-I level but their mean value reduced from baseline. Blood pressure went up in 14.9% cases inspite of intervention. And 10.7% cases were dropped from study due to other reasons. Overall drop-out from study was 25.5% after 18 months.

Mean weight change was - 1.8 ± 1.8 Kg after 18 month which was found statistically significant with paired t-test. At beginning, 44% took extra table salt. After 18 month intervention salt intake was reduced to 1.8% respondents only. Change of salt intake was found significantly related to change of both sBP (F= 9.688; p=0.000; adjusted r^2=0.077) and dBP (F=6.544; p=0.002; r^2=0.050). Increased mean change of physical activities was 4658.9±1395.1 at 18m. Mean change in light, moderate and heavy physical activity were 993.5 ± 318.2 minutes/week. 289.8 ± 171.5 minutes/week and 27.7 ± 24.4 minutes/week respectively. Mean change of smoking tobacco was -4.7 ± 12.5 stick/ week after 18m. Quality of life was improved for both subjective and objective indices. Subjective index for anxiety/ depression scale of the respondents reduced from 8.2 to 2.4 over 18months on a scale from zero to ten.

Conclusion

Reversal of hypertension by 56.7% was possible by structured behavioural risk reduction meaning- intake of balanced diet with exclusion of extra salt, increment of physical activity along with reduction of body weight. Combination of all of these parameters is recommended to be used by physicians while treating and caring patients with stage-I hypertension.

Chapter-I

Introduction

Introduction

Raised blood pressure is an alarming concern in modern societies, because high blood pressure shortens the life, increases hospitalization rate, results more occupancy of hospital beds, increases treatment cost and ultimately patients become social burden. More important issue for high blood pressure is that it affects individuals during their most productive and contributing peak mid life years interrupting the future of the depending families and undermining the development of nations by depriving valuable human resources. Health burden arises out of blood pressure is now not confined to the developed world rather it is spreading more rapidly in the low or middle-income generating communities as well. Control of blood pressure by risk reduction intervention at early stage is the question and demand of developing communities.

Global population is in the midst of a true cardiovascular disease (CVD) epidemic responsible for about 60% of worldwide deaths and 47% of the global burden of diseases each year. In South East Asia Region (SEAR) NCDs accounts for 51% of all deaths and 44% of the disease burden and as such clearly emerging as a major public health challenge for SEAR nationals.[1,2]CVD includes hypertension, coronary heart disease (CHD), cerebrovascular disease, peripheral vascular disease, congestive heart failure (CHF), valvular and congenital heart diseases. Coronary heart disease includes myocardial infarction (MI), angina pectoris, coronary insufficiency, and coronary death. Cerebrovascular disease includes stroke and transient ischaemic attack. High blood pressure is considered as a very pertinent pre-determinant for these overwhelming diseases or clinical conditions.[3]

WHO reports that about 15%–37% of the adult population worldwide is afflicted with hypertension. The prevalence is as many as one-half in those older than 60 years of age. As a whole urban population suffer more from hypertension than rural people. In 1997, an assessment commissioned for the WHO Ad Hoc Committee on Health Research estimated the percentage of global deaths associated with common risk factors. WHO also reports smoking and hypertension as the major causes of global mortality for 1990 AD.[4]

Prevalence of non-communicable disease is also a focused area for research in Bangladesh. Traditionally Bangladeshi peoples were agrarians with fresh fish, fruits and vegetable eating food habit leading physically active life style. But economic transition, under-planned urbanization, disproportionate industrialization, rural to semi-urban migration, formation of urban slum and rapid globalization brought about lifestyle changes among this population. Peoples over here started to interface more sedentary jobs and consumption of more fatty fast fried foods. Such social and dietary changes along with no physical activity contribute increasing prevalence of high blood pressure in Bangladeshi society.

In Bangladesh comprehensive population based community studies on CVD are still inadequate in respect of the magnitude of the disease problem. Mallik[5] (1975) reported about 0.33% prevalence of coronary artery disease while Haque (1985)[6] reported a prevalence of 1.4% among peoples in Bangladesh. Hussain[7](1984) performed a study on 5,000 samples in Tangail district of Bangladesh for 1yr 6 month period between 1981-83 to find about 2.1% people having CHD.[7] Ali (1987) worked on prevalence of cardiovascular diseases among different levels of teachers working in Dhaka University and the rate was alarming during that time comprising about 12.1% through ECG tracing.[8]

Wali Ullah (1976) described 2.68% prevalence of hypertension, above 20 years age, among students and staff of Agricultural university Mymensingh.[9] Islam et al (1979) studied on a 8,172 fixed community samples in Dhaka Secretariat to find the prevalence of 13.3%.[10]Dasherkandi project study in a village by Chowdhury et al (2001) found a prevalence of 5.3% hypertension among 663 respondents (response rate 67.5%) non-adjusted for age.[11]In another study published in BMRC Bulletin, Islam (1983) described the prevalence of 6.7% hypertensives in rural Bangladesh. They studied 5,026 samples comprising 75% of the total population in that area.[12]Begum et al (1984) published article in JOPSOM describing hypertension prevalence study on 1,119 peoples of Dhamrai Upazilla Health Complex, 5,026 peoples at Tongi Health Complex and 7,972 peoples at Mohakhali area. They found the prevalence of hypertension to be 7.1%, 6.7% and 13.7% in these areas respectively.[13] The community based study by Sayeed et al (2002) of BIRDEM reported the hypertension prevalence and related risks among 2,361 native Bangladeshis over 20 years of age. Overall prevalence rates of systolic and diastolic hypertension in the study population were 14.4 and 9.1 percent respectively.[14]

Cross-sectional survey on 2,625 subjects (male 1,277; 48.6% and female 1,348; 51.4%) by Haque and Ali (2007) from May to November 2007 in urban Dhaka found about 23.8%people to have hypertension (5.8% stage II hypertension and 18% stage I hypertension or with medication) according to JNC-7 criteria. Mean age of the respondents was 35.8 ± 12.7 years with mean weight 60.7 ± 11.3 kg and BMI 23.2 ± 3.9 kg/m^2. Mean sBP was 122.9 ± 16.1 mmHg and mean dBP was 79.1 ± 10.3 mmHg.[15]

Important modifiable behavioural risk factors for high blood pressure comprise smoking tobacco, physical inactivity, increased salt intake and overweight or obesity. Both population and laboratory studies indicated the association of dietary and lifestyle factors with the chronic and progressive increase in blood pressure. Increasing number of publications of different reports and experiences from different parts of the world depict more about reductions in blood pressure in persons with hypertension following management with a number of different non-pharmacological interventions. Such observations and laboratory inferences created interest in the possibility of the primordial or primary prevention of hypertension through non-pharmacological intervention on factors related to the development of high blood pressure.

There is increasing number of observations from clinical or community trials that high blood pressure can be controlled or lowered to an acceptable limit by lowering the behavioural risk factors. Results of NHLBI-supported Hypertension Detection and Follow-up Program (HDFP) in the USA and the Multiple Risk Factor Intervention Trial (MRFIT) put concerns about drug related effect, cost of treatment and safety of antihypertensive drugs.[16]

The Hypertension Prevention Trial (HPT) in the USA studied the effectiveness of primordial intervention in a non-hypertensive population and recommended the importance of further work in this area addressing in some detail non-pharmacologic intervention and primary prevention feasibility.[17] Risk of hypertension as the necessary and sufficient causal factor has been established and predicted in many overseas studies.[18-21]There are well documented studies on hypertensive risk and consequences in Bangladesh highlighting the gradually rising burden of hypertension for causation of other cardiovascular morbidities and mortalities.[22-24]

Regarding management of hypertension WHO, British Hypertension Society, and Joint National Committee (JNC-7) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure agreed upon non-pharmacological approaches of behavioural risk reduction interventions for first 6-12 month in case of uncomplicated stage-I hypertension patient having no second risk factor.[25-28]

PREMIER Collaborative Research Group trial and DASH or DASH PLUS[16,29,30] trial demonstrated the benefit of a combination of behavioral steps to control and prevent hypertension. After six months of intervention with lifestyle modification, a significant decrease in blood pressure and hypertension control was noted. One of the key findings was the prescription of the application of the DASH diet and weight loss.

British National Institute for Clinical Excellence (NICE) of United Kingdom National Health Services encourages multiple lifestyle interventions to achieve a reduction in systolic blood pressure of 10 mmHg or more in the short term, up to 1 year in about 25% trial peoples.[31]

Adopting WHO MONICA modified protocol an intervention study was effectively performed in Jamaica by Duff and Wilks (2003) over 80 patients having high blood pressure (>140/90 mmHg) to assess the long term impact of educational and monitoring intervention on blood pressure control. Data were collected on 73 (91%) patients, 40 (95%) cases and 33 (87%) controls by clinic records or by direct measurement of blood pressure and weight. Three (7.5%) cases and two (6%) controls had died. About 28% (11/39) cases and 22% (8/36) controls at the end of the six-month intervention could significantly reduce the blood pressure.[32]

In Bangladesh a quasi-experimental study was performed in Dhaka Medical College Hospital during the period January 2004 to July 2004 by Shaheen (2004) on 110 study subjects with stage-I hypertension. The approach was non-pharmacological intervention to reduce high blood pressure. The author reported reduction of 11.22 ± 12.68 mmHg systolic BP and 4.46 ± 8.58 mmHg diastolic BP as a result of three month intervention.[33]

Based on all these study outcomes this intervention study was performed to address quantitative answers about amount of blood pressure can be reduced in Bangladeshi urban perspective through behavioural risk reduction, up to how many months this reversal can be sustained and the extent of successful reduction through life style modification programmes.

Basics about Blood Pressure

Blood Pressure is the lateral force of running blood that is exerted on the arterial wall while flowing through it. When the pressure on the wall of blood vessel remains persistently high over time, it is called *High Blood Pressure* or *Hypertension* in the clinical word. Maintenance of proper or normal blood pressure is a vital function of the body system. Change of blood pressure directly or indirectly affects most of the vital body organs through different mechanisms or systems resulting to various grades of morbidities and sufferings. In many ways high blood pressure is injurious to health and survival.

Significant fall in blood pressure may be incompatible to life and vitality. On the other hand high rise of blood pressure may cause life threatening morbid conditions like hypertensive heart diseases, cerebrovascular accidents, different degrees of heart failure, kidney diseases and blindness. These are the leading causes of death globally. Heart is the propeller of blood throughout the body and has to work very hard with change in blood pressure gradients. Grading of blood pressure and labeling into normal or high needs careful considerations of several subjective and objective issues. Consequences of low or high blood pressure at micovascular or macrovascular level, subjective feeling of sickness, associated co-morbidity states and pathological changes are the important issues to consider for defining hypertension for a particular individual. Because of causal relationship of blood pressure with many end-organs in the body, functioning as well percentage of damages or malfunctioning of those end-organs should be considered well while grading or classifying blood pressure.

Regulation of Blood Pressure

Blood pressure needs to be regulated within an optimum range for normal functioning of the human body and to keep vitality of organs. The body maintains a dual set of regulatory mechanisms to work for keeping blood pressure within normal range. These regulatory mechanisms might be *neuronal controlled* or *humoral regiulations*.

Nervous mechanism comprises- short term regulation (*Mechanism works within seconds*- Baro-receptor feed back mechanism, Chemoreceptor feed back mechanism, Central nervous system ischemic mechanism or the *Mechanism that works within minutes*- Renin-angiotensine vaso-constrictor mechanism, Capillary fluid shift mechanism, Stress relaxation changes in vasculature) and the Long term regulation- (Renal body fluid mechanism and Renin angiotensin mechanism).

Humoral regulation is done by- Epinephrin-norepinephrin mechanism, Vasopressin vasoconstrictor mechanism (ADH) and the Renin angiotensin aldosterone mechanism.

Baroreceptors or pressuroceptors, stretch spray-type nerve endings extremely abundant in the wall of arch of aorta and in the carotid sinus, can control both increase and decrease of blood pressure, and hence this control system is known as *pressure buffer system*. With rise of arterial blood pressure baroreceptors get stimulated, with BP above 60 mmHg, and send impulses inhibitory to vasomotor centre (VMC) or excitatory to cardio-inhibitory centre through the glossopharyngeal and vagus nerves. This results in decreasing heart rate due to cardio inhibitory effect and vasodilatation due to release of the stimulatory effect of vasomotor centre. And blood pressure is controlled with decreased cardiac output and decreased peripheral resistance. The reverse events occur when to fall blood pressure.

The chemoreceptors, chemosensitive cells, are sensitive to oxygen lack or hydrogen and carbon di-oxide excess not stimulated strongly until the arterial pressure falls below 80mm Hg. With decreased arterial pressure, blood supply to the chemoreceptors are reduced causing excess carbon-di-oxide which results receptor stimulation. This stimulation reaches the vasomotor centre to cause vasoconstriction raising blood pressure.

Decreased blood flow to the vasomotor centre in lower brain causes nutritional deficiency. Neurons in that area become stimulated and help for elevation of the blood pressure. When blood pressure falls juxtra glomerular cells of kidney secrete rennin, a glycoprotein, to convert angiotensinogen (AGT), mainly synthesized in the liver and released into circulation, to angiotensin I (Ang-I). Ang-I is then converted into octapeptide angiotensin- II within the lungs by the carboxypeptidase angiotensin converting enzyme (ACE) mostly present in the endothelial cells. This angiotensin plays roles in vasoconstriction which is one of the mechanisms of short time regulation of blood pressure through retaining sodium and water at renal tubules resulting to stimulate aldosterone release from adrenal glands.[34]

When capillary pressure falls, fluid is absorbed by capillary osmosis from tissue into circulation which ultimately raises the blood pressure by increasing fluid volume. Conversely, the opposite action occurs in case of increased blood pressure.

With high pressure the vessels become stretched more and more with increase in blood volume (increased strain) increases pressure (increased stress). However, pressure does not remain steady, but declines a small amount over time. This decline in pressure (stress) over time at a constant volume (strain) is termed *stress relaxation*. And once it becomes normal, is termed as *stress relaxation mechanism*. When there is increase in blood pressure,

the renal glomerular filtration rate (GFR) also increases resulting in decrease of the extracellular fluid (ECF) volume. As a result there is decrease blood pressure which ultimately decreases the blood pressure. The opposite action is found in case of decreased pressure.

Decreased arterial pressure stimulates the sympathetic nervous system and adrenal gland which causes secretion of epinephrine-norepinephrine secretion. These causes increased peripheral resistance and thus increase the blood pressure.

Decreased blood pressure increases the plasma osmolality which stimulates the osmoreceptors in the hypothalamus to secrete vasopressin or ADH from posterior pituitary gland. This vasopressin causes increased water reabsorption from renal tubule which increases blood pressure. Moreover, in higher concentration vasopressin causes vasoconstriction which also helps in increasing blood pressure.

Risk Factors for Blood Pressure

Hypertension is an emerging epidemic for developing countries. The prevalence and incidence of hypertension in developing countries is rising very rapidly. Previously incidence and prevalence of high blood pressure was supposed to be happened only in the developed or industrial countries. But now the paradigm has been shifted from the developed to the developing world, from the rich and affluent socioeconomic settings to middle class or low-economic settings.

The determinants for these changes are urbanization, changes in occupation and many global influences. Economic transition, urbanization, industrialization and globalisation bring about lifestyle changes that promote cardiovascular diseases like hypertension. Traditional risk factors include tobacco use, physical inactivity, and unhealthy diet. Life expectancy in developing countries is rising and people are exposed to these risk factors for longer periods. Newly emerging hypertensive risk factors like low birth weight, folate deficiency and infection are also more frequent among the poorest in low and middle-income countries. The transition equally affects both adults and children. Cause of high blood pressure is neither unifactorial nor can be explained with single disease agent. Many risk factors are supposed to be associated with the occurrence of high blood pressure. *Risk factors are conditions or behaviors that increase chances of developing a disease*. Risk of developing hypertension or heart disease greatly multiplies when there is more than one risk factor present in one individual. Some of these risk factors are modifiable while others are non-modifiables.[35]

Non-modifiable risk factors include-

- *Age* of the patient has linear progressive relationship with high blood pressure. Age reflects an accumulation of environmental influences and the effects of genetically programmed senescence in the body system. Population studies have shown that systolic pressure rises steadily with age.
- *Sex* differentiates before and after developing menopause in women. Female hormone is considered to have significant protective effect against development of cardiovascular diseases.
- *Family history and heredity* contributes probability of developing hypertension. Based on twin and family studies BP levels appear to be genetically determined with polygenic inheritance. The children of two normotensive parents have a 3% possibility of developing HTN whereas this possibility was 45% in children of two hypertensive parents. Almost one half of respondents reported a family history of heart disease.[36]
- *Genetic* predisposition has been established for monogenic hypertensive syndromes. Genome scanning and contemporary gene expression assays in model organisms could identify candidate genes related to hypertension. Liddle's syndrome, Glucocorticoid-remediable aldosteronism (GRA) apparent mineralocorticoid excess (AME) are good examples.[34]
- *Race* is found to have role in CVD development. South Asians have more CVD prevalence in England and Canada the domestic whites there.[37,38]

Modifiable risk factors for hypertension include-

- *Smoking* causes inhalation or ingestion of nicotine that stimulates adrenergic drive of the human body system resulting high trend of blood pressure. Carbon monoxide causes atherogenesis while inhaled during smoking.
- *Overweight or obesity*- Positive correlation exists between obesity and high blood pressure. Weight gain is considered to stimulate sympathoadrenal system causing hyperinsulinaemia and precedes elevation of leptin level. Salt sensitivity may also work over here.[39,40]
- Lack of optimum *physical activity* causes reduced mobilization of body fat and carbohydrate with also reduced utilization resulting hypertension through different mechanisms.
- *Dyslipidaemia* comprising altered ratio of beneficial to harmful or total cholesterol level and also isolated elevation of the low density lipoprotein or triglycerides is usually associated with rising blood pressure level
- Diabetes Mellitus or Impaired Glucose Tolerance is a known individual risk factor for hypertension
- Unhealthy *dietary habit and food preferences*- Consumption of saturated fat and red meat is injurious to health and is a known risk factor for CVD especially hypertension
- *Salt intake*-There are increasing evidences that high salt intake (more than 5 g/day) increases blood pressure while reducing salt intake can lower BP.[34]
- *Psychological factors* - HTN is a disorder initiated by tension, *stress, anxiety, depression or anger* through mental processes.

- *Personality Pattern* – Persons with personality type A are more prone to develop hypertension. Personality is the "integrated organization of the physical and psychological characteristics of an individual, including intelligence, emotionality and social behaviour, in the way that the individual presents himself to others."[41] Type A individuals possess any or all of three characteristics like-
    - Competitive achievement orientation: individuals become very self-critical and strive towards goal with challenge towards accomplishments.
    - Time urgency: Type A individuals often struggle against clock, become impatient with delay or unproductive time, make tight work schedules and try to do more than one thing at a time.
    - Anger or hostility: These individuals become angry quickly and very reluctant to suppress emotions.[42]
- *Alcohol*- High alcohol intake is associated with an increased risk of high BP. It appears that the systolic pressure is raised more than the diastolic.
- Presence of *other diseases*- Those having other diseases like diabetes mellitus, obesity, hormonal disorders, and nephropathies are at higher risk of high BP.
- Environmental factors- *Industrialization and urbanization* are supposed to be associated with more prevalence of high blood pressure in the community. Several environmental pollutants like *lead poisoning* causes rise of BP.
- *Occupational factors*- Work stress like night duties, odd hour or odd-day duties, lack of job satisfaction and poor employment conditions are responsible for hypertension in many settings.[43]

Strategic priorities and philosophy of WHO on Cardiovascular Disease program

NCDs are in an overwhelming majority in the European, American and Western Pacific regions. In the South-East Asia, Africa and Eastern Mediterranean regions NCD prevalence is in transition. Disease burden by NCDs is going to be more significant as public health problem than infectious diseases during the recent years in spite of the reality that in many of these countries communicable diseases are still predominate. Different strategic analyses and studies explained the risk factors responsible for this growing pandemic from different points of view and clearly pointed out the stepwise approaches needed to reduce their impact. World health reports show high blood pressure to be the major contributing factor to most deaths in the world.[44]

WHO Program on Cardiovascular Diseases (CVD) is concerned with prevention, management and monitoring of CVD globally. It aims to develop global strategies to reduce the incidence, morbidity and mortality of CVD through the-

- effective reduction of CVD risk factors and their determinants
- development of cost effective and equitable health care innovations for CVD management
- monitoring of the trends of CVD and their risk factors

WHO identified that majority of CVDs are preventable and controllable. However, millions are dying in middle age. WHO fixed following working policies on key work areas to control CVD risk factors effectively and to reduce the burden of the fast growing cardiovascular disease (CVD) epidemic particularly in developing countries-

- Reduction of major CVD risk factors and their social and economic determinants through community based programmes for integrated prevention of NCDs.
- Development of standards of care and cost-effective case management for CVD
- Global action for capacity building of countries to meet the CVD health care needs
- Developing feasible surveillance methods to assess the pattern and trends of major CVDs and risk factors and to monitor prevention and control initiatives.
- Developing effective inter-country, interregional and global networks and partnerships for concerted global action.[4]

A multi-centre WHO hypertensive study group work in India and Bangladesh identified that health perceptions (health changes are a natural consequence of aging, constructs of acute versus chronic illness), socioeconomic factors (increased dependence, burden of drug costs), reduced physical mobility, attitudes towards pill taking, and a low level of overall general education (particularly health education) possibly contributes to the low level of awareness, treatment and control of hypertension in Bangladesh.[45]

South Asia mainly focuses on communicable diseases and reproductive health issues keeping behind non-communicable diseases. Since the cost of secondary and tertiary healthcare facilities is tremendously high and practically less accessible by the general community, preventive approaches are *gold-standards* for emerging non-communicable epidemics. Focus points for such events are the three prime target areas like diets not healthy, physical inactivity, and usage of tobacco. Pragmatic solutions are combined co-ordinated approaches for screening for these diseases.[46]

Hypertension is a silent ice-berg epidemic. Gradually rising prevalence of high blood pressure is a global concern. Developing countries especially lower middle-class and lower socio-economic income generating communities are threatened to be the worse sufferers in the coming future. Therapeutic care for high blood pressure and cost of the antihypertensive drugs require involvement of huge amount of money and other resources including infrastructure. Treatment cost and social burden (DALY) for hypertensive diseases and their consequences demand primordial or primary prevention. Global research outcome are revealing the facts that hypertension can be halted and its complication can be limited or prevented if proper care is taken at the Prehypertension or stage-I hypertension level. Studies also suggest life style modification from unhealthy to healthy behaviour can limit the disease progress and rather reduce the level of hypertension even sometimes without application of pharmacological products. This reduces the cost of treatment and ensures the better quality of life for the hypertensive patients. Global transition is an important pre-determinant forming the background orchestra upon which blood pressure gradient dances.

Global Transition: Impact on Hypertension

Directionality of the health of the global community is getting an unprecedented transition on different areas like epidemiological, nutritional and demographic. There is sufficient scientific evidence of a broad shift in disease burden from communicable to non-communicables. The majority of deaths (59%) are from NCDs while injuries comprise about 9% and communicable diseases, maternal, perinatal conditions & nutritional deficiencies comprise about 32% of the total morbidity profiles.

At least three broad categories of transition have been experienced during last two centuries which imposed considerable impact on global health, life and survival. These changed the drift of epidemics from communicable to non-communicable diseases everywhere first at the industrialized nations and then the paradigm shifted towards developing world.

Demographic transition

Demographic transition started in developed industrialized nations and ventilated into rest of the world communities. This change in population size and structure affected the demographic cycle of very high birth and mortality (specially infant and maternal mortality) to low rates. Population growth rate was low at the beginning reaching a peak intermediate rise and followed by considerably low by controlled everywhere except certain sub-Saharan nations. Life expectancy at birth has been increased from a global average of 46 years in 1950AD to 66 years in 1998 AD. Age-sex pyramid showed either cylindrical or at least broader tip pattern meaning increment of the aged population in whom prevalence of non-communicable or degenerative diseases are very high. Control of communicable diseases through improved sanitation, hygienic life style yielded another dimension to the morbidity and mortality pattern in the global health and sickness. Thus demographic transition influenced as a contributory factor for rising blood pressure level and also for rising the number of population having high blood pressure.

Economic, Social and Nutritional Transition

Market driven globalization, competitive economic development, rapid industrialization, urban targeted migration of population changed the scenario in neo-developed or developing countries by last few decades. Improving standard or level of living and expansion of the food economics from local to broad-based ones also imposed detrimental effects towards inappropriate dietary pattern and a reduction in physical activities. Traditional local diets rich in fibres, low fat content, and complex carbohydrate has been being replaced by cheap energy-dense micronutrient-poor food with a high content of saturated fats or trans fatty acids, refined carbohydrate and sugar with a high glycaemic index. Such phenomenon of adversely influenced nutritional status of the population by these factors in the developing countries is known as *Nutritional transition*. This transition in dietary pattern has been accompanied by maldistribution of resources between nations and also among communities in any of nations. Digitalization or mechanization of the society and societal resources is also another factor that associated with the nutrition factor. Compromised social ethics and values for marketing and money-making target also changed the food norms of the adult population especially in the developing countries. Change of nutrition pattern has been associated with reduced energy expenditure through agrarian to sedentary life style with advent of motorized transport and labour-saving home and office appliances. Moreover, leisure-time physical activities like sports, gardening, riding or canoeing has given way to physically inactive past time like watching TV, recreation with computer game or alike. Combination of all of these factors caused to increase the prevalence of CVDs including hypertension in the community.

Low socioeconomic condition, unsafe water, poor sanitation, and unprotected sex are some of the familiar but important risk factors for diseases. Alcohol, tobacco, hypertension, and dyslipidaemia specially rise of triglycerides level in the blood are also newer causes of diseases. Combined reductions in tobacco and alcohol use will have enormous importance for the prevention of NCDs and will lead to major health gains that are cost-effective. Malnutrition also plays important role. Particularly undernutrition is to be considered with equal importance like overnutrition. Now in many countries both forms of malnutrition co-exist. Childhood obesity is also a growing problem across the world, with physical inactivity a major factor. These risk factors are believed to operate either independently or through the association between child and adult obesity.

Epidemiologic transition

Global disease pattern, epidemiology and endemicity of sickness pattern are being changed along with the demographic, socio-economic and nutritional changes in the population. There is a progressive shift from predominantly nutrition deficiency or communicable diseases to more degenerative or metabolic chronic disease. Such phenomenon of changing sickness pattern or disease profile is called *epidemiologic transition*. Researchers on NCDs report that in spite of genetic susceptibility as a factor, still appropriate preventive action can alter environment, protect against risk factors and change life expectations. Relatively modest behavioral changes affecting different risk factors can make swift, affordable and dramatic changes in population health. Dietary control is a powerful tool in this regard.[47]

In June 2003 WHO met with other United Nations agencies, to raise issues such as increased collaboration, a raised profile for nutrition and physical activity, and research priorities. In all of these sessions food consumption pattern and habit or scope of physical activity were declared to be the keys to tackle NCDs. However, these behaviours are embedded also in the environment, the community, and in areas such as agriculture and food policies. WHO recommendations support physical activity enhancement to reduce high blood pressure. Global researchers recommended non-pharmacological approaches of lifestyle changes as pre-treatment up to a certain period or co-treatment (with compelling indication) of stage-I hypertension.

Thus reduction of high blood pressure by controlling of the behavioral risk factors, adopting heart healthy diet and life style modification is in conformity to other studies elsewhere. This present study tested the hypothesis in an urban Bangladesh setting for a study period of 18 months with advanced analytical model and percentage contribution of individual risk factors.

Justification/ Rationale of the study

In 1945 AD President Franklin Roosevelt died from inadequate treatment with diet, digitalis and Phenobarbital for severe hypertension and stroke. His death contributed to international attention for proper addressing the magnitude, treatment and consequences of hypertension with immediate result of finding out *reserpine* in 1949 AD and then *hydrochlorothiazide* abandoning *lumber sympathectomy* as the last resort to reduce severe hypertension.[48]

Clinical care of hypertension in most of the time is costly, prolonged and might be exhaustive in many cases. In low or middle-income group families these costs divert the scarce family and societal resources to medical care. In developed countries lower socioeconomic groups have greater prevalence of risk factors, higher incidence of disease and higher mortality. In developing countries as the hypertension epidemic matures the burden will shift to the lower or middle-class socioeconomic groups.[4,49,50]

Globally cardiovascular diseases are the leading causes of mortality amounting about every one-in-three deaths. Every year about 32 million peoples develop heart attacks and stroke with major risk factors like hypertension.[51] Most of the important risk factors of CVD are preventable if screened properly and proper action is taken at primordial or primary level. In early 1920s the disease showed epidemic character in the USA followed by European countries and lastly to touch the developing nations. It has been reported that mega-countries account for over 60% of world-wide people at risk for non-communicable diseases of which CHD is the leading one.[52]

Studies reveal that the prevalence of coronary heart disease is increasing alarmingly from 0.33% to 10% in 27 years.[53]Hypertension is the most important risk factor for CHD prevalence of which is also increasing. Bangladeshi socio-economic scenario is at a transitional state now. Agro based manual physical labor or job pattern are being replaced by more sedentary urban inactive life style depending on more fatty fast foods. Effect of rapid migration and unplanned urbanization resulted in consumption of more tobacco and alcohol. These are the known modifiable risk factors for essential hypertension and also risk factors for coronary vascular diseases or disorders.

According to 22nd edition of 2001 Statistical Year book of Bangladesh, published in 2003, mortality rate due to high blood pressure and heart diseases comprises 5.73% in both sexes (male 6.08%, female 5.33%) in urban Bangladesh.[53]This is really alarming with our limited resources for specialized clinical care for hypertension and heart diseases which is costly, prolonged and inaccessible for most of the peoples divert direct costs to the scarce family and societal resources to medical care. Because of the huge impact of rampant progression of prevalence and catastrophe associated with high blood pressure on the productivity and also on the cost involvement, it is at the central focus of all health strategy planning. In most of the intervention programs they found positive effect of the behavioral risk factor reduction intervention for controlling Prehypertension and stage-I hypertension. Studies in Bangladesh are limited in number. Such limitations in Bangladesh need to be overcome with more comprehensive manner. This study saturated the demand of the society to highlight the positive changes towards healthy life with healthy heart and blood pressure. These are the reasons that this protocol and research venture was accepted.

Hypothesis

Hypothesis-I

Stage-I hypertension can be managed by reducing the behavioural risk factors and life-style modifications.

Hypothesis-II

People with Stage-I hypertension can be reversed to normal blood pressure with non-pharmacological interventions.

Objectives

General objective

The study was conducted to analyze if modification of life style can reduce systemic hypertension and also to quantify the amount of reduction of blood pressure through intervention by reduction of bodyweight, reduced salt intake, increment of physical activity and cessation of smoking in a selected urban community in Dhaka city.

Specific objectives

1. To find out prevalence of high blood pressure among peoples with age more than 18 years
2. To analyze socio-economic and demographic profile of selected respondents with stage-I hypertension in the urban community of Mohammadpur Thana of Dhaka city
3. To intervene stage-I hypertension in terms of reduction of bodyweight in overweight or obese peoples, reduction of extra salt intake, increment of physical activity and cessation of smoking
4. To compare the outcome of risk reduction intervention for hypertension with the baseline data
5. To recommend developing a package to facilitate hypertension risk management by extrapolating the findings in this study.

Conceptual framework

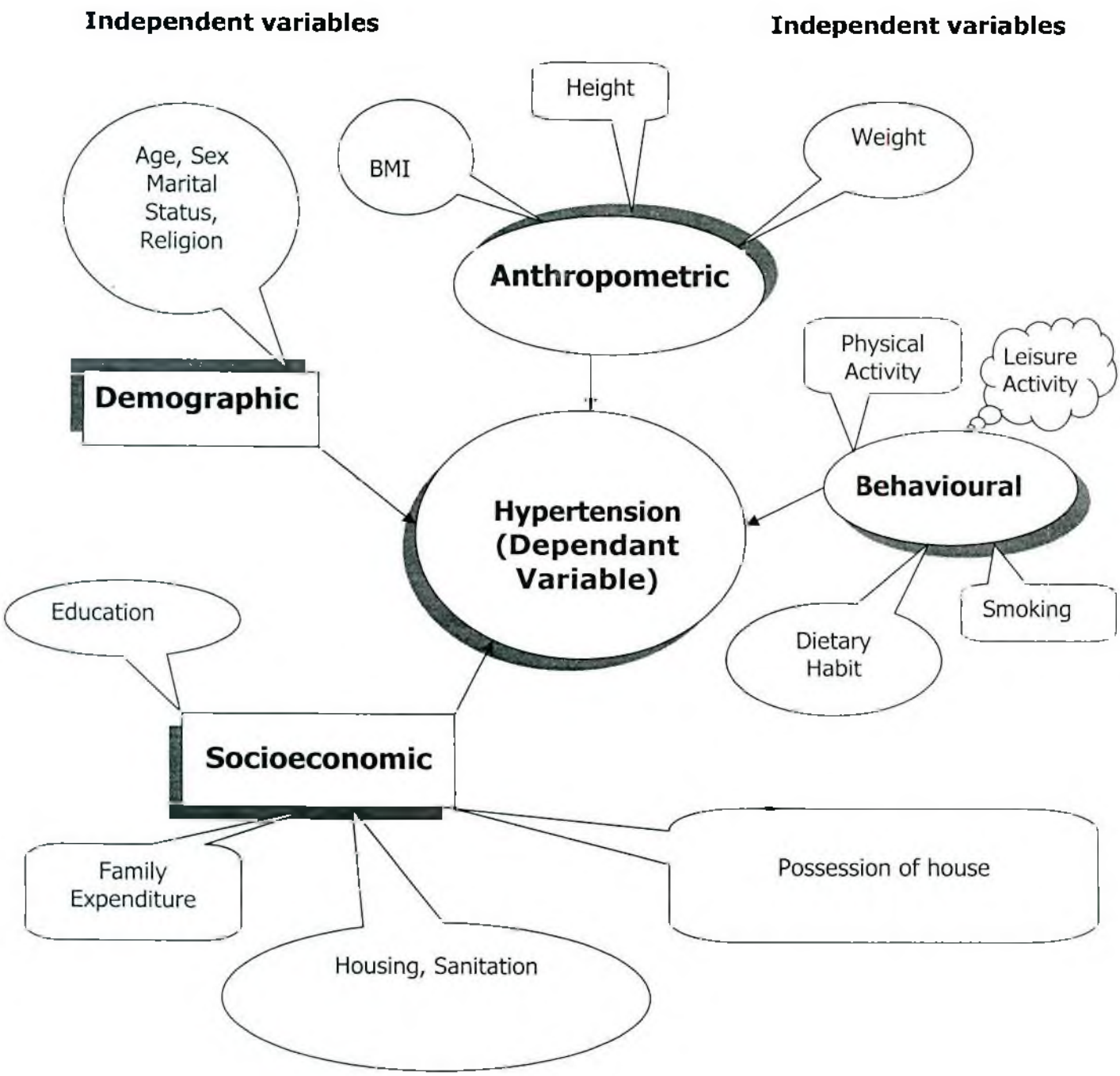


Fig-I Conceptual framework for variables

Key Outcome Variables

Dependent Variable

Blood Pressure

- Systolic Blood Pressure
- Diastolic Blood Pressure

Independent Variable

Anthropometric

- Height
- Weight
- Body Mass Index (BMI)

Demographic

- Age
- Sex
- Marital Status

Behavioral

- Dietary Habit
- Smoking
- Physical Activity – Work time and Leisure time

Socioeconomic status

- Education
- Family Expenditure
- Housing
- Occupation
- Possession of House

Operational Definition

Age

Similar to MONICA data analyses, *age* has been defined as the age in full years on the date of examination. National ID card was the endorsed document. If the year of birth was unknown, the observation was correlated with national or social events and testified with ages of relatives or other family members. If the month was unknown, the day and month were replaced by 30-06. If only the day was unknown, it was replaced by 15.

Marital status

Married means legal wed locked by conventional registration, or social rituals.

Hypertension

Systolic pressure of ≥140 mmHg and/ or diastolic pressure of ≥90 mmHg or patient with antihypertensive medication.

Stage-I hypertension

Systolic pressure of 140-159 mmHg or diastolic pressure of 90-99 mmHg

Treated Hypertension

Respondent reports a prior diagnosis of hypertension and / or use antihypertensive medication.

Control of Hypertension

Systolic pressure of <140 mmHg and diastolic pressure of < 90 mmHg

Physical Activity

Modified Baecke model was followed with average activity more than 10 continuous minutes at sport score, leisure score and work score and WHO approved model of hypertensive group i.e. sedentary, mild level of physical activity and moderate or greater level of physical activity.[54,55,56]

Low CVD risk

Patients under age 60 yrs and having no family history of premature death (<50 yrs) from CVD, no-pregnant mothers, no complicated heart, kidney or liver diseases.[57]

Premature death

That occurs before the age to which the person could have expected to survive if he or she was a member of a standardized model population with a life expectancy at birth equal to that of the world's longest surviving population.[58]

Body Mass Index (BMI)

Body Mass Index (BMI), an index for weight-for-height, is defined as weight in kilograms divided by height in meters squared. Global classification of BMI, with normal range 18.5 to 24.9 kg/m^2, has been considered in this study for universality of the study finding. But the range for acceptable, normal or optimum BMI Asian population has been narrowed to18.5-23 kg/m^2 by WHO expert committee. This was not used in this study.[59]

Stress

Stress is defined as either unpleasant events or issues of external physical and social environment or individual subjective response to threats or challenges arising from that environment.

Limitations of the Study

Community level intervention study is always a challenge for the researchers in developing countries. Repeated Door-to-door data collection and follow-up was a very tedious job. Peoples of this area are mostly outdoor-job oriented. Hence in many cases male adult members were not available at home. On Fridays peoples had guests at their home or they became guests themselves elsewhere while on weekdays they were naturally tired with day long office job and did not expect anybody to share there relax time at home after the office work.

A very difficult variable was the monthly income variable. During pre-test most of the people hesitated to provide any data because of the apprehensive of data transfer to the income tax department. Hence this variable was replaced by annual expenditure variable which was a little bit better.

Data collection regarding tobacco consumption was again a very difficult issue. The reasons varied in different cases. But commonest causes were-

- In Bangladeshi culture, smoking is not taken as a good behaviour and hence many persons normally do not want to share smoking history
- This data were taken at the home settings. Youngsters at home did not admit smoking in front of other members of the family.
- After promulgation of anti-smoking act peoples tried to decline to talk on it scarring any legal connection of this study.

During baseline screening, apparently healthy peoples did not believe rather reacted when identified as hypertensives. They were measured repeatedly at the 'Hypertension Counseling Cell' set at the central part of the study area (1/12, Noorjahan Road, Dhaka-1207) and the whole process of hypertension was explained to them in easy ways.

Waist-Hip ratio measurement is another important variable that the researcher had to exclude from the questionnaire (after pre-testing) because of low and negative respondent compliance during pre-testing. Use of hormonal contraceptives was excluded from the intervention data as persons using contraceptives was not included in the study.

More valid outcome of the study could be expected if '24-hour ambulatory blood pressure monitoring' could be recorded. But there were financial and technical limitations for arranging and working on ambulatory blood pressure monitoring.

The sample size of the study might not hear very big and operated in a single centre but met WHO criteria for intervention study. Another option for a better model would be if a control group could be taken. However, in spite of all the limitations, the study was tried to make epidemiologically more valid and more reliable.

Chapter-II

Literature Review

Grades of Hypertension

Rational staging of blood pressure is very essential to assist early case identification and management before occurrence of any catastrophe. Blood pressure staging considers the risks of hypertension and potentiality of end organ damage. Conventional staging into *mild, moderate and severe* hypertension according to the degree of blood pressure elevation makes less sense if the total scenario is considered. These terms do not truly represent the severity of the overall risk to the patient, rather reflects simply to the extent of the blood pressure elevation at the very time of the assessment. Rate of progression of organ damage like hypertrophy of the cardiac chamber(s), heart failure, retinal changes, disease of arteries, cerebrovascular disorders, and nephropathies varies individually depending upon many still incompletely understood factors. Routine screening for blood pressure, careful ocular examinations, 12 lead ECG tracing, presence of microalbuminuria, elevation of the plasma creatinine concentration and microalbuminuria can indicate organ damage earlier. Echocardiogram (2M/2D) or Colour Doppler may be required in selective cases with borderline findings in ECG. Commonly discussed therapeutic management schedule categorizes hypertension with -

a. no other CVD risk factors and no target organ damage
b. other cardiovascular risk factors
c. evidence of target organ damage
d. other CVD risk factors and evidence of target organ damage.

World Health Organization-International Society of Hypertension Grading

World Health Organization International society of hypertension (WHO-ISH) previously defined hypertension, for diagnostic purposes, as a systolic pressure equal to or greater than 160 mm Hg and/or a diastolic pressure (Phase V) equal to or greater than 95 mmHg. In 1999AD WHO-ISH amended the definition and changed the sensitivity level of the diagnostic criteria for hypertension. WHO-ISH redefined hypertension in adults for a level of systolic blood pressure of 140 mmHg or above and/or a level of diastolic blood pressure of 90 mmHg or above. It is extremely important to confirm the diagnosis by repeated, accurate measurements over a period of time the duration of which is influenced by the perceived risk to the patient. WHO recommended that blood pressure is to be measured at least twice before declaring hypertension. If the difference between the two measurements exceeds more than 10 mmHg, a third measurement is required to confirm the diagnosis.[26] Blood pressure grades are described as-

Table-I : WHO grading of blood pressure for adults (≥ 18 years)

Classification of BP	Systolic BP (mmHg)		Diastolic BP (mmHg)
Optimal Blood Pressure	< 120	and	< 80
Normal Blood Pressure	120-129	and/or	80-84
High Normal Blood Pressure	130-139	Or	85-89
Grade-I Hypertension (Mild)	140-159	Or	90-99
Grade-II Hypertension (Moderate)	160-179	Or	100-109
Grade-III Hypertension (Severe)	≥ 180	and	≥ 110
Isolated Systolic Hypertension	≥ 140		< 90

The seventh report of the Joint National Committee (JNC-7) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure under auspices of the US Department of Health and Human Services has given a new dimension to the classification, category and treatment approach to high blood pressure. In this report a new group Prehypertension has been introduced. This classification refers to the population of 18 years of age or older based on two or more properly measured, seated blood pressure readings on each of two or more settings.[29]

Table-II JNC-7 classification of blood pressure of adults (≥ 18 years)

Classification of BP	Systolic BP (mmHg)		Diastolic BP (mmHg)
Normal	< 120	and	< 80
Prehypertension	120-139	or	80-89
Stage I Hypertension	140-159	or	90-99
Stage II Hypertension	≥ 160	or	≥ 100

Task Force for the Management of Arterial Hypertension of the European Society of Hypertension and of the European Society of Cardiology regularly updates the criteria and grading of hypertension looking care into different parameters. Along with social research findings British Hypertension Society (BHS) also considered the extent or risk of end organ damage and potential risk of the people for grading hypertension. Grades of mild, moderate and severe degree has been still considered in the British classification system. B Williams et al (2004) published article expressing the guideline of BHS with clear descriptions and explanations of many critical issues disputed so far. Setting of clear cut-off values and taking highest level of blood pressure as judgmental value has reduced many confusions. This classification, in true sense, equates ESC/ESH with WHO-ISH classification.[27, 28]

Table III British Hypertension Society classification of blood pressure

Category of Blood Pressure	Systolic BP (mmHg)		Diastolic BP (mmHg)
Optimal Blood Pressure	< 120	and	< 80
Normal Blood Pressure	< 130	and/or	< 85
High Normal Blood Pressure	130-139	and/or	85-89
Grade 1 Hypertension (Mild)	140-159	and/or	90-99
Grade 2 Hypertension (Moderate)	160-179	and/or	100-109
Grade 3 Hypertension (Severe)	≥ 180	and/or	≥ 110
Isolated Systolic Hypertension	≥140	and	< 90

Comparison of Guidelines

Guidelines for management of hypertension are now more clear and user-friendly. However, issues of major agreements and disagreements exist between the recommendations issued by the Joint National Committee (JNC VII) and by the European Society of Hypertension in conjunction with the European Society of Cardiology (ESH/ESC).

Hypertension Guidelines issued by JNC VII and ESH/ESC possesses two dimensions- serving as critically designed well-constructed program components aiming improvement of health outcomes and also to codify best practice behavior by providing a reference point for practitioners and health authorities. These two sets of Guidelines also share many common important theoretical and practical issues. Both the JNC VII and the ESH/ESC guidelines -

- focus on treating high blood pressure to reduce fatal and nonfatal events
- agree on the blood pressure measurement procedure
- recommend ambulatory blood pressure monitoring and home blood pressure readings
- incorporates elements -
    - setting blood pressure targets and thresholds for treatment
    - anti-platelet and lipid-lowering drugs use with antihypertensive treatment
    - follow-up strategies
    - combination drug treatment strategy.

On the other hand a number of major differences exist between the two sets of guidelines like-

- ESH/ESC guidelines are more informative and educational while the JNC VII recommendations are mainly prescriptive
- ESH/ESC Guidelines guarantee a better and more comprehensive evaluation of target organ damage. American recommendations are simpler and less expensive in clinical practice regarding the type of diagnostic procedures but simultaneously less adequate to detect the presence and/or the progression of organ damage
- In JNC guidelines named pre-hypertension as the group unifying previously defined blood pressure categories high-normal and normal. For this state, they recommend non-pharmacologic interventions
- European guidelines value total cardiovascular risk issue as a crucial part of the hypertension diagnosis while American guidelines do not recommend any quantification of it.[60]

Principle of Measurement

Blood pressure is usually measured indirectly with a small, portable instrument called sphygmomanometer (*Sphygmo* in Greek means pulse and a manometer measures pressure). The instrument measures blood pressure using the impulse of pulse beat. It consists of an air pump, a pressure gauge, and a rubber cuff. The instrument registers the blood pressure in units called millimeter of mercury (mm Hg).

The cuff is placed around the upper arm and inflated to block the flow of blood in the brachial artery travelling through the arm. Then the air in the cuff around the arm is gradually released. With deflation of the cuff, the first appearance of pulsation is heard with stethoscope put over the brachial artery. This is the systolic blood pressure. When pulsation sound becomes inaudible through stethoscope, it is called diastolic blood pressure.

Mercury sphygmomanometers are ideal after standard digital devices. Aneroid devices are cheap and portable, but users need to be trained in the auscultatory technique. The aneroid sphygmomanometers need to be calibrated every six months. Regardless of the type of sphygmomanometer used – mercury, aneroid or automated – the inflatable bladder has to be selected to suit the circumference of the arm in which blood pressure is being measured. Inappropriately small bladders will give falsely high readings, and inappropriately large bladders will give falsely low blood pressures. The width of the bladder should be 40% of the arm circumference and the bladder length should encircle at least 80% of the arm.

American Heart Association (AHA)

American Heart Association (AHA) has definite and specific guidelines for measurement of blood pressure. The statement of AHA was approved by the American Heart Association Science Advisory and Coordinating Committee on October 13, 2004 and published in an article in the journals Hypertension and Circulation. The statement described, in detail, different aspects of measuring blood pressure in different settings. AHA prefers electronic devices to measure blood pressure to reduce inter-observer or intra-observer variations. However the auscultatory technique with a trained observer and mercury sphygmomanometer continues to be the mainstay of clinical blood pressure measurement in the office, using the first and fifth phases of the Korotkoff sounds. Traditional 5 phases are-

- Phase-I: appearance of clear tapping sounds corresponding to the appearance of a palpable pulse
- Phase-II: sounds become softer and longer
- Phase-III: sounds become crisper and louder
- Phase-IV: sounds become muffled and softer
- Phase-V: sounds disappear completely.

The use of mercury has been declining because of varieties of environmental health risk reasons. In that case aneroid devices with frequent calibration are suitable alternatives. Aneroid devices are inherently less accurate than mercury sphygmomanometers and require regular calibration.

Hybrid devices that use electronic transducers instead of mercury have promise in the future. The oscillometric method can be used for office measurement. They have the

advantage of being able to take multiple measurements. Proper training of observers, positioning of the patient, and selection of cuff size are all essential. It is increasingly recognized that office measurements correlate poorly with blood pressure measured in other settings, and that they can be supplemented by self-measured readings taken with validated devices at home. There is increasing evidence that home readings predict cardiovascular events and are particularly useful for monitoring the effects of treatment.

Twenty-four-hour ambulatory monitoring gives a better prediction of risk than office measurements and is also useful for diagnosing white-coat hypertension. There is increasing evidence that a failure of blood pressure to fall during the night may be associated with increased risk. In obese patients and children, the use of an appropriate cuff size is of paramount importance. The same recommendation is also applicable for pregnant women. American Heart Association recommendation for reduction of instrumental error is to use the proper cuff size.[61]

Table-IV AHA Recommended Cuff size for BP Machine

Arm circumference (cm)	Cuff size (cm)
22-26	Small adult size (12 x 12)
27-34	Adult size (16x30)
35-44	Large adult size (16x36)
45-52	Adult thigh size (16x42)

British Hypertension Society (BHS)

British Hypertension Society (BHS) clearly prescribed methods for measuring blood pressure in their guidelines. The society guideline gave special emphasis on the validated accuracy of the device to be used for measuring blood pressure. It has to be regularly calibrated with known standards and also has to be maintained properly in all respects. This guideline prefers patients need to be seated comfortably with the pressure measuring arm at the level of heart. The cuff bladder size would be properly adjusted for the arm circumference. During recording of blood pressure the arm cuff has to be deflated at the rate of 2 mm/sec. Blood pressure has to be recorded to the nearest 2 mmHg. Diastolic pressure is measured with disappearance (phase V) of the sounds.[27,28]At least two measurements be made at each of several visits to determine blood pressure thresholds. BHS recommends cuff size for measuring blood pressure in the following manner.[28]

Table-V BHS recommended cuff size for BP Machine

Indication	Bladder Width x Length (cm)	Arm circumference (cm)
Small adult / Child	12 x 18	< 23
Standard Adult	12 x 26	< 33
Large adult	12 x 40	< 50
Adult thigh cuff	20 x 42	< 53

World Health Organization International Society of Hypertension (WHO-ISH)

World Health Organization International Society of Hypertension (WHO-ISH) recommends blood pressure to be recorded on right arm two times after a brief rest of five minutes sitting with legs uncrossed. Arm cuff size specification entails small, medium, large and extra large size for 17-22 mm, 22-32 mm, 32-42 mm, > 42 mm arm circumference respectively.[62]

A good sphymomanometer and a good quality stethoscope are essential for an accurate recording of the Korotkoff sounds using the auscultatory technique.WHO CVD-risk management package encourages digital machines and recommended that mercury sphygmomanometers as reasonably accurate but need regular standardization. If blood pressure is being measured with a mercury sphygmomanometer the observer needs to be trained in the auscultatory technique of blood pressure measurement and assessed for accuracy in the technique. Parameters like observer error, observer bias and terminal digit preference by the observer may cause inaccurate measurements.[4]

Due to issues of environmental toxicity of mercury, some European countries have banned mercury. UK and some others are recommending that mercury sphygmomanometers should not be replaced. In settings where it is considered necessary to continue to use mercury sphygmomanometers special precautions have to be taken in servicing them, in avoiding mercury spills and in ensuring the safe disposal of nonfunctioning devices. Alternatively question of using aneroid blood pressure machine is getting more and more popularity. But use of the aneroid one needs careful maintenance and regular calibration after every day use.

NHS (UK) tips for correct estimation of blood pressure by auscultation

Blood pressure recording recommendation for National Institute of Clinical Excellence in the United Kingdom is very candid and precise. The recording environment is maintained as much patient-friendly as possible with the patient seated relaxed with arm out-stretched and supported in line with mid-sternum. The cuff is then wrapped correctly around the upper arm with an appropriate sized bladder connected to a manometer. Brachial pulse is palpated in the antecubital fossa of that arm. The cuff is inflated rapidly 20 mmHg above disappearance of brachial pulse. The cuff is the deflated and approximate systolic pressure is noted when the pulse re-appears. The cuff is re-inflated 20 mmHg above the point at which the brachial pulse disappears. Stethoscope is placed over the brachial artery with no intervening clothes between skin and cuff. Cuff is slowly deflated at the rate of *2–3 mmHg* per second listening for Korotkoff sounds. For repeating the measurement, deflate the cuff when the sounds disappeared. When possible, readings are taken at the beginning and end of consultations.[31]

There are different schools of thoughts about how many times we have to measure blood pressure. Both British Hypertension Society and WHO-ISH recommended at least two standard measurements of blood pressure before declaring it to be high for any patients. In Netherlands a study was done over 99 outpatients over a period of 7 months. Blood pressure was measured ten times including the initial one among patients with elevated diastolic ($95 \leq$ dBP ≤ 115 mmHg) and/or systolic ($160 \leq$ SBP ≤ 200 mmHg) blood pressure. None of the patients was given anti-hypertensive drug treatment during the study. A significant reduction in systolic (161.0 to 152.5 mmHg) and diastolic (101.5 to 97.1 mmHg) blood pressures ($P < 0.01$) was observed between the first (initial) and second measurements. Analysis revealed that at a threshold value of 95 mmHg patients required only two repeat measurements (misclassification in 7% of cases after four repeat measurements). Of those with initial diastolic blood pressure values between 95 and 105 mmHg, 24% were misclassified after four repeat measurements. The study proposes larger numbers of measurements for borderline diastolic values than are recommended in international guidelines.[63]

WHO- Life course perspective

Poor nutrition at different stages of gestational or fetal life is linked with increased rates of cardiovascular disease and non-insulin-dependent diabetes as adults. Many of these babies may have intrauterine growth retardation, some are small for date, some may be thin at birth, and some fail to gain weight in infancy. When these babies get thicker at adult age they are more prone to suffer from high blood pressure. In addition to low adult socio-economic position, low childhood socio-economic position, too, has often has been found to be associated with higher blood pressure in later life.[64,65] In developing countries, blood pressure patterns are typically assumed and found to show marked rural/urban differences with levels considerably higher in urban populations, and among higher socio-economic groups. CRISIS study (Coronary Risk of Insulin Sensitivity in Indian Subjects) in India found hypertension prevalence to be highest among urban middle class population (12.4%), much lower prevalence in urban slum dwellers (3.8%), and the lowest prevalence in rural populations (2.4%). Evidence from Nigeria, Tanzania and the Gambia, similarly shows significantly higher levels of hypertension in urban compared to rural areas and in the higher socioeconomic groups. In urban China, for example, blood pressure was found to be highest among those with lowest socio-economic positions. In South Africa, similarly, blood pressure levels were not found to simply rise with degree of urbanization. Rather, the highest levels were found among newcomers to cities living in informal settlements. The lowest levels were, in fact, found in the most urbanized group.[51]

Prevalence of Hypertension in North America

Multicentre meta-analysis of surveys in North America and Europe with sample size ranging from 1800 to 23 100 (response rates 87.5%) were analyzed to provide age-specific and age-adjusted estimates of BP and hypertension prevalence. Average BP was found 136/83 mm Hg in the European countries and 127/77 mm Hg in Canada and the United States among men and women combined who were 35 to 74 years of age. In the analysis age and sex-adjusted prevalence of hypertension was 28% in the North American countries at the 140/90 mm Hg threshold.[66]

Hospital Morbidity Database demonstrated that CVD was the leading cause of hospital admissions for men and women (excluding pregnancy and childbirth) in Canada. CVD accounted for about 21% of all hospital admissions of Canadian women over the age of 50 in 1999, and rates among older women were still higher. High blood pressure is an independent risk factor for CVD in women. Both in women and men mean blood pressure increases with age till age 65 after that high blood pressure is more common in Canadian women than Canadian men. Over one-third of post-menopausal Canadian women have hypertension. After intervention women tend to respond more than men in respect of control.[67]

In another report it was mentioned that hypertension affected more than 20% of all Canadian adults. Management of hypertension remains sub-optimal despite the evidence that lowering blood pressure lowers the risk of cardiovascular events and death. There is inconsistent application of the clinical trial evidence and substantial inter-physician variability in the initial management of individuals with hypertension.[68]

UK prevalence study

United Kingdom National Health Survey of 1998 for England depicted estimates that about 37% of adults over 16 years of age had a blood pressure (BP) of more than 140/90 mmHg. Studying with a sub-set of 738 confirmed cases, prevalence was 11.7% for all ages, 14.4% for those aged more than 16 years, and 46% in those over 65 years of age. The sub-survey coined a new term 'potential' hypertension with some 442 patients who had their last blood pressure measurement being greater than 140/90 mmHg but inadequate follow-up could not conclude.[69]

National Health Survey 2006 showed the prevalence of high blood pressure to be 33.5% among male and 28.8% among females. Proportion with high blood pressure is similar among men but decreased among women compared with scenario at 2003 (34.3% to 33.5% among male Vs 30.1% to 28.8% among female). Proportion of untreated hypertensives decreased from 2003 to 2006 (22.6% to 20.4% among male and 16.5% to 13.8% among female) while proportion of controlled hypertension increased for both sexes (5.2% to 6.4% in male Vs 5.6% to 7.6% in female).[70]

Greek study for prevalence

The Greek study was done by Psaltopoulou et al (2004) on 26,913 volunteers, aged 20–86 years, from several regions of Greece with the hypothesis that premature mortality from cardiovascular diseases could be prevented by the effective control of hypertension in the context of the Greek component of the European Prospective Investigation into Cancer and nutrition (EPIC). After modeling data through multiple regression analyses prevalence of hypertension (based on two arterial blood pressure measurements on a single occasion) was found 40.2% for men and 38.9% for women (age-adjusted to the adult Greek population of

2001). Awareness among hypertensives was found to be 54.4%, pharmaceutical treatment among those aware was 83.9%, and effective control among hypertensives was 15.2%. Prevalence of hypertension increased with age and was higher in rural areas and among individuals of lower education.[71]

Czeck prevalence study

Bobak et al (1999) conducted a cross-sectional survey among randomly selected 1,141 men and 1,212 women (overall response rate 75%) in six former communist Czech Republic districts to analyze the presence and magnitude of the socioeconomic gradient in cardiovascular risk factors (participating in the MONICA study). Two indicators of SES were used- education and material conditions (the indicator constructed from car ownership and crowding). Linear regression analysis depicted the relation between SES and total and high-density lipoprotein (HDL) cholesterol, body mass index (BMI), and waist-hip ratio (WHR). Logistic regression was used to assess the association between SES and smoking and hypertension. In mutually adjusted analyses, educational gradients persisted but associations with material conditions disappeared or became substantially weaker. The magnitude of the educational differences was similar to those found in western countries.[18]

Brazil study

Fuchs et al (2001) conducted a cross-sectional study on a 1,174 multi-stage representative sample among adult urban population of Porto Alegre, from 1996 to 1998 to find out prevalence of systemic hypertension. Initially the boroughs of Porto Alegre were listed with their population estimated by the Instituto Brasileiro de Geografia e Estatística (IBGE - Brazilian Institute of Geography and Statistics). The individuals who should be included in each borough were randomly picked, and their number was proportional to the size of the borough. The census sectors of each borough were listed and the conglomerates taking part in the study were randomly picked. Each census sector was visited to check the distribution of dwellings, presence of hotels, hospitals, headquarters, or commercial facilities. Dwellings were selected in a systematic manner i.e. the first dwelling was randomly picked and then, following a clockwise direction, one after 10 dwellings was identified. In each dwelling, all individuals >18 years of age were considered eligible. The resulting sample comprised 488 dwellings distributed in 27 census sectors of the IBGE. To calculate the size of the sample, 1 million individuals >18 years of age were considered part of the population: estimating that 14% of this population had high blood pressure levels.[72]

South African study

The Mamre Hypertension Project in the Western Cape, South Africa was done to collect baseline information on the prevalence of hypertension and other cardiovascular disease risk factors in a rural community. The age-adjusted prevalence of hypertension was 13.9% in men and 16.3% in women in people aged 15 years or more. Of the hypertensive subjects, 27% were not aware of their hypertension, a further 14.4% were not on treatment, and only 16.8% had their blood pressure (BP) controlled below 140/90 mm Hg. The survey results was used to assess the impact of the intervention programme using a before and after design. The intervention program comprised a BP station catering primarily for people with hypertension, and a health education and promotion program directed at the general community. The BP station screened for hypertension, monitored BP and compliance with medication in hypertensives, and encouraged risk factor modification. Health promotion activities included a smoking cessation group and a weight reduction and exercise group.[73]

Egyptian study

Ibrahim et al (1995) reported, from the Egyptian National Hypertension Project, a national estimate of 26.3% prevalence of hypertension (≥ 140/90 mmHg) among 6,733 adults (85% response rate). The study was conducted among peoples ≥ 25 years of age conducted in six Egyptian governorates using stratified multistage probability design. Hypertension prevalence increased progressively with age, from 7.8% in 25- to 34-year-olds to 56.6% in those 75 years or older. Hypertension was slightly more common in women than in men

(26.9% versus 25.7%, respectively). Overall, 37.5% of hypertensive individuals were aware about their high blood pressure, 23.9% were under medications, and 8.0% were controlled (<140/90 mm Hg). Hypertension prevalence as well as awareness, treatment, and control rates varied by region, with Cairo having the highest prevalence (31.0%) and the Coastal Region having the highest control rate (15.9%). Result indicated that hypertension was highly prevalent in Egypt and that the rates of hypertension awareness, treatment, and control were relatively low. These findings argued for a nationwide effort to prevent and control high blood pressure in Egypt in order to avert an epidemic of cardiovascular disease.[74]

Study in Sub-Saharan Africa

Cappuccio et al (2004) assessed prevalence, detection, management, and control of hypertension among 1,013 (385 male 628 women), aged 55±11 years, living in 12 villages in Ashanti, Ghana with a prevalence of 28.7% hypertension (≥140 / ≥90 mm Hg). Of the study peoples, 532 lived in semi-urban and 481 in rural villages. The participants underwent measurements of height, weight, and blood pressure (BP) and answered a detailed questionnaire. Women were heavier than men. Participants in semi-urban areas were heavier and had higher BP (129/76 [26/14] versus 121/72 [25/13] mm Hg; $P<0.001$ for both) than in rural areas. Detection rate was lower in men than women (13.9% versus 27.3%; $P=0.007$). Treatment and control rates were low in both groups (7.8% and 4.4% versus 13.6% and 1.7%). Detection, treatment, and control rates were higher in semi-urban (25.7%, 14.3%, and 3.4%) than in rural villages (16.4%, 6.9%, and 1.7%). [75]

Study in Tanzania

Edwards et al (2000) conducted a two-linked cross-sectional population-based survey on 770 adults (> 15 years) in Ilala and 928 adults in Shari (two middle-income group areas of Tanzania) to reveal hypertension (≥140 / ≥90 mm Hg) prevalence as 30% (95% CI) in men and 28.6% in women in Ilala, and 32.2% in men and 31.5% in women in Shari. Age-standardized hypertension prevalence was 37.3% among men and 39.1% in women in Illala, and 26.3% in men and 27.4% in women in Shari. The study revealed that under 20% of hypertensive subjects were aware of their diagnosis, approximately 10% reported receiving treatment and less than 1% were controlled (BP < 140/90 mmHg).[76]

Chinese Study for Prevalence

Gu et al (2002) conducted on 15,540 adult populations in China, age 35 to 74 years, during 2000–2001 using the multistage cluster sampling method to estimate the prevalence and distribution of hypertension and to determine the status of hypertension awareness, treatment, and control. Blood pressure was measured by trained observers in 03 sessions using a standardized mercury sphygmomanometer after a 5-minute sitting rest. About 27.2% of the Chinese adult population aged 35 to 74 years (representing 129,824,000 persons) had hypertension (≥ 140/90mmHg). The age-specific prevalence of hypertension was 17.4%, 28.2%, 40.7%, and 47.3% in men and 9.7%, 26.8%, 38.9%, and 50.2% in women age 35 to 44 years, 45 to 54 years, 55 to 64 years, and 65 to 74 years, respectively. Among hypertensive patients, 44.7% were aware of their high blood pressure, 28.2% were taking antihypertensive medication, and 8.1% achieved blood pressure control (<140/90 mm Hg).[77]

Study in Pakistan

The National Health Survey of Pakistan (NHSP) conducted during 1990 to 1994 highlighted the magnitude of the burden of hypertension (adapted to ≥ 140/90 mmHg) in Pakistan. Hypertension was shown to affect 18% of adults > 15 years and 33% of adults >45 years; however, < 3% had their BP controlled to 140/90 mm Hg or below.[78]

Another cross sectional survey, through multi-stage sampling, was done in a low-income community in Karachi among 857 adult subjects (mean age 35.14 years) in 405 households between April and September 2002 to assess the prevalence of hypertension. The

overall prevalence of hypertension was 26% (males 34%; females 24%). Fifty-eight percent of hypertensives were unaware of their hypertension. Hypertension was 1.7 times more common among males then females. Age analysis revealed that the prevalence of hypertension increased with age and hypertensive subjects were 5.6 times more likely to be over 35 years of age. The survey results indicated high prevalence and poor control of hypertension in the community.[79]

Study in Saudi Arabia

Abolfotouh MA et al (1996) studied on 3,969 subjects (target population 4769; response rate 83.2%) to find 442 cases of hypertension 11.1%. Among hypertensives 104 (23.5%) had been previously diagnosed with positive history and 338 (76.5%) were newly diagnosed by the blood pressure measurement during the survey. The male-female ratio was higher, though not significantly, among the newly diagnosed cases (1.2:1) than among the previously known cases (1:1.3). The newly diagnosed cases were significantly younger (mean age = 33.5 ± 15.8 years) than those previously diagnosed (53.5 ± 16.2 years). With regard to blood pressure measurements, a significantly higher mean SBP was detected for the previously diagnosed cases (150.8 ± 23.5 mmHg) than that for the newly diagnosed cases (141.5 ± 18.2 mmHg). Non-response was higher among men (19.9%) than among women (13.5%) and was mostly among students attending school in nearby cities who were not available at the time of the survey.[80]

About prevalence of hypertension quite a large number of studies were done in India in different time and geographical settings. Chopra (1942) performed one of the earliest studies in the general population. Since then a number of studies have been published. Three serial epidemiological studies during 1994, 2001 and 2003 (Criteria:≥ 140/90 mm of Hg) to demonstrate rising prevalence of hypertension (30%, 36%, and 51% respectively among males and 34%, 38% and 51% among females) in Jaipur. Hazarika et al (2002) reported 61% prevalence (criteria: =JNC VI) among adults aged ≥30 years in Assam.[81] Another study in 2000AD among the ≥ 40 year urban Chennai population reported a higher prevalence of hypertension (54%) among low income group (monthly income < Rs 30000/annum and 40% prevalence among high-income group (monthly income > Rs 60000/annum).[82]

Indian Database for hypertension has been published for general use after searching the MEDLINE, EMBASE and INDMED databases from 1940-2005, to obtain prevalence studies on hypertension in Indian population. The Sentinel Surveillance Project in India documented 28% overall prevalence of hypertension (JNC VI) from 10 regions of the country in the age group 20-69 years. According to the database Dubey (1954) carried out one of the earliest study amongst industrial workers of Kanpur, and reported a 4% prevalence of hypertension (≥160/95). Wasir et al (1984) reported 3% prevalence of hypertension (≥160/95) in Delhi. Gopinath and Chadha et al reported the prevalence of hypertension in Delhi (criteria: >=160/90) to be 11% among males and 12% among females in the urban areas and 4% and 3% respectively in rural areas during 1984-87. Another 2 studies (1994-95) demonstrated 4.5% prevalence of hypertension (JNC V criteria) in rural Haryana while

ICMR (1994) fostered a study involving 5,537 individuals (3050 urban; 2487 rural) to find out 25% and 29% prevalence of hypertension (≥140/90 mmHg) among males and females respectively in urban Delhi and 13% and 10% in rural Haryana.[83]

Bharucha et al (2003) conducted a study among 2,879 (response rate 84%) subjects of the Parsi community living in Bombay with age ≥ 20 years through 1 in 4 systematic random sampling technique. The overall prevalence of hypertension (≥ 140/90 mmHg) was 36.4%, of whom 48.5% were unaware of their hypertensive status. Of those aware of having high blood pressure, 36.4% were non-compliant with their anti-hypertensive drugs and only 13.6% had optimally controlled hypertension. The study highlighted the need for regular screening coupled with educational programs to detect and optimally treat HTN in the community.[84]

A multicentre study, at five study sites, was conducted by WHO hypertension group on 1,203 individuals aged > 60 years in India and Bangladesh. Independent variables were residence (rural or urban), educational level, marital status, smoking, physical activity, diabetes mellitus, and BMI. The study sample was lean (mean BMI 20.8+ 4.6), with women having a significantly higher body mass than men. The majority of participants were aged <70 years, but 14% were over 80 years of age. Most study subjects were literate, though only about 15% reported having had received 10 years school education. Two-thirds of the subjects reported a sedentary life style.

The overall prevalence of hypertension was 65% (95% CI = 62– 67%). There were 777 subjects (333 men and 444 women) with hypertension according to WHO–ISH/ JNC–VI criteria. Using the older criteria for hypertension, i.e. sBP > 160 mm Hg, and/or dBP > 95 mmHg, and/or use of antihypertensive medications, the prevalence of hypertension was 47% (95% CI = 44–49%; 230 men and 330 women).

The distribution of blood pressure grades was similar for men and women, but varied among the different study sites. Only 12.1 % of study subjects had optimal blood pressure, with the urban areas having a lower prevalence of such individuals than the rural sites. A total of 13.1% of subjects had high normal blood pressure, with the highest proportion being noted in rural Kerala. Approximately 30% study subjects had mild raised blood pressure (grade 1), and almost the same proportion had stage II or higher levels of hypertension, with the highest proportion being observed in urban Dhaka.

Results of multivariable logistic regression models found that higher BMI, self-reported diabetes mellitus and a higher education level (5 10 years of schooling) were associated with increased odds of being hypertensive. Factors associated with lower odds of being hypertensive included self-reported physical activity (mild or moderate level), rural residence and a history of current smoking. Sex, age, and marital status were not correlated with the prevalence of hypertension. Only 45% of the hypertensive subjects were aware of their high blood pressure status and only about 10% of hypertensive subjects were having their blood pressure controlled according to JNC–VI recommendations. Analyses demonstrated that women were more aware of their hypertensive status. In addition, 7% of all hypertensives (and 18% of treated hypertensives) had blood pressure levels indicative of severe hypertension (sBP > 180 mmHg or dBP > 110 mmHg). Elderly hypertensive individuals in rural Kerala demonstrated a greater awareness of their condition and were more likely to be treated than their counterparts in rural Dhaka.

A higher education level (adjusted OR = 3.1), and female (adjusted OR = 1.8) were positively associated with increased awareness of hypertension. Age or place of residence (urban versus rural) did not influence awareness of hypertension. The association of hypertension with BMI, diabetes mellitus, and physical activity has been reported. Factors that may contribute to a better degree of hypertension control in Kerala (relative to other study sites) are probably the same as those responsible for the general good level of health in this state, i.e., high female literacy, universal access to health care, and a high utilization of health care facilities.[45]

Several studies were done by researchers Haque, Ali, Islam, and Malik in different perspective and geographical locations in different times to find out the magnitude of CVD in Bangladesh.[5-8]Wali Ullah (1976) conducted a research on 1,177 students and staff of Agricultural University Mymensingh, Mymensingh Medical College and different jute mills in Mymensingh. Casual blood pressure of the subjects was measured. The study subjects were above 20 years of age. Prevalence of hypertension was 2.3% among them.[9]

Islam (1979) studied on 8,291 fixed community population in Dhaka Secretariat with 8,172 samples. They found the prevalence of 13.3% having diastolic blood pressure of 90 mmHg or more.[10] A renowned study in Bangladesh, Dasherkandi project, by Chowdhury et al (2001) found a prevalence of 5.3% hypertension among 663 respondents (response rate 67.5%) non-adjusted for age.[11]

In a preliminary survey, Islam (1983) studied 5,026 samples comprising 75% of the total population in a rural area. They described the prevalence of 6.7% hypertensives in rural Bangladesh.[12]

Begum et al (1984) published an article in JOPSOM, Dhaka describing hypertension prevalence study on 1,119 peoples of Dhamrai Upazilla Health Complex, 5,026 peoples at Tongi Health Complex and 7,972 peoples at Mohakhali area. They found the prevalence of hypertension to be 7.1%, 6.7% and 13.7% in these areas respectively.[13]

In Bangladesh Karim et al (July 2004) studied the prevalence of hypertension among 230 low-income group (Fourth class) employees of or their family members Dhaka Medical College and Hospital campus. The study was done during the period May to June 2000. The

mean age of the respondents was 31.62 years. The overall prevalence of hypertension (Blood Pressure more than 140/90 mm Hg) was found to be 13.04%. In 15.65% people isolated diastolic blood pressure was above 90 mmHg. About 91.3% hypertensives did not practice physical exercise, 8.64% took extra table salt during meal and 36% of respondents were found to be habituated with betel leaf and chewing tobacco. About 73.91% peoples were found to be suffered from different grades of anxiety and tension.[85]

Haque and Ali et al (2008) conducted a cross-sectional survey on 2,625 subjects (male 1,277; 48.6% and female 1,348; 51.4%) between May 2007 and November in urban Dhaka. Mean age of the respondents was 35.8 ± 12.7 years with mean weight 60.7 ± 11.3 kg and BMI 23.2 ± 3.9 kg/m^2. Mean systolic blood pressure was 122.9 ± 16.1 mmHg and mean diastolic blood pressure was 79.1 ± 10.3 mmHg. About 23.8%people were found to have hypertension (5.8% stage II hypertension and 18% stage I hypertension or with medication) according to JNC-7 criteria.[15]

A cross-sectional study was conducted by Alamgir et al (2004-2005) among randomly selected 493 peoples of aged 18-64 years to find the mean Blood Pressure of the community to be 124/80 mmHg. Prevalence of hypertension was 27.6% according to JNC-7. Mean body weight of the whole study subject was 60.6 ± 11.3 kg while mean height was 161.5 cm ± 8.7. Mean body mass index (BMI) was 23.23. Prevalence of smoking tobacco was 13.8% (n=68) with total tobacco consumption of 25.8%. Blood pressure was found to relate with increasing age (r^2 =0.108). Blood pressure was found to rise with increment of body weight (sBP r^2 = 0.021, p= 0.001 and for dBP r^2 = 0.044, p <0.001). BMI and high blood pressure were related significantly (χ^2 29.926, p< 0.001). Quantity of tobacco intake less affected blood pressure to rise (r^2=0.022 for SBP and r^2=0.042 for DBP, p< 0.001).[86]

Lifestyle modification- WHO-ISH recommendation

WHO-ISH recommended certain universal guidelines in 2003 where importance has been given on lifestyle modification unanimously for every individual for management of hypertension. In different clinical trials lifestyle modifications, weight loss in the overweight, physical activity, moderation of alcohol intake, diet with increased fresh fruit and vegetables and reduced saturated fat content, reduction of dietary salt intake, and increased dietary potassium intake, have been shown to lower BP and to reduce the incidence of hypertension.

The overall antihypertensive effect of lifestyle interventions varied with the patient's adherence to therapy. When adherence is optimal, systolic blood pressure has been reduced by more than 10 mmHg. Trials to evaluate the effects of lifestyle interventions on levels of blood pressure have not been designed or powered to evaluate reductions in overall or cardiovascular mortality or morbidity.

In addition to their possible influence on blood pressure, observational studies have found that other lifestyle modifications, in particular cessation of smoking reduce cardiovascular disease mortality. Furthermore, unlike drug therapy, which may cause adverse effects and reduce the quality of life in some patients, non-pharmacological therapy has no known harmful effects, rather it improves the sense of well-being of the patient and is often less expensive.[87]

USA Joint National Committee-7th: Report 2003

All the authorized schools of hypertension study recommends life style and behavioural risk factor intervention as the first step intervention before and along with application of pharmacological preparation for intercepting progress of the sequelae of high blood pressure. Joint national commission recommends intervention like-

Table-VI Recommended approach to manage BP in adults (≥ 18 years) [adopting JNC-7]

Classification of High BP	Systolic BP (mmHg)		Diastolic BP (mmHg)	Lifestyle Modification	Drugs Usage
Normal	< 120	And	< 80	Encourage	
Prehypertension	120-139	Or	80-89	Yes	Compelling indication
Stage I Hypertension	140-159	Or	90-99	Yes	Compelling indication
Stage II Hypertension	≥ 160	Or	≥ 100	Yes	2-drugs for most

JNC-7 categorically describes the positive beneficial effects of lifestyle modification for reducing blood pressure and thus decreasing cardiovascular risks in hypertensive patients. Major events of lifestyle modifications related to reduction of blood pressure are reduction of body weight in overweight or obese individuals, adaptation with recommended Dietary Approaches to Stop Hypertension eating plan as per locally available prudent diet rich in potassium and calcium, reduction of dietary sodium intake, increment of physical activity, and moderation of alcohol consumption.[28]

JNC-7 report also highlighted study results in favour of quantitative reversal of blood pressure with reduction of extra body weight through dietary control in conformity to the Dietary Approach to Stop Hypertension regime (Table-VII).

Table- VII Recommended Lifestyle modification to manage hypertension (from JNC-7)

Modification	Recommendation	Approxiamate sBP reduction
Weight reduction	Maintain normal body weight (BMI 18.5 – 24.9)	5-20 mmHg/ 10 kg weight loss
Adopt DASH eating plan	Consume a diet rich in fruits, vegetables and low-fat dairy products with a reduced content of saturated and total fat	8-14 mmHg
Dietary sodium reduction	Reduce dietary sodium intake to no more than 100mEq/L (2.4g sodium or 6g sodium chloride)	2-8 mmHg
Physical activity	Engage in regular aerobic activity such as brisk walking (at least 30 min/day, most days of the week)	4-9 mmHg
Moderation of Alcohol	Limit consumption to no more than 2 drinks/day (1 oz or 30 mL ethanol [e.g. 24 oz beer, 10 oz wine or 3 oz 80-proof whiskey]) in most men and no more tan 1 drink/day by women and lighter-weight men	2-4 mmHg

In all cases cessation of smoking is recommended because of its multi-organ ill-effects.

British National Institute for Clinical Excellence (NICE) of United Kingdom

British National Institute for Clinical Excellence (NICE) of United Kingdom National Health Services published Clinical Guideline 18-Hypertension to provide a uniform, effective and efficient care to patients. The guidelines aimed at reduction of CVD complications. It encourages healthy, low-calorie diets for hypertensive patients and thus about 5-6 mmHg of systolic and diastolic blood pressure could be reduced in trials. Almost 40% of patients were estimated to be able to reduce systolic blood pressure of 10 mmHg or more in the short-term period of 1 year. Multiple lifestyle interventions were estimated to achieve a reduction in systolic blood pressure of 10 mmHg or more in the short term, up to 1 year in about 25% trial peoples. The guideline recommends that a healthier lifestyle may reduce, delay or remove the need for long term drug therapy in certain proportion of patients by lowering blood pressure and thus reducing risk of cardiovascular diseases.[31]

British Hypertension Society

British Hypertension Society guideline for hypertension management describes clearly about the pattern of hypertension case management with also the predicted outcome and further intervention strategies. The guideline recommends non-pharmacological advice to all hypertensive people. This measure may delay or remove the need for drug treatment or at least reduce the dose or number of pharmacological preparations to control blood pressure. Such measure is recommended to continue during the initial 4-6 month period in patients with mild (stage-I) hypertension but with no complication or end organ damage. Good evidence from trials shows lowering of blood pressure with such lifestyle modifications.[24,25]

Aucott (2005) conducted a systematic review of literature published from 1966 to 2001 including all prospective studies and trials, performed on participants with body mass index of ≥28 kg/m^2 with a follow-up of >2 years and weight changes recorded. Their analysis model suggested an expectation of - 4.6 / -6.0 mm Hg change in systolic/ diastolic blood pressure for every 10 kg weight loss, about half of that predicted from the short-term trials. He concluded that initial blood pressure, the length of follow-up, medication changes, and physiological restrictions contribute to this reduced effect in the long-term studies on complex weight/hypertension relationship.[88]

Jamaican Study for six month

Duff EM and Wilks R (2003) conducted a study over 80 patients having high blood pressure (>140/90mmHg) in January 1999 at the Specialist Hypertension Clinic, the University Hospital of the West Indies to assess the long term impact of educational and monitoring intervention on blood pressure control. Forty-two of the hypertensives attended the monthly educational and monitoring intervention for six months, in addition to their usual care. Other 38 (controls) attended only one educational intervention at the end of 6 months. One year later, patients were traced by telephone or clinic attendance. Data were collected on 73 (91%) patients, 40 (95%) cases; 33 (87%) controls, by clinic records or by direct measurement of blood pressure and weight. Three (7.5%) cases and 2 (6%) controls died. One (2.5%) case and 5 (15%) controls had been referred to renal or cardiac clinics. Twenty five (59.5%) cases, and 14 (36.8%) controls were still attending the clinic. At the end of 1 year, 26% (7/27) of the cases and 30% (6/20) of the controls had blood pressure (BP) controlled (<140/90 mmHg). At the end of one year, neither cases nor controls showed significant mean changes in BP, weight, nor body mass index (BMI).[32]

Lifestyle modification- American Heart Association model

Lifestyle modification refers to certain specific recommendations for changes in dietary habit and doing exercise. Such modifications can lower the blood pressure as well as improve the patients' wellbeing and response to blood pressure medications. Dietary changes include restricting salt, planning healthy diet, and avoiding excess alcohol intake.

The American Heart Association recommends that the consumption of dietary salt should be less than 6 grams of salt per day in the general population and a lower level (for example, less than 4 grams) for people with hypertension. To achieve a diet containing less than 4 grams of salt, a person should not add salt to their food or cooking. Also, the amount of natural salt in the diet can be reasonably estimated from the labeling information provided with most purchased foods.[30,66]

Lifestyle modification- Dietary Patterns on Blood Pressure (DASH)-11 week study

Appel LJ et al (1997) assessed the effects of dietary patterns on blood pressure in their clinical trial on Dietary Approaches to Stop Hypertension over 459 adults with systolic blood pressures of less than 160 mm Hg and diastolic blood pressures of 80 to 95 mm Hg with the assumption that that obesity, sodium intake, and alcohol consumption influence blood pressure. Mean systolic and diastolic blood pressures were 131.3±10.8 mm Hg and 84.7±4.7 mm Hg respectively at the beginning.

For 3 weeks, the subjects were fed a control diet low in fruits, vegetables, and dairy products, with a fat content. They were then randomly assigned to intake for eight weeks the control diet, a diet rich in fruits and vegetables, or a combination diet rich in fruits, vegetables, low-fat dairy products with reduced saturated and total fat. Sodium intake was maintained at constant levels. Among the 133 subjects with hypertension (sBP ≥140 mm Hg

and/ dBP ≥90 mm Hg), the combination diet reduced systolic and diastolic blood pressure by *11.4 and 5.5 mm* Hg more respectively, than the control diet (P<0.001 for each). On the other hand among the 326 subjects without hypertension, the corresponding reductions were 3.5 mm Hg (P<0.001) and 2.1 mm Hg (P = 0.003).[16,89]

Appel LJ also studied for 11 weeks on the impact of DASH dietary pattern on BP in a randomized, controlled feeding among 459 individuals with dBP 80 to 95 mm Hg and sBP <160 mm Hg. Thus, the trial included individuals with prehypertension (71%) as well as those with stage 1 hypertension (29%). The study found that DASH dietary pattern reduced sBP by 5.5 mm Hg and dBP by 3.0 mm Hg. Fruits-and-vegetables diet reduced systolic blood pressure by 2.8 mm Hg more (P<0.001) and diastolic blood pressure by 1.1 mm Hg more (P=0.07) than the control diet.[16,89] In the participants with prehypertension, corresponding reductions were 3.5 mm Hg (*P*<0.001) and 2.1 mm Hg (*P*=0.003). The BP-lowering effect of DASH in prehypertension was confirmed in the DASH sodium trial and the PREMIER trial. Overall, prehypertension was reduced to normal BP in 62% of study participants eating the DASH dietary pattern.[90]

PREMIER 6m Intervention Study - Duke Hypertension Centre, Durham, NC, USA

Duke Hypertension Centre, the Sarah W Stedman Nutrition and Metabolism Centre along with Duke University Medical Centre at Durham, NC, USA conducted intervention studies on 810 individuals to find Dietary Approaches to Stop Hypertension (DASH) plan effective to lower BP. This study emphasized lifestyle modification, including weight loss, reduced sodium intake, increased physical activity, and limited alcohol consumption to control high blood pressure.

The PREMIER randomized trial for 6 month tested multicomponent lifestyle interventions on blood pressure in demographic and clinical subgroups. Participants with above-optimal BP through stage-I hypertension were randomized to an Advice Only group or one of two behavioural interventions that implement established recommendations (Est) or established recommendations plus DASH diet (Est plus DASH). The study population was 810 individuals with an average age of 50 years comprising 62% women, 34% African American (AA), 95% overweight/obese, and 38% hypertensive. Participants in all the three groups made lifestyle changes. Mean net reductions in systolic sBP in the Est intervention were 1.2 mmHg in AA women, 6.0 in AA men, 4.5 in non-AA women, and 4.2 in non-AA men. The mean effects of the Est Plus DASH intervention were 2.1, 4.6, 4.2, and 5.7 mmHg in the four race-sex subgroups, respectively. BP changes were consistently greater in hypertensives than in nonhypertensives, although interaction tests were nonsignificant.[17,90]

STEPS for life style modification intervention

Life style modification has been found effective by researchers of Department of Community and Family Medicine in the University of Missouri- Kensas City, USA for the prevention and treatment of hypertension.[21]

Life style modification can reduce the blood pressure by observing certain steps. The intervention can be given by ascertaining patients' diet and exercise patterns because a healthy diet and regular exercise can reduce blood pressure. Appropriate guidance and written or audiovisual materials are offered to promote lifestyle changes. Education about lifestyle on its own is unlikely to be effective.

- In overweight individuals with raised blood pressure, healthy low-calorie diets was found to reduce blood pressure on average by about 5-6 mmHg in trials. About 40% patients could achieve systolic blood pressure reduction ≥ 10 mmHg up to 1 year.
- Doing aerobic exercise like brisk walking, jogging or cycling for 30–60 minutes 3 to 5 times a week can reduce 2–3 mmHg blood pressure. About 30% of patients could achieve systolic blood pressure reduction ≥ 10 mmHg up to 1 year.
- Combined exercise and diet reduced 4–5 mmHg blood pressure in trials. About 25% of patients receiving multiple lifestyle interventions could achieve systolic blood pressure reduction ≥ 10 mmHg up to 1 year
- Relaxation therapies could reduce blood pressure and individual patients may like to adapt these as part of their treatment.

NICE guideline - Hypertension include: stress management, meditation, cognitive therapies, muscle relaxation and biofeedback.

Non-pharmacological lifestyle modification interventions, to reduce stress and promote relaxation, had a modest effect on blood pressure, reducing systolic and diastolic blood pressure on average by about 3–4 mmHg. About one-third of patients receiving relaxation therapies were estimated to achieve a reduction in systolic blood pressure of 10 mmHg systolic or more in the short term, up to 1 year.

NICE Guide-1: Ascertains patients' alcohol consumption and encourages a reduced intake -

- *Excessive alcohol consumption* (men >21 units/week and women >14 units/week) is associated with raised blood pressure and poorer cardiovascular and hepatic health.

- Brief interventions by clinicians of 10–15 minutes, assessing intake and assisting with appropriate counseling, have been reported to reduce alcohol consumption by one-quarter in excessive drinkers with or without raised blood pressure. It is more effective with specialist interventions.
- Structured interventions to reduce alcohol consumption, or substitute low alcohol alternatives, had a modest effect on blood pressure, reducing systolic and diastolic blood pressure on average by about 3–4 mmHg in trials. About 30% of patients can achieve a 10 mmHg or more systolic blood pressure reduction up to 1 year.

NICE Guide-2: Discourages excessive coffee and other caffeine-rich products consumption.

- Excessive consumption of coffee (5 cups or more / day) is associated with a small increase in blood pressure (2/1 mmHg) in participants with or without raised blood pressure in studies of several months duration.

NICE Guide-3: Encourages low dietary sodium intake to reduce blood pressure by reducing or substituting sodium salt.

- Reduction to *less than 6.0 g/day* (equivalent to 2.4 g/day dietary sodium) dietary salt intake can achieve a modest reduction in systolic and diastolic blood pressure of 2–3 mmHg in hypertensives. About 25% of patients could achieve a reduction in systolic blood pressure of 10 mmHg systolic or more in the short term, up to 1 year.
- Long-term evidence over 2–3 years from studies of normotensive patients shows that reductions in blood pressure tend to diminish over time.
- Reduced sodium salt, as a replacement in both cooking and seasoning, is as effective as restricting the use of table salt in reducing blood pressure.

NICE Guide-4: Discourages calcium, magnesium or potassium supplements as a method to reduce blood pressure.

- The best current evidence does not show that calcium, magnesium or potassium supplements produce sustained reductions in blood pressure.
- The best current evidence does not show that combinations of potassium, magnesium and calcium supplements reduce blood pressure.

NICE Guide-5: Advises and assists smokers to stop smoking

- Smoking cessation strategies are cost effective and ensures cardiovascular and pulmonary health.[91]

Physical Activity Intervention- Finnish study

This prospective study on physical activity in relation to the risk for hypertension was conducted on 8,302 Finnish men and 9,139 women aged 25 to 64 years aiming at finding out whether regular physical activity can reduce the risk of hypertension. Both single and joint associations of physical activity and body mass index with the risk of hypertension were examined using Cox proportional hazard models. During a mean follow-up of 11 years, there were 1,600 incident cases of drug-treated hypertension. This association persisted for all subjects irrespective of body weight. Multivariate-adjusted hazards ratios of hypertension based at different levels of body mass index (<25, 25 to 29.9, and ≥30) were 1.00, 1.18, and 1.66 for men (P_{trend}<0.001), and 1.00, 1.24, and 1.32 for women (P_{trend}=0.007), respectively. The study indicated that regular physical activity and weight control can reduce the risk of hypertension. The protective effect of physical activity was observed in both sexes regardless of the level of obesity.[92]

Leisure time Physical Activity Intervention- STORM study

Baak et al (2003) conducted Sibutramine Trial on Obesity Reduction and Maintenance at multiple centres in European. He followed for weight loss and weight maintenance in obese subjects over 18 months. Factors included in the analysis were initial body weight, dietary intake, various components of physical activity, treatment (sibutramine or placebo), age, and sex. Multiple regression analysis explained 20% of the variation in weight maintenance ($p<0.001$) among treatment group (sibutramine or placebo), the percentage of the initial body weight that was lost during the 6-month weight-loss phase, and the leisure-time physical activity index as significant determinants of weight maintenance. Diet, age, and sex were not found significant predictors of weight-maintenance success.

The success rate of long-term maintenance of weight loss in obese patients was usually low. Weight-maintenance success after weight loss is positively influenced by sibutramine treatment during weight maintenance, by a greater initial weight loss, and by a higher leisure-time physical activity index- higher levels of activities such as walking and cycling and lower levels of television viewing.[93]

Spanish intervention study

Spanish quasi-experimental study on 60 subjects consisted of chronological series for paired groups with double objectives- relationship of the variables with essential hypertension and comparison of two intervention programs on hypertensive patients. Both programs included general information about hypertension and the cares required, but they differed in their emphasis on medical factors. Group-I package comprised physical exercise and nutrition issues while Group-II focused on psychological factors like stress and anger.

This differentiation was not conceptual but practical. Pairing variables were age, life styles, stress and anger level. Data were analyzed through ANOVA for repeated measures and t-test for paired and for independent samples. In both groups hypertension level decreased, but only in Group-II the decreasing was maintained over one month. Life style and stress improved in both groups, while decrease in anger was only significant in Group-II. Results suggested adoption of anger management strategies to modify long term hypertension.[94]

Canadian Intervention Recommendation

Hill (2000) presented an intervention study trial to test association between uncontrolled high blood pressure and social, psychological, behavioral, and genetic factors at the 72nd scientific sessions of the American Heart Association, Atlanta, Georgia. The study was done on 309 inner-city hypertensive black men aged 18 to 54 with and without controlled blood pressures. Patients were randomized to less intensive (n=152) or more intensive (n=157) intervention strategies. Follow-up was done for 24 months to determine the effect of both intensive and less intensive interventions on blood pressure and other cardiovascular health outcomes.

After 24 months of intervention, 84% of respondents were evaluated. Blood pressure could be controlled among 39% compared with the baseline of 19%, meaning a significant 105% improvement. The improvement in blood pressure control was significant in both groups at both 12 months and 24 months. Mean systolic and diastolic blood pressures for the more intensively treated group were 149.5/101.1 mmHg at baseline, 138.3/90.8 mmHg at 12 months, and 142.3/86.8 at 24 months. For the less intensively treated group, these values were 151.2/103.4, 141.9/94.9, and 143.2/90 mmHg.[95]

Campbell et al (2002) with the hypertension group of Canada recommended individualized lifestyle modification for all patients who have or are at risk for hypertension. The study commented that single lifestyle intervention can prevent hypertension or can reduce blood pressure to an extent similar to that accomplished by a single antihypertensive medication. The lifestyle modification might be the sole therapy or it might be used in conjunction with pharmacotherapy to significantly enhance the effectiveness of the medication. All of the lifestyle modifications suggested in the hypertension recommendations improve general health, in addition to lowering blood pressure. A diet high in fresh fruit, vegetables and low-fat dairy products and low in saturated fat and salt is effective at reducing blood pressure. Commonly referred to as the DASH diet, this diet is also consistent with Canada's guide to healthy eating. Regular cardio-respiratory physical activity (e.g., brisk walking) is also a highly effective means of lowering blood pressure. Low-risk alcohol consumption, defined as abstinence or moderate alcohol consumption (less than 2 standard drinks per day) is effective for heavy alcohol consumers. For those who are overweight, the single most effective intervention is weight loss. For comprehensive reduction of cardiovascular risk, a smoke-free environment is critical.[96]

USA intervention study with dietary fibre

He Jiang et al (2004) performed a randomized, double-blind, placebo-controlled trial community in New Orleans, Louisiana, USA on a total of 110 trial participants aged 30 to 65 years to examine the effect of dietary fiber intake on blood pressure. The respondents were untreated, but had higher than optimal BP or stage-1 hypertension and were randomly assigned to receive 8 g/day of water-soluble fiber from oat bran or a control intervention.

As main outcome measures trained observers recorded nine BP measurements, using random-zero sphygmomanometers, over three clinical visits. An average of the nine measurements was used to determine mean BP at the baseline and termination visits.

The net changes in systolic blood pressure were -2.2 mmHg after 6 weeks, -1.8 mmHg after 12 weeks, -2.0 mmHg for an average of the 6- and 12-week visits. The corresponding net changes in diastolic blood pressure were -0.8 mmHg after 6 weeks, -1.2 mmHg after 12 weeks, and -1.0 mmHg for an average of the 6- and 12-week visits. In conclusions the findings suggested that a diet rich in fiber might have a moderate BP-lowering effect and indicated the need for further investigation of this important question.[97]

The Community Intervention Trial for Smoking Cessation (COMMIT) Study

National Cancer Institute funded intervention study The Community Intervention Trial for Smoking Cessation (COMMIT) was done to evaluate the effects of a community based smoking cessation intervention on adult smokers. The intervention program included youth oriented multicomponent activities focusing four principle areas-

- school based education programs
- anti-smoking policies in schools
- legislative activities related to youth smoking, and
- participation by students and teachers in other COMMIT activities.

The evaluation involved a two-group, pre-test/post-test, quasi-experimental design with ninth grade classroom (aged 14–15 years) students as the unit of assignment.

Researchers calculated rank correlations contrasting pair wise differences in adolescent seven day smoking prevalence with pair wise differences in adult cohort quit rates from the 1993 COMMIT Endpoint survey. Adult rate differences for each community pair

were correlated with youth smoking differences in the same community. The correlation coefficient was 0.2 ($p < 0.001$) indicating that higher quit rates among youth smoking.[98]

Hypertension and tobacco consumption are supposed to be related to each other. Experimental evidence claimed 5 to 10 mm Hg elevation of blood pressure level by cigarette smoking during the day. Study found that cigarette smoking increased the systolic blood pressure count by at least 20 mm Hg. The first cigarette of the day was found to have the particular effect on the smoker's body. Simultaneously it has been observed that tobacco consumers generally have low blood pressure than the non-smokers.[99]

Women's Health Study prospectively studied 28,236 cohort women with 8,571 (30.4%) incident of hypertension for a median follow-up period of 9.8 years. Multivariable-adjusted hazard ratios of developing hypertension among never, former, and current smokers of 1 to 14 and ≥15 cigarettes per day were 1.00 (reference), 1.03, 1.02, and 1.11 respectively. The study concluded with modest association of cigarette smoking with an increased risk of developing hypertension (strongest among women smoking at least 15 cigarettes per day).[100]

Hypertension Risk Stratification

I. **Risk Group A: Low Cardiovascular Risk**

A. Criteria
   1. No Cardiovascular Risks (Risk Group B)
   2. No Target organ damage or Cardiovascular Disease

B. Prehypertension (120-139 / 80-89)
   1. Lifestyle Modification in Hypertension

C. Stage-I Hypertension (140-159 / 90-99)
   1. Lifestyle Modification in Hypertension
   2. Consider Antihypertensive after up to 6-12 months
      a. Hydrochlorothiazide first choice in most patients

D. Stage-II Hypertension or greater (≥160/100)
   1. Lifestyle Modification in Hypertension
   2. Hypertension Combination Therapy

II. **Risk Group B: Moderate Cardiovascular Risk**

A. Criteria
   1. Tobacco Abuse
   2. Dyslipidaemia
   3. Renal insufficiency
   4. Patient age over 60 years
   5. Male gender of postmenopausal women
   6. Cardiovascular Family History
   7. No Diabetes Mellitus
   8. No Target organ damage or Cardiovascular Disease

B. Prehypertension (120-139 / 80-89)
   1. Lifestyle Modification in Hypertension

C. Stage-I Hypertension (140-159 / 90-99)

1. Lifestyle Modification in Hypertension
2. Antihypertensive (e.g. Hydrochlorothiazide)

D. Stage-II Hypertension or greater (≥160/100)

1. Lifestyle Modification in Hypertension
2. Hypertension Combination Therapy

III. **Risk Group C: High Cardiovascular Risk**

A. Criteria

1. Target organ damage or Cardiovascular Disease
   a. Left Ventricular Hypertrophy
   b. Angina or prior Myocardial Infarction
   c. Prior coronary revascularization
   d. Cerebrovascular Accident (Stroke or CVA)
   e. Transient Ischemic Attack (TIA)
   f. Nephropathy or Chronic Kidney Disease
   g. Peripheral Vascular Disease
   h. Retinopathy
2. Cardiovascular Risks (Risk Group B)

B. Prehypertension (120-139 / 80-89) or greater

1. Lifestyle Modification in Hypertension
2. Antihypertensive
3. Hypertension Combination Therapy if >20/10 over goal.[101]

Cardiovascular risk has to be assessed by discussing with the patients if blood pressure remains high in spite of interventions. Tests should exclude eyes, diabetes mellitus, rule out damages to heart or kidneys and secondary causes of hypertension. Tests for urine microalbumin, plasma glucose, creatinine, electrolytes, serum lipid profile and a 12-lead electrocardiograph can exclude cardiovascular risks.[62]

Chapter-III

Materials and Methods

Study population
Case selection criteria
Study Design
Study Type
Study Area
Study Period
Sampling Techniques
Sample Size
Data Collection Tools
Data Collection Methods
Methods of Measurement
Procedures of Measurement
Behavioural Change Evaluation
Analysis of Data

Study Population

The published voters' list for the area was used as the source of information for the population size of 18 years of age and above comprising 7,474 adults (Noorjahan Road- 5,559 = ♂ 2,993 + ♀ 2,566 and Razia Sultana Road- 1,915 = ♂ 1,052 + ♀ 863). Population size in the study site showed a little change to 7,566 (Noorjahan Road- 6,319 = Male 3,448 + Female 2,871 and Razia Sultana Road- 1,247 = Male 700 + Female 547) in the recently completed voter list in 2008AD. But baseline study was done with the latest voter list available during that time.[102]

A small proportion (6%) of the total population of Bangladesh constitutes the elderly population, but the absolute number of them is quite significant (about 7.2 million) and the rate of their increase is fairly high. For better cooperation and multiplicity of diseases, person of old age (above 64 year of age) was excluded from the study. There is no hard and fast rule about the age beyond which a person should be considered old. In developed societies, chronological age plays a paramount role and the age of 65 is said to be the beginning of old age. In developing countries, chronological age has little importance in defining old age.[103]

Meeting with the elected ward commissioner, elites in the community, many house owners, religious leaders and political personalities was held at phases before beginning of the study. All of them expressed their interest and support with the spirit of community participation. The Investigator of the project described details of the project in the meetings.

Case Selection for study

Case selection was done as per inclusion and exclusion criteria.

Inclusion criteria:

1. Living in the Mohammadpur area of Dhaka city at least for last 6 years and having no plan to leave within next 2 year
2. Having age 18 year or above at last birth day
3. Presenting with Stage I hypertension but taking no medicine
4. Willing to participate into the study with informed consent
5. Regular follow-up possible

Exclusion criteria:

1. Stage –II hypertensives
2. Hypertensives already on medication
3. Family history of premature CVD
4. Pregnant mothers
5. Patients with features or history of any CVD, cardiac or renal complication
6. Having any evidence of end organ damage e.g. eye, kidney, heart etc.
7. Any severe life threatening diseases unrelated to hypertension
8. Any clinical suspicion for secondary hypertension due to renal, endocrine or other reasons like medication etc.

Study Design

This quasi-experimental study (before-after type) was carried out by dividing into 03 distinct phases. Theses phases were discrete in nature but very much interdependent in respect of total methodology. The phases were-

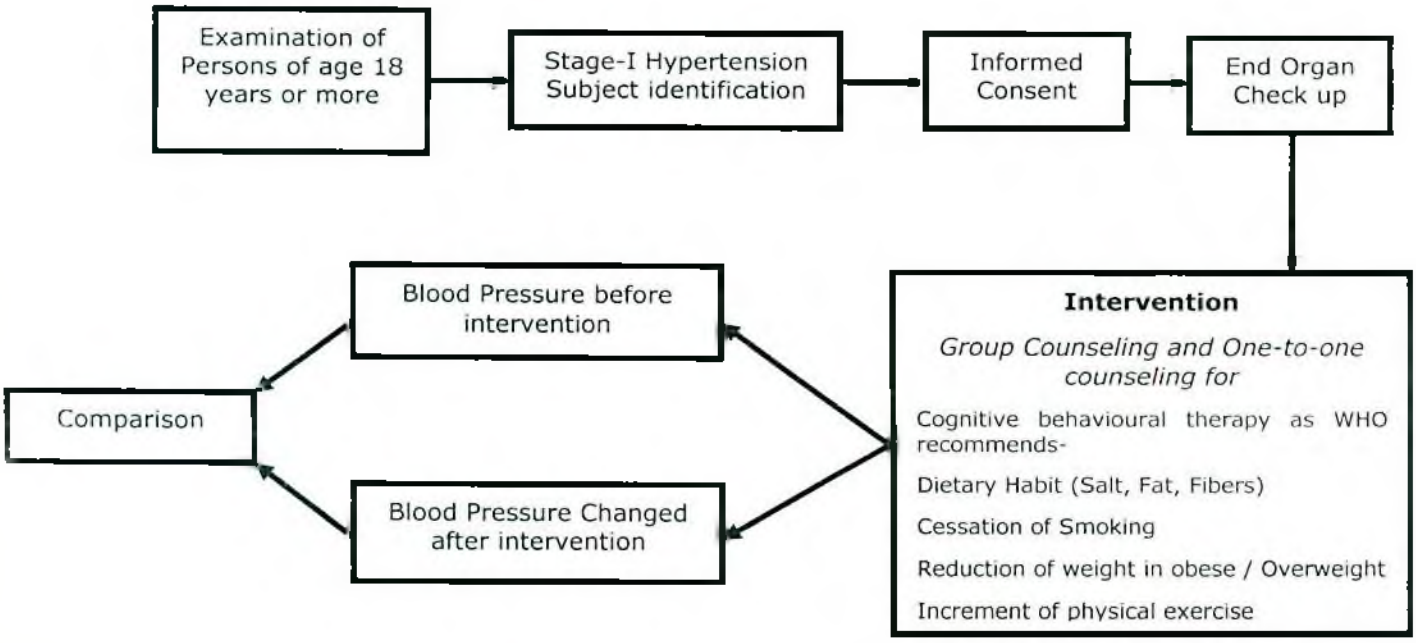
Phase – I *Case identification or Survey Phase* – This phase of research was dedicated to find out hypertensive respondents of age 18 years or more from the community through home-to-home visit in the study area. Their blood pressure was measured following WHO recommendation for MONICA available in website for general use. They were screened for any evidence of end organ damage. Respondents with any co-morbidity were not selected for intervention.[104]

Phase- II *Intervention Phase:* This phase was designed to give one-to-one counseling to the stage-I hypertensives included into the study through prefixed criteria and written informed consent. Counseling comprised of health education session for reduction of salt intake, reduction of weight among respondents with overweight or obesity, demonstration of increment of physical activity and cessation of tobacco consumption. Physical activity profile was checked and was expressed in terms of Metabolic Equivalent (METs) consistent with globally accepted and WHO endorsed protocols. WHO guidelines and approved intervention recommendations were adopted with the lifestyle and behavioural modification tools for these selected cases. Counseling sessions were modified according to local culture, belief and available appropriate technology and techniques and food habit.[62,104]

Any complicated case was immediately referred to cardiologist or nearby specialized cardiology centre. Endpoint data collection was completed in February 2009. Study or intervention end-points meant drop-out, migration of study subject or entering any point noted in the exclusion criteria. No incident of death happened during study period.

Phase- III *Evaluation Phase*: It was a factorial design to monitor and test statistically the outcome of interest i.e. change of blood pressure, individual impact of physical wellbeing as expressed by the patients, weight reduction, increment of the duration of physical activity and cessation of tobacco consumption. Qualitative changes of the stage-I hypertensives were also assessed. Evaluation was done 6, 12 and 18 months after starting the counseling intervention. Outcome variables were recorded in quantitative measurement units as close as possible with repeated cross-checking and validation using proper statistical tools and valid indicators. Questionnaire was checked for completeness, consistency, mutually exclusiveness, exhaustion, reliability and validity.

Figure-II Algorithm of Study design



Study Type

The study was a Community Trial type of intervention study. A true intervention design has three criteria to fulfill- *randomization, manipulation and control*. This study had no matched control group. This was rather a before-after model of quasi-experimental study type with non-pharmacological approach as the intervention or manipulation.

Study Area

Place of this study was Noorjahan Road and Razia Sultana Road of ward 44 under Mohammadpur Thana of Dhaka City Corporation, Bangladesh. Mohammadpur Thana has got the geographical location of 23°75′42″N, 90°36′25″E and is bounded by Mirpur and Kafrul Thana on the north, Hazaribagh Thana on the south, Tejgaon and Dhanmondi Thana on the east, Savar upazila on the west.

Area of Mohammadpur Thana is 12.14 sq KM (Census 2001) containing 11 wards, 50 Mahalla (smallest sub-unit), and 97,240 households. Population of this Thana is 456, 300 with 244,800 male and 211,500 female. Population over 18 years was enumerated to be 290,760 with literacy level of 63.54% over age 7 years in whole Thana area. Religious profile of Mohammadpur Thana as a whole comprises Muslim 92.87%, Hindu 6.73%, and others 0.4%. Educational institutions comprise at least 07 universities, 07 colleges, 02 medical colleges, 13 high schools, 14 primary schools and at least 14 English medium schools. Main occupations of the peoples are 32.91% service, 22.11% business, 16.29% transport related and about 2.95% daily unskilled wage labourers.[105]

Study Period

The total study period was about 43 months including intervention period of 18 calendar months. Literature review and protocol preparation was started from August 2005 for submission, review, and permission by the university authorities in series before starting field trial from May 02, 2007 to be continued till February 28, 2009. Data collection was followed by sorting, processing and analyzing of data to prepare for seminar presentation and submission of this report. Careful search and consultation of the updated appropriate literature review was done at all stages of the study.

Sampling Technique

Sampling technique was Cluster Randomized Sampling. This design is being used more frequently in preventive interventions trials. Cluster randomized trials are told to have particularly important role in behavioural interventions studies to have an additional group effect.[106]Clusters of the study area were selected by simple random sampling technique through lottery. Clusters of holdings were selected by simple random sampling method from all the holding numbers of the particular cluster. Household adults, with ages 18 year and above, as appeared in voter list were taken as sampling units. Uncomplicated Stage-I hypertension cases were selected from these sampling units for intervention depending upon the inclusion, exclusion criteria and informed consent form.

Sample Size

Size of the sample was calculated and ascertained according to the WHO recommendation for sample size determination.[107] For phase-I case sorting and prevalence study sample size was 4,930 from total population of 7,474 adults comprising response rate of 65.96%. This is consistent with absolute precision level and confidence interval more than ninety five.

For intervention 282 respondents with stage-I hypertension were selected having no co-morbidity.

Data Collection Tools

Data collection tools comprised of *quasi-open questionnaire*, *check list*, an *informed consent* form and equipments for anthropometrical measurement and relevant clinical examination like-

- Stethoscope - *3M Littmann* Classic II SE (USA)
- Mercurial Sphygmomanometer - *BOKANG Model 1001*
- Height-length Measuring stadiometer – Fujita Japan
- Weighing Scale - Omron Digital [Model HN-280]
- Precision Scale - Tanita Digital
- Other support tools like ECG Fukuda C 100 machine & Glucometer etc.
- GHQ-28, SF-36, PHQ-9, HADS questionnaire

Data Collection Method

Face to face interview was taken for the respondents. Clinical and anthropometric examination was done. Review of laboratory reports or records were done if the participants desired to show. Intervention was given for weight reduction, smoking cessation and increment of physical activity. Measurements were taken as accurately as possible up to 0.1 kg, 0.2 cm and 2mmHg.

Validation of BP machine

The machines for BP and other parameter measurement were tested for accuracy frequently before every day measurement. These were in conformity to the globally accepted protocol. For BP machine British Hypertension Society (BHS) revised protocol in 1993 was followed. It was done by comparison of the device with standard one for 5 cases by two trained observers. Devices were recommended for approval if BP readings were within 5 mm Hg difference for at least 50% of readings. Accuracy of BOKANG *mercury BP machine* was done by checking that the upper curve of the mercury column meniscus was at zero mmHg, the column was free of dirt and it rose or fall freely during cuff inflation or deflation. Validation of anaeroid machine was done by comparing the reading with a standard machine with the needle set at 'zero point' before the cuff is inflated and returned instantaneously at zero after deflation.[61]

Cuff size of BP machine

Cuff size of the BP machines used in this study was maintained according to standard protocols. Following WHO protocol, on average 22-32 cm adult arm circumference was considered prototype for usual purpose with cuff size 24 cm x 14 cm. But one machine was maintained for extra large size arm circumference. The cuff had a bladder length that was 80% and a width at least 40% of arm circumference (length-width ratio was 2:1).[108,25-27,61,62]

Procedure of BP Measurement

Measurement of Blood Pressure was done as per WHO protocol. Machine was calibrated at the beginning of the day. Blood pressure was measured at the home-setting with comfortable room temperature without background noise, without tension of muscles or bladder. Respondent was advised to take rest on a chair for 5 minutes immediately before readings. Blood pressure was not taken if respondents consumed nicotene or alcohol within half an hour before recording. The person sat legs uncrossed without talking. Back of her/his arm had support in such position that middle of the cuff on the arm was at the level of the right atrium.[61,96] Respondent was then asked to remove clothing covering the cuff area of the arm. Proper size cuff was wrapped around arm above antecubital fossa. The cuff bladder was inflated rapidly, with 3 fingers on radial pulse, up to 20 mm above the level when pulse could not be felt. The cuff was deflated at the rate of *2–3 mmHg* per second. Approximate systolic pressure was noted when the pulse re-appeared. The cuff was re-inflated 20 mmHg above that point putting the stethoscope on brachial artery as much inner of the cuff as possible. Korotkoff sound phase I was considered for sytolic and phase V for diastolic blood pressure. Blood pressure was measured initially at both arms. A second reading on right arm was taken after 5 minutes. If the difference between the two readings was more than 5 mm of mercury, a third reading was taken again at right arm after another 5 minutes of relaxation. The mean value of the right arm readings was taken as the blood pressure of the individual up to 2 mmHg. In case of any cofusion, a second day visit was scheduled to mesaure BP again. Blood pressure was also measured in standing posture if required. If BP fall was more than 20/10 mmHg on standing from sitting, that case was excluded from study and was referred to consultants.

The identified hypertensives were requested to visit *Hypertension Counseling Centre (HCC)* opened at the central point of the study area once in 20-30 days to measure their BP and follow up in addition to the routine home visit and counseling sessions.

This centre was equipped with-

- Basic clinical measuring equipment (Omron Digital weighing scale, stethoscope, sphygmomanometer, height measuring stadiometer etc.
- Patient waiting room with average comfortable condition
- Separate patient counseling room
- Emergency and first aid arrangement
- ECG machine (Fukuda C 100, 3 channel automatic, Japan) and glucometers and
- Arrangement for other blood sample collection for the study.

Height Measurement Protocol

WHO has got definite protocols and directions for measuring height of the person under study. A portable height-length measuring stadiometer was required for this purpose. The special flat tape was assembled and was placed on a firm plain surface.

Measuring height

1. The respondent was asked to remove shoes, socks, slippers and any head gear (hat, cap, hair bows, comb, ribbons, etc).
2. The respondent was then asked to stand on the board facing forward with their feet put together, heels against the backboard and knees straight.
3. The respondent was asked to look straight ahead in the Frankfurt plane (the eyes are the same level as the ears) and not to look up.
4. Height in centimeters was recorded to the exact point on top of head.

Weight Measurement Protocol

Weight measuring scale (Omron Digital Weighing Scale Model HN-280 and Tanita Digital Precision Scale) was calibrated at the beginning of the day. It was placed on a firm and flat surface (not on a carpet or a sloping surface).

Measuring weight using the measuring scale

1. The respondent was inquired and requested to make the bladder and bowl empty
2. She/he was then asked to remove footwear and socks
3. She/he was requested to put off dresses as much as possible
4. She/he was told to step onto scale putting one foot on each of the footprints
5. The respondent was asked to stand still, facing forward and arms on the side and wait until told to step off.
6. The weight was recorded in kilograms after making average of 3 measurements

Physical Activity Measurement

Physical activity was measured at beginning, after 6 m, 12m and 18m of intervention. For assessment of physical activity International Physical Activity Questionnaire (IPAQ)), Minnesota Leisure Time Physical Activity Questionnaire and Baecke's model was used. Physical activities less than 10 continuous minutes were ignored during calculation.

Common physical activities in study area were pre-categorized into 03 groups. Light activities were walking slowly (1-2mph), cycling stationary (<50w), swimming slow treading, sedentary fishing, golf playing and easy home care etc. Moderate activities were walking briskly (3-4 mph), cycling for pleasure (<=10mph), swimming with moderate effort, racket sports, table tennis, standing fishing, leisure canoeing (2-3.9mph), general home cleaning, power mower, hand-mopping of floors, home repair, washing light apparels or

linens and painting etc. Vigorous/ heavy activities were walking with load, fast cycling (>10mph), fast swimming, crawling, conditioning exercise with stair ergometer, racket sports competitive, fishing in stream, rapid canoeing (>4 mph), pulling rickshaw or cart, moving furniture, hand washing of heavy cloths, force home cleaning etc.

Physical activity minutes were converted to metabolic equivalent unit METs. The metabolic unit is the ratio of the metabolic rate during exercise to the metabolic rate at rest (work metabolic rate/ resting metabolic rate). One MET corresponds to an energy expenditure of approximately 1 kcal per kilogram of body weight per hour, or an approximate rate of oxygen consumption of a seated adult at rest or about of 3.5 ml oxygen uptake per kilogram per minute. [112-114]

Measuring physical activity as continuous score as per IPAQ Scoring protocol

- Expressed as MET-min per week: MET level x minutes of activity x events / week

Table-VIII Physical activity conversion to METs

Activity Type	MET level	:	**Formula**	**Code**
Light (Walking)	3.3	:	3.3 x min. of activity x no. of days/ week	LMET
Moderate	4.0	:	4.0 x min. of activity x no. of days/ week	MMET
Vigorous	8.0	:	8.0 x min. of activity x no. of days/ week	VMET
Total == (LMET + MMET + VMET) =			MET-min/wk	

Phase- II Intervention Phase

The total intervention setting was non-pharmacological i.e. change of lifestyle, physical activity, cessation of smoking and modification of dietary habit from unhealthy to healthy dietary pattern through one-to-one counseling, printed leaflets and colored cards. Behavioural change communication approaches were also adopted to raise morale.

Fig-III Intervention models for physical activity & diet control

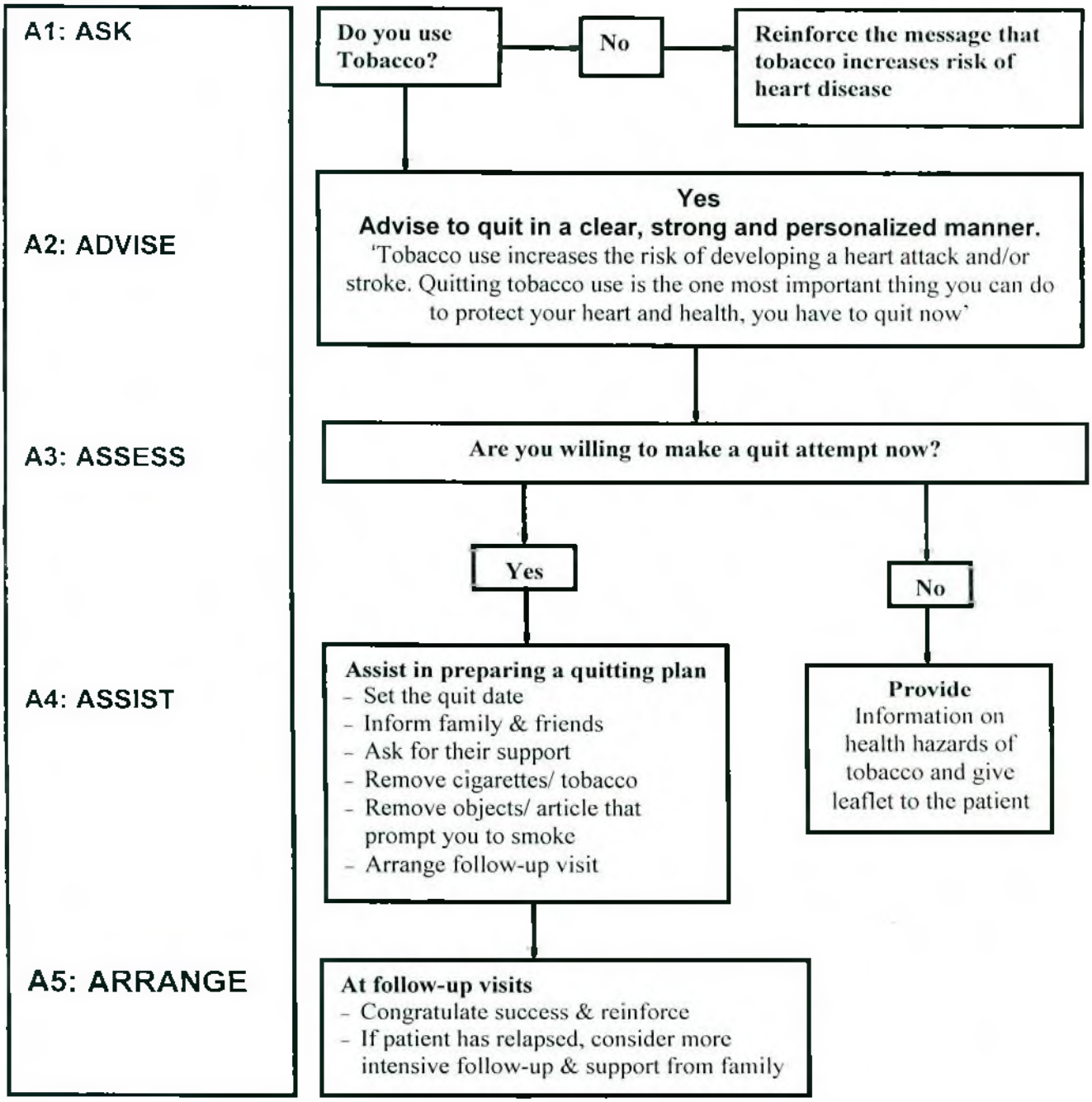
Physical Activity
Everyday do physical exercise

- Start day with **washing** your night gowns by hand
- Use stair while going down
- Use elevator/lift **less than two** of your desired level while going up
- **Move around** for 10 minutes after every meal.
- **Walk** 2 km everyday /05 taka rickshaw fair
- **Pray/meditate** regularly if believer
- Progressively increase **moderate physical activity** such as brisk walking, cycling to at least 30 minutes per day.
- Make your **working hours** more heart healthy.
- Plan a heart healthy **resting or leisure time.**

Dietary Counseling
Eat a 'Heart Healthy Diet'

- Don't **rush while eating**, Chew properly
- **Salt** (Sodium Chloride)
  Restrict to less than 5 gram (1 teaspoon) per day
  Reduce salt when cooking
  Limit processed and **fast foods**
- **Fruits and Vegetables**
  5 servings (400-500g) of fruits and vegetables per day
  1 serving equals 1 orange or apple or mango or banana or 3 tablespoons of cooked vegetables
- **Fatty Food**
  Limit fatty meat, dairy fat and cooking oil (<2 tablespoons per day)
  Replace coconut oil with olive/soybean/corn/ safflower oil
  Replace other meat with chicken (without skin)
- **Fish**
  Eat fish at least three times per week, preferably oily fish
  Eat more sea fish
- **Drinks**
  Avoid beverages
  Avoid alcohol

Fig – IV Stop tobacco use : 5 steps- 5 As [WHO]



All the patients were followed every month after giving the intervention. Telephone contacts were routine follow up media while home visit were done in case of failure to reach the telephone contact. Any complication or symptom of end organ involvement was immediately referred and guided to departmental institutional treatment. At the end of 06, 12 and 12 months required parameters were evaluated to compare with the case-to-case primary baseline data over time series pattern. Difference of systolic-to-systolic and diastolic-to diastolic blood pressure was measured to find out any change because of the risk reduction intervention for 6, 12 and 18 months. It was then statistically treated.

Controlling Confounding Factors

Assessment of demographic variables, medical history, family history of diseases, smoking, and socioeconomic status was carried out. A Hypertension index was calculated from scores for dichotomized disease variables (a score of 0 for the normal blood pressure and a score of 1 for high blood pressure). Confounders were minimized during designing the study and also during data collection for physical activity, resting hours, leisure time activities, and pastime. Tobacco consumption indices were carefully analyzed. Advanced statistical methods and maneuvers were adopted to reduce impact of confounders during data analysis by SPSS.

Phase- III Evaluation Phase: Data processing and Analysis

Statistical Package for Social Sciences (SPSS) for Windows was used for data processing and analysis. Data were tested for normal distribution before testing and analysis. Otherwise to avoid kurtosis or skewness, squaring or logarithmic computation was planned for correction. Other than descriptive statistical tests, inferential tests like t-test, chi-square ($\chi 2$) test, Analysis of variance (ANOVA), General Linear Model (GLM), multiple regression or other related tests were done. Analysis was done with age, sex, residence, educational level, marital status, tobacco consumption, physical activity pattern, height, weight and BMI as the independent variables.

Analysis of variance (ANOVA) was the test for a linear, curvilinear or higher order association technique by which total variations in data set was partitioned into two or more components. It was used to estimate and test hypothesis about population means. Oneway ANOVA had the strength to perform *a posteriori* or *post Hoc* test to see the difference of means after initial analysis of variance has shown significant heterogeneity. General Linear Model (GLM) allowed comparing the means of two or more groups. GLM Univariate procedure provided analysis of variance for one dependent variable by one or more factors or variables. GLM went further than t-test and Oneway, because it allowed '*to partition*' the variance of a continuous character into several component parts. Multiple logistic regression analyses was done to examine the varying degrees of relationship between one dependent variable blood pressure/ hypertension and several independent variables through controlling for the effects of other variables which might have important relationship with the dependent variable. In these analyses, presence or absence hypertension was the dichotomous dependent

variable, while age, sex, education level, place of residence and a visit to a doctor in the previous year were the independent variables.[115]

The association and percentage contribution of individual risk factors versus hypertension were estimated with coefficient of determinants (r^2) with the strength of explaining the relationship. The level of physical activity, and quantity of smoking was entered as continuous variable for analyzing the central tendency or differences of means. Again variables were categorized for statistical treatment by computing into different variables. Food habit was treated for pattern, frequency and relation with hypertension by adopting standard analytical model. After removing the effects of certain variables like age, sex and marital status, the researcher tried to found out the effect of other confounding factors for any effect. Three different sets of fixed covariates were used.

Behavioural Change Evaluation

Evaluation was done by consulting General Health Questionnaire (GHQ-28),[109] The short Form Health Survey (SF-36 MH 1-5),[110] Patient Health Questionnaire (PHQ-9) and Hospital Anxiety and Depression Scale (HADS).[111]

Anger management was managed by advice for time out, deep breathing, controlled thinking and looking for the positive. *Problem solving* counseling was step wise- defining the problem, brainstorming the alternative options, critically evaluating each options, decision making, action planning and skill building. *Thought challenges* for fighting irrational and negative thoughts were counseled in six modified steps like - worst that might happen, evidences supporting and against that idea, benefits and costs of thinking that worst and things to do to avoid the worst.

Ascertainment of Follow-up Events

The collection of data and follow-up strategy was in conformity to the NCD strategy by the MONICA (Monitoring of Trends and Determinants of Cardiovascular Diseases) registry. When multiple events occurred during follow-up, the first event in each subject was considered the end point for the analyses in this study. Non-response was reduced by effective enhanced motivation and incentive to the patients in respect of free medical counseling, low cost ECG and blood sugar measurement. Any dissatisfaction or discomfort by respondents resulted immediate referral to consultant or cardiology centre.

Referral system for respondents not fitted or not agreed for study

All stage-II hypertensives or hypertensives with complication were referred to the community health centre or National Institute of Cardiovascular Diseases (NICVD) or appropriate health institutions to initiate treatment for hypertension or continue treatment. Peoples were advised to take regular medication from the appropriate treatment authority if required even if excluded or dropped from the study because of any valid reasons. Information collected during the visit was entered in to the computer for analysis. If some one wanted to go to a different medical system other than the allopathic system they were not barred to go there.

Endpoint of the intervention

1. Death – no such occurrence encountered
2. Disability
3. Stage-II hypertension
4. Any CVD, Stroke, Heart or Renal disease
5. Any disease threatening outcome or life
6. Pregnancy
7. Change of address hampering follow-up
8. Respondent's change of mind set to continue

Ethical Perspective

Ethical aspect of the study was considered althrough the study. This study is being done in many countries under WHO sponsorship. The same recommendations and protocols for measuring and grading of blood pressure, protocols for measuring height and weight were adopted in this study. WHO recommended and endorsed *Informed Consent form* was used before collecting information and giving intervention for the study.

For patient management JNC-7, ESH and WHO/ISH recommendations was stringently followed. A formal application was also submitted along with fund request to the BMRC for Ethical Clearance in the prescribed format and after clearance BMRC allocated partial fund for study.

Chapter-IV

Result

Blood Pressure Survey

Mean Systolic Blood Pressure (SBP) is found 121.4 ± 15.9 mmHg with median value of 120 mmHg and mode value of 110 mmHg measured among 4,930 adults, aged 18 years or above. sBP is found to range from 90 mmHg to 270 mmHg. Mean diastolic blood pressure is 78.2 ± 9.6 mmHg with median value 78 mmHg and mode value 70 mmHg (Table-1). Diastolic blood pressure ranges from 50 mmHg to 120 mmHg.

Table-1 Baseline Survey : Blood pressure for all respondents (n=4,930)

Description	Pulse / minute	Systolic Blood Pressure	Diastolic Blood Pressure
Mean value	76.7 ± 7.8	121.4 ± 15.9	78.2 ± 9.6
Median	76	120	78
Mode	80	110	70
Range	62	180	72
Minimum	48	90	50
Maximum	110	270	122

Mean Blood Pressure 121 / 78 mmHg

Pattern of Blood Pressure at Baseline Study

Blood pressure measurement catering is done among 4,930 adults out of 7,474 population showing a response rate of 65.96%. Among them 2,249 (45.6%) respondents are found to be normal according to JNC-7 criteria (Fig-1&2). More than 34% (n=1,691) respondents suffer from Prehypertension. And 20.1% respondents suffer from different stages of hypertension. Among respondents with hypertension, 63.7% (n=631; 12.8% of total respondents) suffer from stage–I hypertension and 36.3% (n=359; 7.3% of total respondents) from stage-II hypertension or they take antihypertensive medication (Fig-1). Among the stage-I hypertensives, 349 respondents (7.1% of total) could not be included in the study either because of lack of informed consent or due to exclusion criteria (Fig-2). Intervention was given on 282 respondents with stage-I hypertension.

Figure 1 Distribution of respondents by blood pressure level (n=4,930)

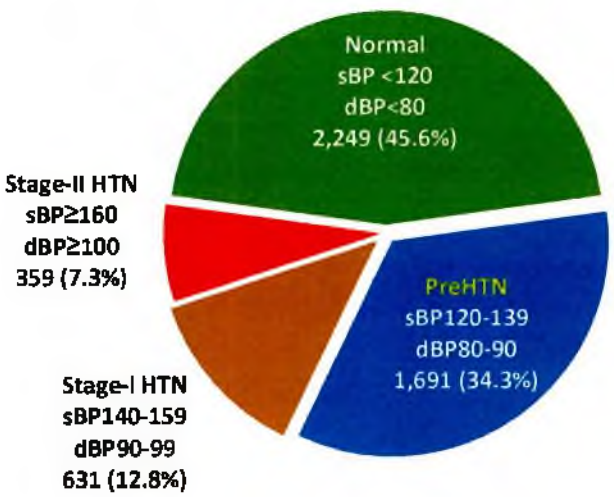
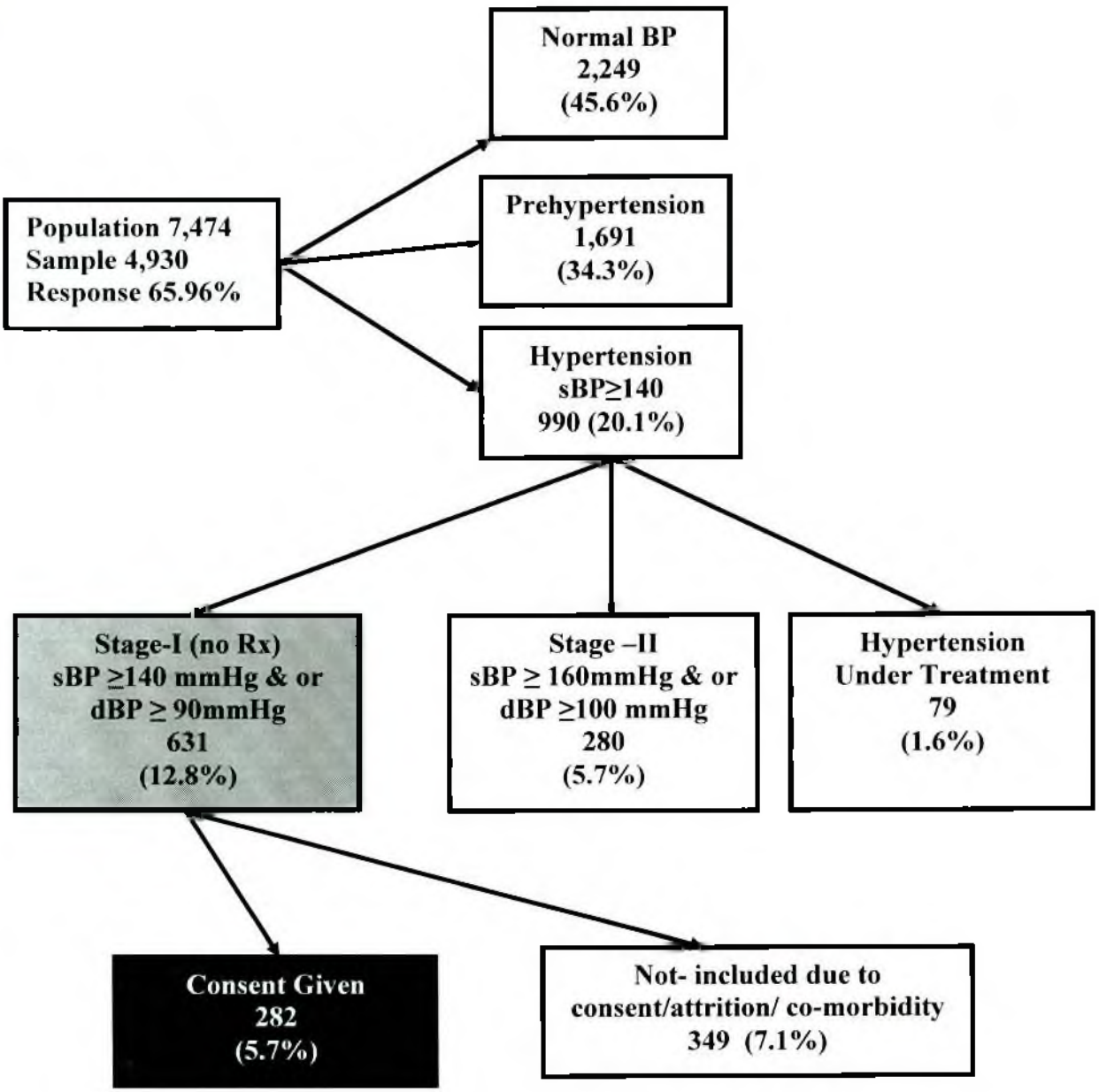


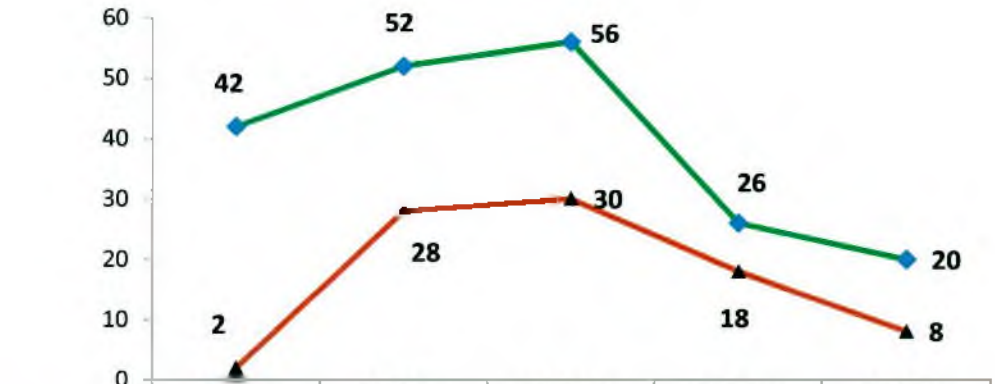
Figure – 2 Scenario of blood pressure pattern (n=4,930)



Age, Age group and Sex of the respondents with Stage-I hypertension

Age distribution of 282 respondents shows the range from 18 years to 64 years. Mean age is 36.82 ± 11.4 year, median 35, and mode 35 years. Age group distribution (Fig-3) shows majority of the samples 86 (30.5%) to be in the 35-44 year age group while 44 (15.6%), 80 (28.4%), 44 (15.6%) and 28 (9.9%) in 18-24 year, 25-34 year, 45-54 year and 55-64 year respectively. Peak age group of 58.87% respondents is in 25-44 years with male suffering about double number of female.

Fig 3 Age specific distribution of Stage-I Hypertension (n=282)



	18-24 yr	25-34 yr	35-44 yr	45-54 yr	55-64 yr
Male	42	52	56	26	20
Female	2	28	30	18	8

This study includes 196 (69.5%) male and 86 (30.5%) female. The overall male-female ratio of stage-I hypertension is 228:100.

There is direct relationship between increasing age and rise of blood pressure among these respondents. Testing with General Linear Model for Univariate variable for hypertension against age, Levene's Test of Equality of Error Variance shows significant correlation of age with level of both systolic and diastolic blood pressure (Table-2). Coefficient value for systolic blood pressure against age is r^2=0.258 with F=3.568, df 38 p< 0.001 and the value for diastolic blood pressure is r^2=0.342, F= 3.318, df 38 p<0.001.

When analyzed for occurrence of high blood pressure between male and female after the age of 45 years, statistically significant difference is not found (F=1.779 df 1 p= 0.183 and t = 1.334 p= 0.183). But before 45 years of age (average menopausal age) female appears to be protected against high blood pressure.

Table- 2 Test between age and hypertension (UniAnova)

Dependent Variable: Hypertension

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	0.777	38	0.020	1.568	.024
Intercept	167.357	1	167.357	12842.434	.000
AGE	0.777	38	0.020	1.568	.024
Error	3.167	243	0.013		
Total	278.000	282			
Corrected Total	3.943	281			

r^2 = 0.197 (Adjusted r^2 = 0.071)

Marital Status

Three times more untreated stage-I hypertension is found among married respondents (74.5% married, 25.5% unmarried). Among married respondents male comprises 46.1% in comparison to 28.4% females (Table-3). Male unmarried respondents comprise 23.4% of the sample while females are 2.1%.

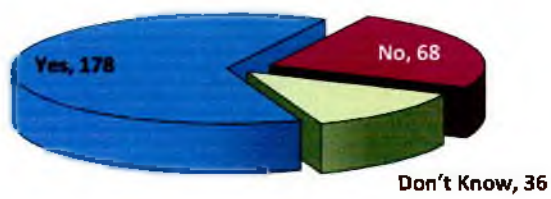
Table- 3 Distribution of stage-I hypertension by marital status and sex (n=282)

Marital Status	Sex				Total	
	Male		Female			
	n	%	n	%	n	%
Married (%)	130	46.1	80	28.4	210	74.5
Unmarried (%)	66	23.4	6	2.1	72	25.5
Total (%)	**196**	**69.5**	**86**	**30.5**	**282**	**100**

Family History

Positive history of high blood pressure among first-degree family members is found among 63.1% (n=178) respondents with hypertension at baseline study while no relation is found among 24.1% (n=68) respondents (Fig-4). Thirty six respondents (12.8%) could not reply definitely. One sample t-test result shows significant difference (t= 19.61 df 281 $p<0.001$) between positive and negative responses for family history.

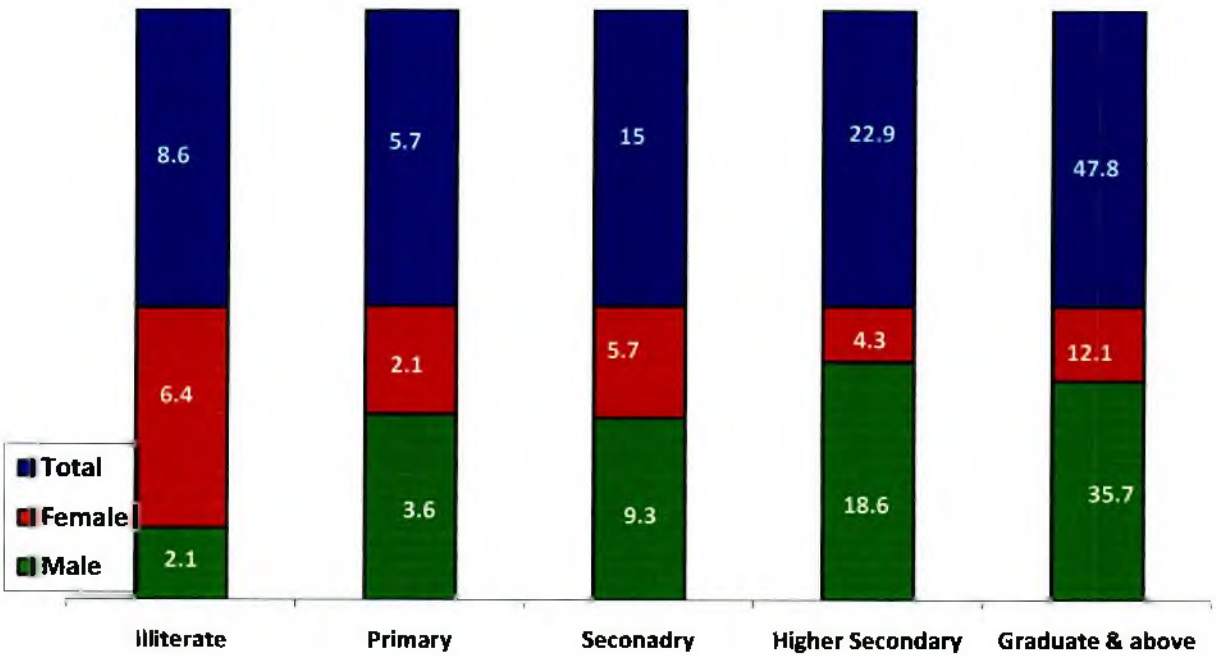
Fig 4 Family History of HTN



Educational status

Regarding educational status, 02 respondents (0.7% out of 282) decline to give any information. Among the rest 280 respondents, only 8.6% are illiterate (Fig-5). While primary, secondary, higher secondary, graduate and university education level is found among 5.7% (n=16), 15% (n= 42), 22.9% (n= 64), 7.1 % (n=20) and 40.7% (n=114) respectively. Illiterate females suffer more (2.1% male, 6.4% female). Males of higher literacy level suffer more (35.7% male, 12.1% female - graduate or above).

Figure-5 Distribution of stage-I hypertension by Educatinal Status

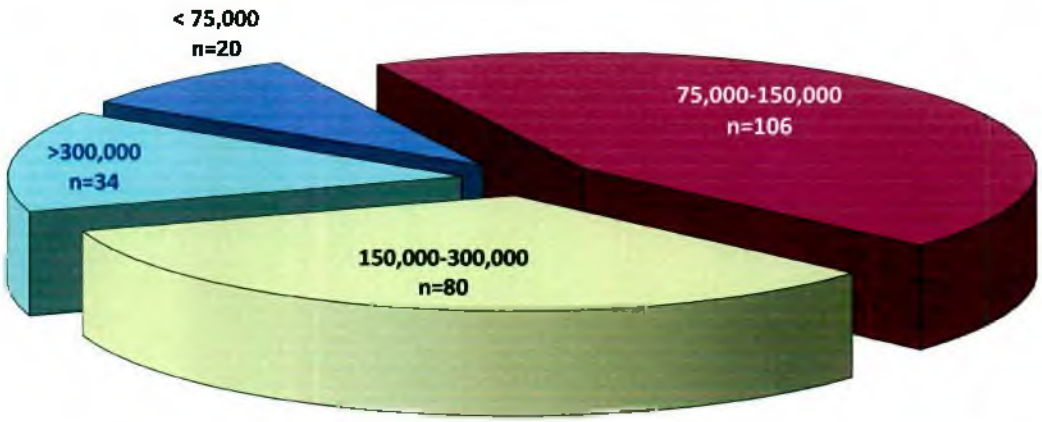


$\chi 2 = 29.9$, df 5 $p < 0.001$
1 cells (8.3%) have expected count less than 5. The minimum expected count is 4.91.
Fisher's Exact Test value is 27.7 $p < 0.01$ at 99% CI

Annual expenditure

Mean annual expenditure of the respondents is calculated to be Tk. 168,767.30 ± 14.1, median being Tk-144,000.00 and mode Tk-140,693.30 only. Tk-75,000.00 -150,000.00 is found in majority (106 out of 282, 37.6%) of the cases as yearly expenditure. Annual expenditure of 7.1 % respondents is less than Tk-75,000.00. Where as 28.4% (n=80) declares annual expenditure between Tk- 150,000.00 to Tk-300, 000.00, and about 12.1% (n=34) requires annual expenditure of Tk-300,000.00. About 14.9% refuse to discuss about annual expenditure (Fig -6).

Fig6 Annual Expenditure (Tk) of respondents with stage-I hypertension



Main occupation

Distribution of the frequency and category of the main occupations is shown in Table-4. It shows that service holders suffer more from hypertension comprising 48.2%. Percentage wise distribution of respondents with stage-I hypertension after service is House wives (18.4%), Business (14.2%), Students (9.9%), Unemployed (4.3%), Day labourers (1.4%), Self employed (1.4%) and others (2.1%).

Table -4 Distribution of stage-I hypertension by main occupation

Occupation	Frequency	Percent
Service	136	48.2
Housewife	52	18.5
Business	40	14.2
Student	28	9.9
Unemployed	12	4.3
Day labourer	4	1.4
Self employment	4	1.4
Others	6	2.1
Total	**282**	**100.0**

Diet habit

Data analysis (Table-5) reveals rich fast food intake preference of 35.5%, vegetable-preference of 23.4%, Home-food preference 19.1% and mixed preferences 22.0% have mixed preferences for food habit. More than 99% respondents use soybean oil as cooking oil.

Table-5 Distribution of stage-I hypertension by food habit and preferences (n=282)

Description	Number	Percentage
Rich fast food preferences	100	35.5
Vegetables preference	66	23.4
Mixed preference	62	22.0
Home made food	54	19.1
Total	**282**	**100%**

In an average week 40.4% respondents do not take beef while 41.9% take less than 4 times and 17.7% take beef 4 times or more per week. Mean beef intake of the community is 1.79 ± 2.6 sessions per week (Fig-7).

In an average week 79.4 % hypertensives take no mutton, 19.2% take less than 4 times per week and 1.4% take mutton 4 times or more per week. Mean sessions of mutton intake are 0.32 times ± 0.7 per week.

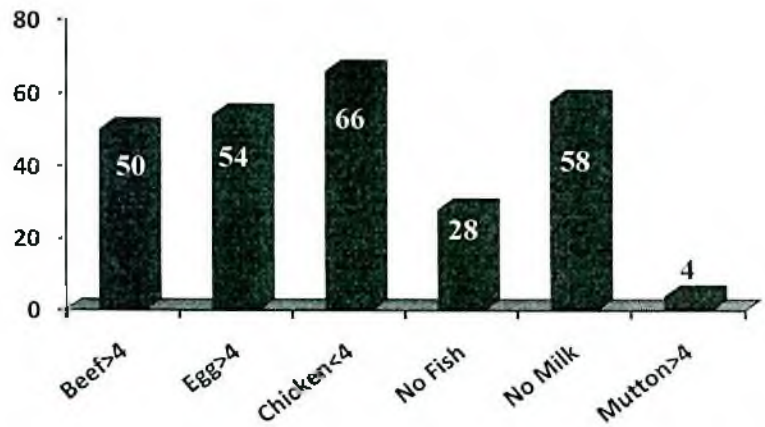
Mean egg intake is 2.01 ± 2.7 in an average week. Egg is not taken by 36.2% stage-I hypertensives every week, though 44.7% take less than 04 eggs and 19.1% take 04 eggs or more per week (Fig-7).

Chicken is taken by 73% of the hypetensives every week. Sixty six respondents 23.4% take chicken more than 4 times while 49.6% take less than 4 times every week. The mean value for taking chicken is 2.27 ± 2.5 per week.

Similarly fish consumption data shows a mean value of 10.8 ± 5.6 sessions per week. Fish is taken 4 times or more by 87.9% respondents while 10% take less than 4 times in an average week and only 2.1% (n=6) took no fish.

Mean milk consumption is 2.37 ± 3.6 times in an average week. Fifty eight hypertensives (20.6%) take milk less than 4 times while 25.5% take milk 4 times or more in a week. Vegetables are taken by 97.2% respondents with 31.2% taking 10 servings or more in a week, while 66% eat 10 servings or less in a week.

Fig-7 Distribution of stage-I hypertension by weekly food intake (n=282)



Salt consumption

Extra table salt is taken in 44% respondents with stage-I hypertension at the beginning of the study. Amount of salt intake is very high amounting to 7 tea spoonful per week on average.

Table-6 Distribution of stage-I hypertension by extra salt intake (n=282)

Description	Number	Percentage
No use of extra table salt	158	56.0
Use of extra table salt	124	44.0

Multinominal regression analysis shows chi-square value of 25.8 df 13 p=0.018 between use of extra table salt and systolic blood pressure while the value is 28.684 df 11 p= 0.003for diastolic blood pressure (Table-7) in a -2 Log Likelihood reduced model. The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are zero.

Table –7 Likelihood ratio tests between BP and Salt intake at baseline

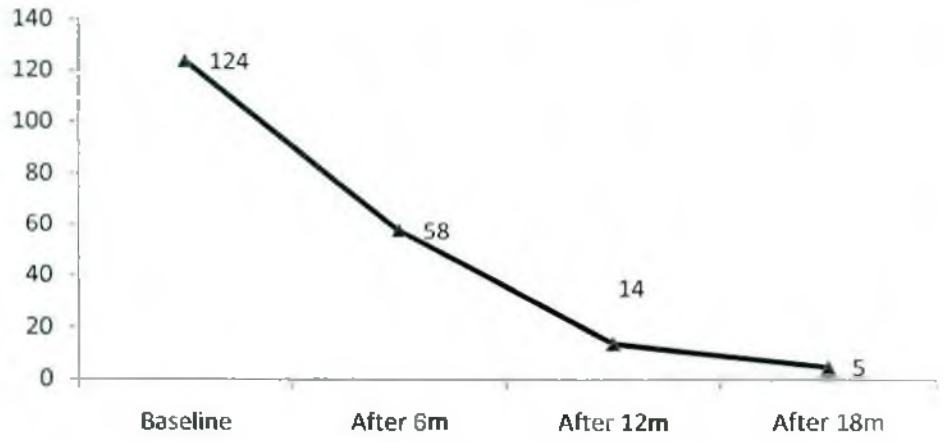
Effect for *Systolic* BP	-2 Log Likelihood of Reduced Model	Chi-Square	df	p
Intercept	81.551(a)	.000	0	.
SLTUS	107.346	25.795	13	.018
Effect for *Diastolic* BP	**-2 Log Likelihood of Reduced Model**	**Chi-Square**	**df**	**p**
Intercept	51.432(a)	.000	0	.
SLTUS	80.116	28.684	11	.003

(a) This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Change of Salt Intake

Salt intake behaviour is significantly reduced during the intervention period. After 6m, 12m and 18m of intervention salt intake is found among 58 (20.6%), 14 (5.0%) and 05(1.8%) respondents respectively (Fig-8). Quantity of salt intake also reduces from 07 teaspoonfuls per week at beginning to 0.3 teaspoonfuls after 18m intervention.

Fig-8 Change of number of respondents with HTN taking extra salt (n=282)



Change of salt intake significantly relates to change of both sBP (F= 9.688; p=0.000; adjusted r^2=0.077) and dBP (F=6.544; p=0.002; r^2=0.050) (Table-8).

Table-8 GLM Test between change of salt intake and BP

Dependent Variable: Change of BP at 18m

Statistic	Type III Sum of Squares	df	Mean Square	F value	p
Corrected Model	591.175(a)	2	295.588	9.688	.000
Intercept	178.324	1	178.324	5.844	.016
SLTUS18 for sBP	591.175	2	295.588	9.688	.000
Corrected Model	263.861(a)	2	131.930	6.544	.002
Intercept	1779.401	1	1779.401	88.261	.000
SLTUS18 for dBP	263.861	2	131.930	6.544	.002

a r^2= 0.086 (Adjusted r^2= 0.077) for sBP and a r^2 = 0.059 (Adjusted r^2 = 0.050) for dBP

Consumption of tobacco

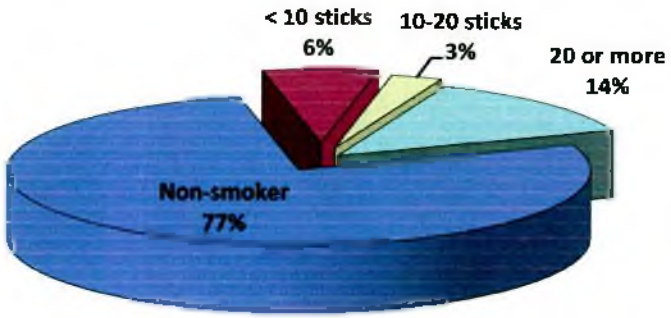
Smokers comprise 22.7% (n=64) respondents (Table-9) and 9.2% (n=26) respondents are non-smoking tobacco users. Thirty eight respondents (13.5%) admitted that they smoked tobacco in the past and stopped at least 06 months back. Among the respondents 72 persons (25.5%) are exposed to passive smoking either at home or at work station. Mean exposure to passive smoking is reported to be 160 ± 12.9 minute per week.

Table-9 Distribution of stage-1 hypertension by tobacco consumption (n=282)

Description	Number	Percentage
Presently Not-Smoking Tobacco	218	77.3
Presently Smoking Tobacco	64	22.7
Previously Smoking Tobacco	38	13.5
Non-smoking Tobacco consumption	26	9.2

Thirty eight respondents (13.5%) comprising 59.4% of the present smokers consume 20 sticks of cigarette or more per week, while 6.4% (n=18) consume less than 10 sticks per week and 2.8% (n=8) consume 10-20 sticks per week (Fig-9).

Fig-9 Quantity of Smoking/week



There is statistically significant relation between quantities of smoking and systolic blood pressure but relation with diastolic blood pressure is not significant (Table-10). For systolic blood pressure adjusted r^2 value = 0.081 (two-tail) F= 2.074 p=0.003. For diastolic blood pressure adjusted r^2 value is 0.08 with F= 1.099 and p=0.346.

Table-10 Correlation between smoking quantity and BP

Dependent Variable: **Systolic BP (baseline)**

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	6017.066(a)	23	261.612	2.074	.003
Intercept	1141334.674	1	1141334.674	9047.273	.000
SMQNTY1	6017.066	23	261.612	2.074	.003
Error	32547.303	258	126.152		
Total	5400144.000	282			
Corrected Total	38564.369	281			

a $r^2 = 0.156$ (Adjusted $r^2 = 0.081$)

Dependent Variable: **Diastolic BP(baseline)**

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	580.428(a)	23	25.236	1.099	.346
Intercept	516321.098	1	516321.098	22483.957	.000
SMQNTY1	580.428	23	25.236	1.099	.346
Error	5924.706	258	22.964		
Total	2350856.000	282			
Corrected Total	6505.135	281			

a $r^2 = 0.089$ (Adjusted $r^2 = 0.008$)

Change of smoking habit-post intervention

At the beginning, 22.7% respondents with uncomplicated stage-I hypertension are found to have smoking habit with an average consumption of 8.7 ± 24.2 sticks per week (Table-10). After 6 months number of smokers reduces to be 50 (17.7%) and quantity of sticks consumption comes down to 5.1 ± 13.9 per week. Number of smokers after 18 month intervention become 30 (10.6%) including drop-outs at different phases taking 2.1 ± 7.8 sticks per week.

Paired-sample t-test between baseline and 6, 12 and 18 month value, indicates significant difference from baseline smoking habit. Calculated t-test value is found to be 4.429 df 257 $p < 0.001$, 5.770 df 223 $p < 0.001$ and 5.480 df 209 $p < 0.001$ (Table-10).

Table-11 Smoking habit change among respondents at different period

Description	Baseline	After 6 m	After 12 m	After 18 m
Number of participants	282	258 (24 drop-outs)	224 (58 drop-outs)	210 (72 drop-outs)
Number of smokers	64 (22.7%)	50 (17.7%)	40 (14.2%)	30 (10.6%)
Mean smoking sticks/wk	8.7 ± 24.2	5.1 ± 13.9	3.6 ± 11.2	2.1 ± 7.8
Mean smoking sticks Change (Per week)		- 2.9 ± 10.5	- 3.2 ± 8.2	- 4.7 ± 12.5
Paired t-test value		4.429 df 257	5.770 df 223	5.480 df 209
p value		< 0.001	< 0.001	< 0.001

Physical Activity - Baseline

Among the respondents with stage-I hypertension, 4.3% are physically inactive, 95.7% are minimally active, 73.8% are moderately active and 25.5% are vigorously active (Table-11). Only 12.8% respondents performed 840 minutes, 9.2 % performed 420 minutes and 6.4% performed 210 minutes of light physical activity. The rest of the respondents had no exposure to light physical labour.

Table 12 Distribution of respondents for physical activity (n=282)

Description	Number	Percentage
Minimally inactive	270	95.7
Moderately inactive	208	73.8
Vigorously inactive	72	25.5
Physically Inactive	12	4.3

Only 12 respondents (4.3%) out of 282 perform 60 min and another 4.3% do 30 minute heavy exercise in an average week. Twenty two respondents 7.8% perform 420 minutes of weekly moderate exercise. Also another 3.5% do 360 minutes, 3.5% do 210 minutes and another 3.5% do 120 minutes of moderate exercise per week. Thirty six respondents (12.8%) do 840 minutes of light exercise per week before any intervention is given. Twenty six respondents (9.2%) perform 420 minutes, and 18 respondents (6.4%) perform 210 minutes of light grade of physical activity in an average week.

Analysis of the physical activities, after removing effects of confounders, indicates significant contribution of physical activity by more mobility hours. For heavy, moderate and light grades of physical activities the statistical F values are 2.773, $p< 0.001$; 3.081, $p< 0.001$ and 2.481, $p < 0.001$ respectively indicating high degree of relationship or dependency between these two variables (Table-13).

Table-13 Tests between physical activity and BP

Dependent Variable: **Hypertension (sBP≥140 &/ or dBP ≥90 mmHg)**

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	.629(a)	18	0.035	2.773	.000
Intercept	54.920	1	54.920	4358.101	.000
HVYXRS1	.629	18	0.035	2.773	.000
a $r^2 = 0.160$ (Adjusted $r^2 = 0.102$)					
Corrected Model	15874.995(a)	52	305.288	3.081	.000
Intercept	2774230.865	1	2774230.865	27999.841	.000
MODXRS1	15874.995	52	305.288	3.081	.000
a $r^2 = 0.412$ (Adjusted $r^2 = 0.278$)					
Corrected Model	15126.256(a)	58	260.798	2.481	.000
Intercept	2956902.744	1	2956902.744	28133.208	.000
LTXRS1	15126.256	58	260.798	2.481	.000
a $r^2 = 0.392$ (Adjusted $r^2 = 0.234$)					

When all types of physical activities are converted into METs, mean value is found 2626.8 ± 1739.1 Met-min/week with median value of 2339.8 Met-min/week. Association of METs- min is tested with systolic and diastolic blood pressure (Table-14). Both Systolic and diastolic BP are found to be significantly dependant on physical activity expressed in METs (adjusted r^2 for sBP=0.819 and for dBP=0.744).

Table- 14 GLM tests between METs and BP

Dependent Variable: **Systolic BP (baseline)**

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	34657.869(a)	124	279.499	11.233	.000
Intercept	4987327.962	1	4987327.962	200437.857	.000
MET1	34657.869	124	279.499	11.233	.000
Error	3906.500	157	24.882		
Total	5400144.000	282			
Corrected Total	38564.369	281			

a $r^2 = 0.899$ (Adjusted $r^2 = 0.819$)

Dependent Variable: **Diastolic BP (baseline)**

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**p**
Corrected Model	5573.801(a)	124	44.950	7.577	.000
Intercept	2188736.292	1	2188736.292	368967.356	.000
MET1	5573.801	124	44.950	7.577	.000
Error	931.333	157	5.932		
Total	2350856.000	282			
Corrected Total	6505.135	281			

a $r^2 = 0.857$ (Adjusted $r^2 = 0.744$)

Physical Activity – Post intervention

Mean baseline heavy physical activity among respondents is found to be 9.8 ± 22.1, 15.8 ± 28.0, 26.7 ± 29.7, and 36.8 ± 35.2 minutes at beginning, after 6, 12 and 18 month respectively (Table- 15). Mean value of moderate physical activity is measured to be 230.8 ± 224.4, 337.9 ± 256.5, 433.1 ± 267.6, and 518.0 ± 275.7 minutes at beginning, 06, 12 and 18 months observation respectively. Mean value of light activity is calculated to be 492.4 ± 380.2, 824.2 ± 432.9, 1133.6 ± 431.7 and 1512.7 ± 438.3 minute respectively at baseline study, after 6 month, 12 month and 18 month.

Table-15 Mean physical activity at different Period

Description	Baseline	After 6 m	After 12 m	After 18 m
Number of participants	282	258 (24 drop-outs)	224 (58 drop-outs)	210 (72 drop-outs)
Mean Heavy Activity (Min)	9.8 ± 22.1	15.8 ± 28.0	26.7 ± 29.7	36.8 ± 35.2
Mean Moderate Activity (Min)	230.8 ± 224.4	337.9 ± 256.5	433.1 ± 267.6	518.0 ± 275.7
Mean Light Activity (Min)	492.4 ± 380.2	824.2 ± 432.9	1133.6 ± 431.7	1512.7 ± 438.3

The mean change of heavy physical activity is 6.4 ± 12.3 minute, 17.9 ± 18.8 minute and 27.7 ± 24.4 minutes after 6, 12 and 18 month intervention respectively (Table-16). This mean change for moderate physical activity is 108.9 ± 96.7 minute, 210.5 ± 136.6 minute and 289.8 ± 171.5 minutes after 6, 12 and 18 month intervention respectively. Similarly for light physical activity change of values are 314.3 ± 232.6 minute, 623.3 ± 261.9 minute and 993.5 ± 318.2 minutes after 6, 12 and 18 month intervention respectively.

Table-16 Physical Activity change in stage-I HTN at different period

Description	Baseline	After 6 m	After 12 m	After 18 m
Number of respondents (Drop-outs)	282	258 (24 drop-outs)	224 (58 drop-outs)	210 (72 drop-outs)
Mean Heavy Activity Change (Min)		6.4 ± 12.3	17.9 ± 18.8	27.7 ± 24.4
Mean Moderate Activity Change (Min)		108.9 ± 96.7	210.5 ± 136.6	289.8 ± 171.5
Mean Light Activity Change (Min)		314.3 ± 232.6	623.3 ± 261.9	993.5 ± 318.2

Physical Activity change in respect of METs

Status of physical activities in terms of METs is obvious from Table-17. The Table also indicates the increased mean change of physical activities at the end of 6m (1524.4±962.7), 12m (3042.6±1152.1) and 18m (4658.9±1395.1).

Table-17 METs status for stage-1 HTN (n=282)

Statistic	METs baseline	METs after 6m	METs after 12m	METs after 18m	Change of METs after 6 m	Change of METs after 12 m	Change of METs after 18 m
N	282	258	224	210	258	224	210
Drop out	0	24	58	72	24	58	72
Mean	2626.8	4197.6	5687.3	7358.5	1524.4	3042.6	4658.9
Median	2339.8	3892.0	5485.8	7188.6	1462.6	2903.5	4586.4
Mode	.00(a)	6280.0	707.8(a)	2966.0(a)	396.0(a)	14.8(a)	2112.0(a)
Std. Deviation	1739.1	2096.4	2193.7	2253.6	962.7	1152.1	1395.1
Minimum	.0	.0	707.8	2966.0	-824.0	14.8	2112.0
Maximum	8984.0	11944.0	13031.8	16110.0	6032.0	8256.0	12762.0

Influence of METs change on BP is shown in Table-18. Sum of square and mean square shows association of METs impact on BP, more on diastolic than on systolic.

Table-18 Tests of ANOVA between-change of METs and change of BP

Dependent Variable: *Change of SBP at 18m*

	Sum of Squares	df	Mean Square	F	p
Regression	115.282	1	115.282	3.531	.062(a)
Residual	6791.785	208	32.653		
Total	6907.067	209			

Dependent Variable: *Change of DBP at 18m*

	Sum of Squares	df	Mean Square	F	p
Regression	91.695	1	91.695	4.389	.037(a)
Residual	4345.429	208	20.891		
Total	4437.124	209			

Height

Mean height is calculated to be 160.1 ± 7.4 cm (male 163.2 ± 5.8 cm, female 153.3 ± 5.8 cm). Median height value is 160 cm (Male 163 cm, female 154cm), and mode value is 160cm (Male 160 cm, female 152cm). Table-19 shows that 36.9% males are in the height range of 160-169 cm, while 22% females are in the height range of 150-159 cm.

Table-19 Distribution of height by sex for stage-I hypertension

Height Group in cm		Male	Female	Total (%)
Up to 140	Count	0	2	2
	% of Total	(0%)	(0.7%)	(0.7%)
140 – 149	Count	6	18	24
	% of Total	(2.1%)	(6.4%)	(8.5%)
150 – 159	Count	66	62	128
	% of Total	(23.4%)	(22.0%)	(45.4%)
160 – 169	Count	104	4	108
	% of Total	(36.9%)	(1.4%)	(38.3%)
170 and above	Count	20	0	20
	% of Total	(7.1%)	(0%)	(7.1%)
Total Count		196	86	282
% of Total		(69.5%)	(30.5%)	(100.0%)

The relation between height and blood pressure gradient is found statistically significant by Levene's Test of Equality of Error Variances through univariate analysis of variances (Table-20). For systolic BP adjusted $r^2 = 0.259$, F= 3.235 p=0.000 and for diastolic blood pressure adjusted $r^2 = 0.224$, F= 2.848 p=0.000.

Table- 20 Test of significance between height and blood pressure

Systolic BP	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	14469.852(a)	44	328.860	3.235	.000
HT1	14469.852	44	328.860	3.235	.000

a $r^2 = 0.375$ (Adjusted $r^2 = 0.259$)

Diastolic BP	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	2249.901(a)	44	51.134	2.848	.000
HT1	2249.901	44	51.134	2.848	.000

a $r^2 = 0.346$ (Adjusted $r^2 = 0.224$)

Weight

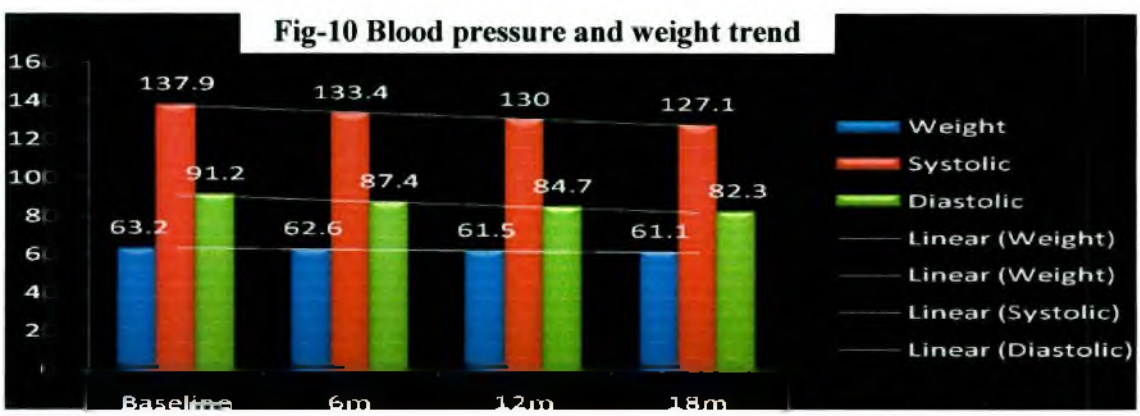
Mean weight is found to be 63.2 Kg ± 8.1 (Male 64 ± 7.5 kg, female 61.3 ± 8.9 kg). The median weight is 62.2 kg and the mode is 60 kg. Range of weight value is from 39 kg to 83 kg in both sexes. Peak weight (n=108; 38.3%) is between 60-69 kg followed by 106 respondents (37.6%) in the weight group 50-59 kg (Table-21).

Independent sample t-test for sex difference for weight showed Levene's test for equality of variances shows F=0.761 p=0.384 meaning non-significant equal variances and hence asking for t-value when equal variances not assumed (t= 2.548 df=139.4 $p < 0.05$ meaning statistically significant difference between male and female.

Table-21 Distribution of stage-I hypertension by body weight and sex (n=282)

Weight (Kg)	Sex		Total
	Male	Female	
Below 40	0 (0%)	2 (0.7%)	02 (0.7%)
40 -49	6 (2.1%)	6 (2.1%)	12 (4.3%)
50 - 59	66 (23.4%)	40 (14.2%)	106 (37.6%)
60 - 69	84 (29.8%)	24 (8.5%)	108 (38.3%)
70 or above	40 (14.2%)	14 (5.0%)	54 (19.1%)
Total	**196 (69.5%)**	**86 (30.5%)**	**282 (100%)**

Fig-10 shows the weight change trend during intervention along with relationship with BP.



Computing ANOVA by GLM shows significant linear correlation of both systolic and diastolic blood pressure with increment of body weight (for sBP r^2 = 0.421, F=2.739, p< 0.001 and for dBP r^2 = 0.451, F=3.094, p <0.001). Adjusted r^2 =0.267 means that 26.7% of the variance of systolic blood pressure can be explained by dependency of sBP on weight. Similarly adjusted r^2 =0.305 means that 30.5% of the variance of systolic blood pressure could be explained by dependency of dBP on weight (Table-22).

Table-22 Test between-body weight and BP at baseline

Dependent Variable: **Systolic BP (baseline)**

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	16245.174(a)	59	275.342	2.739	.000
Intercept	3373918.099	1	3373918.099	33558.998	.000
WT1	**16245.174**	**59**	**275.342**	**2.739**	**.000**
Error	22319.195	222	100.537		
Total	5400144.000	282			
Corrected Total	38564.369	281			

a r^2= 0.421 (Adjusted r^2= 0.267)

Dependent Variable: **Diastolic BP(baseline)**

Corrected Model	2935.551(a)	59	49.755	3.094	.000
Intercept	1441704.907	1	1441704.907	89662.683	.000
WT1	**2935.551**	**59**	**49.755**	**3.094**	**.000**
Error	3569.584	222	16.079		
Total	2350856.000	282			
Corrected Total	6505.135	281			

a r^2= 0.451 (Adjusted r^2= 0.305)

Change of Weight

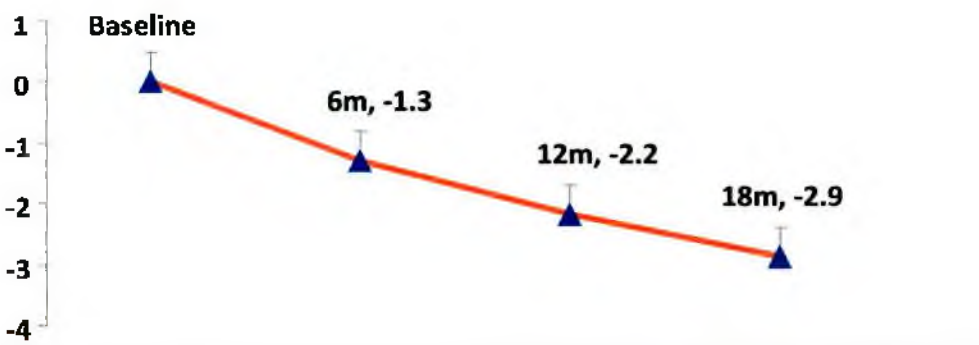
Mean baseline bodyweight of the respondents with stage-I hypertension is 63.2 ± 8.1 kg with median and mode 62.2 kg and 60 kg respectively. After 06, 12 and 18 months intervention mean value became 62.6 ± 8.1 kg, 61.5 ± 7.7 kg and 61.1 ± 7.8 kg respectively (Table-23). The mean changes of weight are - 0.8 ± 2.0, - 1.4 ± 1.8 and - 1.8 ± 1.8 kg after 6, 12 and 18 month respectively. Mean weight changes at baseline and after 6, 12 and 18 months intervention is found statistically significant (Table-23).

Table-23 Body weight change among stage-I hypertensives at different period

Description	Baseline	After 6 m	After 12 m	After 18 m
Number of participants	282	258 (24 drop-outs)	224 (58 drop-outs)	210 (72 drop-outs)
Mean Value (Kg)	63.2 ± 8.1	62.6 ± 8.1	61.5 ± 7.7	61.1 ± 7.8
Mean Change (Kg)		- 0.8 ± 2.0	- 1.4 ± 1.8	- 1.8 ± 1.8
Percentage Change (Kg)		-1.3	-2.2	-2.9
Paired t-test value		6.023 df 257	11.758 df 223	14.411 df 209
p value		< 0.001	< 0.001	< 0.001

Percent reduction of body weight was -1.3, -2.2 and -2.9 Kg after 6, 12 and 18 month respectively (Figure-11).

Fig 11 Percent reduction of body weight



Body Mass Index (BMI)

Mean BMI is 19.7 ± 2.4 kg/m^2 (Male 19.6 ± 2.2, female 19.9 ± 2.8) with median 19.5 (Male 19.6, female 19.7) and mode 19.5 (Male 16.9, female 19.5). Independent sample t-test is performed for BMI to compare the male and female values difference between male and female. The result is found statistically significant (Levene's test for equality of variances showed: F=3.210 significant level 0.074; t= - 2.155 df = 489.340 p= 0.032).

BMI respondents are categorized using the Quetelet's Index (Table-24). More than 65% (n=184) of the 282 stage-I hypertensives are found to have normal body weight, while 12.1% (n=34) are overweight, 18.4% (n=52) are underweight and 4.3% (n= 12) are obese for their respective height. Women are found to be thicker than male members.

Table- 24 Distribution of stage-I HTN by BMI (n=282)

Score for BMI	Description	Number		Total (%)
		Male	Female	
Less than 18.5	Underweight	38 (13.4%)	14 (5.0%)	52 (18.4)
18.5 - 24.9	Normal	137 (48.6%)	47 (16.6%)	184 (65.2)
25.0 - 29.9	Overweight	16 (5.7%)	18 (6.4%)	34 (12.1)
30.0 and above	Obese	5 (1.8%)	7 (2.5%)	12 (4.3)
Total		**196 (69.5%)**	**86 (30.5%)**	**282 (100)**

Univariate analysis of variances confirms the significant relationship between BMI and both systolic and diastolic blood pressure. Adjusted r^2 indicates that nearly 83.7% of the change of systolic blood pressure can be explained by level of BMI (Table-25). For diastolic blood pressure this explanation capacity value is more precise i.e. 95.9%. This established BMI as a stronger determinant for diastolic blood pressure.

Table-25 Tests between-BMI and HTN

Dependent Variable: Systolic BP (baseline)

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	35207.035(a)	131	268.756	12.008	.000
Intercept	5216408.242	1	5216408.242	233060.336	.000
BMI1	35207.035	131	268.756	12.008	.000

(a) $r^2 = 0.913$ (Adjusted $r^2 = 0.837$)

Dependent Variable: Diastolic BP(baseline)

Corrected Model	6362.135(a)	131	48.566	50.943	.000
Intercept	2263271.284	1	2263271.284	2374060.788	.000
BMI1	6362.135	131	48.566	50.943	.000

(a) $r^2 = 0.978$ (Adjusted $r^2 = 0.959$)

Post-intervention outcome

This study started to follow 282 respondents. After 06 months of study, 24 respondents (8.5%) dropped from the study. Another 34 respondents (12.1%) dropped at the end of 12 months. The cumulative drop-out after 12 month is 58 respondents 20.6% out of 282 from the beginning (Table-26). During the follow-up period between 12 months to 18 months 14 more respondents (4.9%) are found dropped. As a whole, 72 respondents (25.5%) dropped from study at the end of 18 month follow-up. Attrition of male members is found to be more than female members in every stage. Drop-out of uncomplicated male stage-I HTN from study is 65.2% in comparison to 34.8% female. Drop-out rate is found to be higher during the follow-up period between 06 month and 12 months periods.

Table-26 Distribution of non-respondents by duration (n=282)

Duration	Respondents started with	Respondents ended with	Number dropped	Percent	Cumulative (%)
6 months	282	258	24	8.5	24 (8.5)
12 month	258	224	34	12.1	58 (20.6)
18 month	224	210	14	4.9	72 (25.5)

As Table-27 shows, BP of 11.3% cases could not be reduced and all of them are referred to the consultant cardiologists to start pharmacological preparations. While 5.7% respondents withdrew their consent to continue study, another 5.7% respondents changed their residents elsewhere at different times of the study period and 2.8% respondents are dropped because of their non-CVD co-morbidity like pregnancy, identification of DM etc.

Table-27 Causes of Drop-out (n=72)

Period	BP not Controlled	Refused to Continue	Address Change	Co-morbidity	Total (%)
After 06 month	8	4	10	2	24 (8.5)
After 12 month	16	12	4	2	34 (12.1)
After 18 month	8	0	2	4	14 (4.9)
Total	**32 (11.3%)**	**16 (5.7%)**	**16 (5.7%)**	**8 (2.8%)**	**72 (25.5%)**

Blood Pressure

Table-28 shows mean systolic blood pressure is 137.9 ± 11.7 mm Hg at beginning of survey. After 6m, 12m and 18m intervention mean systolic blood pressure becomes 133.4 ± 11.4, 130.0 ± 9.5 and 127.1 ± 9.5 respectively.

Mean diastolic blood pressure is 91.2 ± 4.8 mm Hg at baseline survey. After 6m, 12m and 18m intervention mean diastolic blood pressure becomes 87.4 ± 5.7, 84.7 ± 5.1 and 82.3 ± 4.6 respectively.

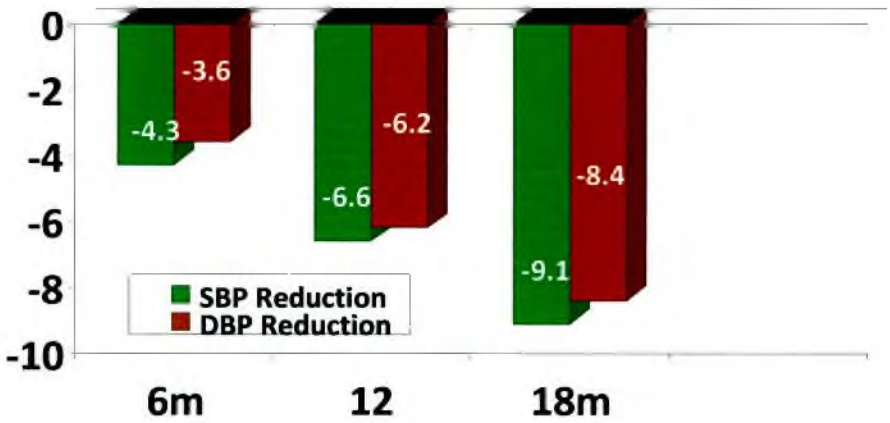
Rate of change of blood pressure is pronounced in sBP and fall of BP is relatively gradual in dBP.

Table-28 Change of Blood Pressure after Intervention

	Systolic Hypertension (mmHg)				Diastolic Hypertension (mmHg)			
	Base	After 06 m	After 12 m	After 18 m	Base	After 06 m	After 12 m	After 18 m
Sample	282	258	224	210	282	258	224	210
Mean Value	137.9 ±11.7	133.4 ± 11.4	130.0 ± 9.5	127.1 ± 9.5	91.2 ± 4.8	87.4 ± 5.7	84.7 ± 5.1	82.3 ± 4.6
Median	140	132	129	125	90	88	85	82
Mode	140	120	118	120	90	90	80	80
Change of BP		- 4.3 ± 6.5	- 6.6 ± 5.7	- 9.1 ± 5.7		- 3.6 ± 4.8	- 6.2 ± 4.5	- 8.4 ± 4.6
Percent reduction		- 3.1	- 4.9	- 7.0		- 3.9	- 7.1	- 9.9

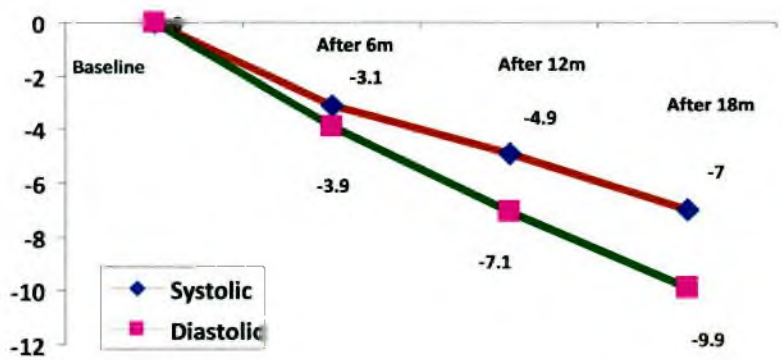
Blood pressure significantly reduces after intervention. It shows a negative mean change of -4.3±6.5 / -3.6±4.8 mmHg after 06 month for sBP/dBP. The change of blood pressure is found to be -6.6± 5.7 mmHg over - 6.2 ± 4.5 mmHg after 12 month of risk reduction intervention. After 18 months of intervention, change of blood pressure (in mmHg) is -9.1±5.7 for systolic blood pressure and - 8.4 ± 4.6 for diastolic blood pressure (Fig-12).

Fig- 12 Change of BP after Intervention



Systolic blood pressure reduces 3.1%, 4.9% and 7.0% after 6m, 12m and 18m intervention respectively while the percentage reduction value for DBP is 3.9%, 7.1% & 9.9% in order (Fig-13).

Fig-13 Percent Reduction of BP during intervention



Paired Sample t- Test (Student t-test) shows significant change of both systolic and diastolic blood pressure at the end of 06, 12 & 18 months intervention (Table-29). Value of t is found to be 10.8 df 257, 17.3 df 223, 22.9 df 209 for systolic blood pressure at the end of 6, 12 and 18 months of intervention respectively. Value of p is < 0.001 in all of the cases. These values for diastolic blood pressure are 12.2 df 257, 20.8 df 223 and 26.5 df 209 respectively with p value < 0.001 in all cases. Mean change of blood pressure at the end of the study is - 9.1/8.4 mmHg.

Table-29 Test of Significance for Change of BP after Intervention

	Systolic Hypertension (mmHg)				Diastolic Hypertension (mmHg)			
	Base	After 06 m	After 12 m	After 18 m	Base	After 06 m	After 12 m	After 18 m
Sample	282	258	224	210	282	258	224	210
Mean Value	137.9 ± 11.7	133.4 ± 11.4	130.0 ± 9.5	127.1 ± 9.5	91.2 ± 4.8	87.4 ± 5.7	84.7 ± 5.1	82.3 ± 4.6
Change of BP		- 4.3 ± 6.5	- 6.6 ± 5.7	- 9.1 ± 5.7		- 3.6 ± 4.8	- 6.2 ± 4.5	- 8.4 ± 4.6
Percent reduction		- 3.1	- 4.9	- 7.0		- 3.9	- 7.1	- 9.9
STD error	0.835	0.403	0.382	0.397	0.349	0.298	0.299	0.318
Paired t-test t-value		10.8 df 257	17.3 df 223	22.9 df 209		12.2 df 257	20.8 df 223	26.5 df 209
p value		< 0.001	< 0.001	< 0.001		< 0.001	< 0.001	< 0.001

Respondents with stage-I hypertension

Among the 282 respondents with stage-1 hypertension, 56.7% (n=160) revert their blood pressure to lower level (7.8% to normal level and 48.9% (n=138) to pre-hypertension level). Blood pressure of 17.7% (n=50) remains in stage-I level but their mean blood pressure reduces from their own baseline level. Blood pressure goes up among 14.9% (n=42) cases inspite of behavioural intervention (Table-30). Other 10.7% respondents were dropped because of causes not related to high blood pressure.

Table-30 Outcome of Intervention : Stage-I Hypertension respondents (n=282)

Outcome	Reversed to Normal BP	Reversed to Pre-HTN	Remained Stage-I HTN	Drop-out		Total
				Went up Stage-II HTN	Other causes	
Baseline			**282**			
After 06 months	14 (5%)	128 (45.4%)	116 (41.1%)	8 (2.8%)	16 (5.7%)	282 (100%)
After 12 months	20 (7.7%)	132 (51.2%)	72 (27.9%)	26 (10.1%)	8 (3.1%)	258 (100%)
After 18 months	22 (9.8%)	138 (61.6%)	50 (22.3%)	8 (3.6%)	6 (2.7%)	224 (100%)
End Result	**22 (7.8%)**	**138 (48.9%)**	**50 (17.7%)**	**42 (14.9%)**	**30 (10.7%)**	**282 (100%)**

Combined Effects of Risk Factors on BP

Multiple regression analysis is done for testing individual role of change of physical activity expressed in METs, change of body weight in Kg, salt intake and change of smoking habit, after removing the effect of age, sex, level of education, yearly expenditure, owner of house, height and intake of beef. For systolic BP reduction of salt intake is found to be the best predictor (Beta =0.273, t= 4.148, p=0.000) followed by increment of physical activity (MET18) (Beta =0.179, t= 2.702, p=0.007) (Table-31). Role of reduction of weight in 18 months is critical to decide (Beta =0.126, t= 1.860, p=0.064) with no significant role of reduction of smoking tobacco (Beta =0.009, t= 0.124, p=0.902) for systolic BP. For dBP weight reduction is also found to have significant role (Beta =0.144, t= 2.038, p=0.043) and smoking contributing no significant reduction (Beta =0.025, t= 0.340, p=0.735) with salt reduction best predictor (Beta =0.173, t= 2.462, p=0.015) followed by METs increment (Beta =0.138, t= 1.982, p=0.049) (Tables-32,33,34,35).

Table-31 Predictor co-efficient and significance for BP at 18m

Systolic Blood Pressure *Predictors*				
Sl. No	**Description**	**Beta**	**t**	**p**
1.	Salt reduction	0.273	4.148	0.000
2.	METs increment	0.179	2.702	0.007
3.	Weight Reduction	0.126	1.860	0.064
4.	Smoking Reduction	0.009	0.124	0.902
Diastolic Blood Pressure *Predictors*				
1.	Salt reduction	0.173	2.462	0.015
2.	Weight Reduction	0.144	2.038	0.043
3.	METs increment	0.138	1.982	0.049
4.	Smoking Reduction	0.025	0.340	0.735

Table 32 Regression model- summary results for sBP at 18m

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.309(a)	.096	.078	5.52003	.096	5.420	4	205	.000
2	.338(b)	.114	.093	5.47621	.019	4.294	1	204	.040
3	.364(c)	.133	.107	5.43251	.018	4.295	1	203	.039
4	.430(d)	.185	.156	5.27998	.052	12.898	1	202	.000
5	.471(e)	.222	.191	5.17191	.037	9.530	1	201	.002

a Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level
b Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk
c Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk, Chicken Intake/wk
d Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk, Chicken Intake/wk, Salt intake after 18m
e Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk, Chicken Intake/wk, Salt intake after 18m, Change of METs after 18 m

Table 33 Regression ANOVA(f) results for sBP at 18m

Model		Sum of Squares	df	Mean Square	F	p
1	Regression	660.557	4	165.139	5.420	.000(a)
	Residual	6246.510	205	30.471		
	Total	6907.067	209			
2	Regression	789.326	5	157.865	5.264	.000(b)
	Residual	6117.741	204	29.989		
	Total	6907.067	209			
3	Regression	916.094	6	152.682	5.174	.000(c)
	Residual	5990.972	203	29.512		
	Total	6907.067	209			
4	Regression	1275.668	7	182.238	6.537	.000(d)
	Residual	5631.399	202	27.878		
	Total	6907.067	209			
5	Regression	1530.585	8	191.323	7.153	.000(e)
	Residual	5376.482	201	26.749		
	Total	6907.067	209			

a Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level
b Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk
c Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk, Chicken Intake/wk
d Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk, Chicken Intake/wk, Salt intake after 18m
e Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Egg intake/wk, Chicken Intake/wk, Salt intake after 18m, Change of METs after 18 m

Table 34 Regression model summary results for dBP at 18m

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	p
1	.135(a)	.018	-.001	4.60974	.018	.952	4	205	.435
2	.199(b)	.039	.016	4.57082	.021	4.507	1	204	.035
3	.245(c)	.060	.032	4.53302	.020	4.417	1	203	.037
4	.299(d)	.089	.058	4.47292	.029	6.491	1	202	.012
5	.339(e)	.115	.080	4.42048	.026	5.821	1	201	.017

a Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level
b Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk
c Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk, Beef intake 18m
d Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk, Beef intake 18m, Salt intake after 18m
e Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk, Beef intake 18m, Salt intake after 18m, Change of weight at 18m

Table 35 Regression ANOVA results for dBP at 18m

Model		Sum of Squares	df	Mean Square	F	p
1	Regression	80.927	4	20.232	.952	.435(a)
	Residual	4356.197	205	21.250		
	Total	4437.124	209			
2	Regression	175.080	5	35.016	1.676	.142(b)
	Residual	4262.044	204	20.892		
	Total	4437.124	209			
3	Regression	265.832	6	44.305	2.156	.049(c)
	Residual	4171.292	203	20.548		
	Total	4437.124	209			
4	Regression	395.707	7	56.530	2.825	.008(d)
	Residual	4041.416	202	20.007		
	Total	4437.124	209			
5	Regression	509.460	8	63.683	3.259	.002(e)
	Residual	3927.663	201	19.541		
	Total	4437.124	209			

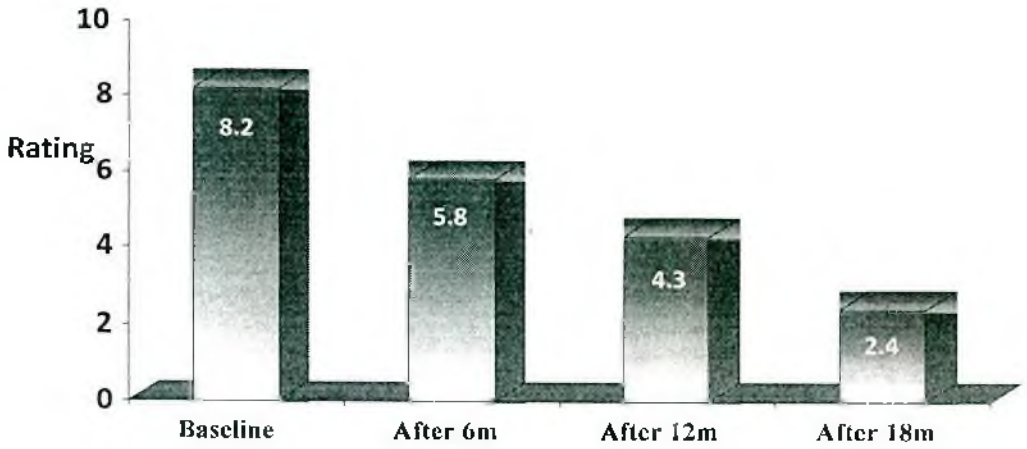
a Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level
b Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk
c Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk, Beef intake 18m
d Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk, Beef intake 18m, Salt intake after 18m
e Predictors: (Constant), Annual FamilyExpenditure, Sex, Age (Completed years), Education level, Mutton Intake/wk, Beef intake 18m, Salt intake after 18m, Change of weight at 18m.

Behavioural Change Outcome

Outcome of subjective behaviour

Perceived change of the respondents about their feeling of wellbeing is assessed with rating scale from '0' to '10' as highest. This is very much individualized but en mass mean reduction is from 8.2 at baseline to 5.8 after 6 month, 4.3 after 12 month and 2.4 at the end of 18 months Fig-14.

Fig-14 Subjective rating about Wellbeing



Outcome of objective behaviour

Average GHQ-28 consistent score reduces from 38 on average to 35 at the end of 6 month, 28 at the end of 12 month and 25 at the end of 18 months intervention (Table-36).

Table- 36 Objective outcome in hypertension intervention

Description	Baseline	After 6m	After 12m	After18m
GHQ-28 Rating	38	35	28	25

Chapter-V

Discussion

Baseline Survey: Prevalence of Hypertension

Prevalence of hypertension (JNC-7 criteria) was found to be 20.1% at this urban study (Fig-2). Mean blood pressure found in this study (121/78 mmHg) was consistent with findings of other studies in Bangladesh. Measurement tools, procedures and protocols adopted in this study were very consistent and valid. This prevalence rate reflected a similar finding by Ali et al[8] who studied among 331 Dhaka University teachers of all levels and also by meticulous survey by Haque (2002).[6] Panel speakers at World Hypertension Day 2008 seminar in Bangladesh also declared that about 15 million peoples in Bangladesh suffer from high blood pressure, the prevalence being 15-20% after analysis of several reports.[116]However the current rate differed in narrow range with some other previous report of 14.4% for systolic hypertension and 9.1% for diastolic hypertension by Sayeed (2002) in Bangladesh. Transition of time, sampling validity, and measurement protocols were factors but still consistent with the present study if time trend is considered.[14] Other recent studies in Bangladesh also reported the prevalence rate of around 14-27% in populations of different age group in the urban areas.[85,86]

Many large studies among developing country population showed 14-26% prevalence rate. An Iranian study showed similar statistics of 25.2% hypertension in 25-64 year of age.[117]Extensive studies on adult Chinese population aged 35 to 74 years were done to find out the sickness pattern in the community. Hypertension was found to be present among 27.2% of the peoples. But the population in that particular study was a little older by age group.[77]

Baseline survey: prevalence of Pre-hypertension

Prevalence of Prehypertension was found to be 34.3% in this study when patients were catered through door-to-door survey. In a Netherland study among African Surinamese, Hindustani Surinamese and white Dutch in Amsterdam prevalence of prehypertension was reported to be 32.8% (men 37.9%; women 29.9%).[118] Jamaican study used data from Jamaica Lifestyle Survey conducted from 2000–2001 and reported a prehypertension prevalence rate of 30% (95% confidence interval [CI] 27%–33%) among 2,012 participants aged 15–74 years old. Prevalence was more common among males (35%,) than in females (25%).[119]

Japanese evaluated 4,706 males and 7,342 females aged 18 to 90 years for the prevalence and determinants of prehypertension in general population. Prevalence of prehypertension was 34.8% among males, and 31.8% among females.[120] A survey among 36,424 Israeli defense forces found the prevalence of 35.9% prehypertensives among women employees. This study is very close to our study by prevalence rate.[121]

Turkish study on 4,809 adults in central province of Trabzon and nine towns found 44.0 % prehypertensives (male 46.1%; female 41.6%).[122] Chinese rural area study on 45,925 adults aged 35 years or more showed 44.1% prehypertensives (male 48.7%; female 39.6%). Here the age group was older than any other study. Hence prevalence would be reduced if the sample is standardized for younger age group.[123] United States National survey in 1999-2000 among 4,805 American adults aged 18 years and above was found 60% prevalence of Prehypertension.[124]

Previously there was a definition paradox among the studies for defining hypertension and grading of blood pressure. Most of the previous studies were done when hypertension was defined as the blood pressure of 160/90 mmHg. With changing cut-off

values specificity and sensitivity of the research outcome would be altered. Again difference of prevalence value can be explained to some extent by referring sensible explanations like poor analytical design, unclear generalization of data, measurement skill, uniformity of measurement protocols and age of the target population. Protocol for measurement of blood pressure is also a determinant like standardization of the tools for comparing the different reports. In the present study hypertension was defined as a sBP of ≥ 140 mmHg and or a dBP of ≥90 mmHg and all measurements, including height-weight, were done stringently according to current WHO protocols.

Seasonal variation is a factor for study on blood pressure. It was not considered in many study designs in many countries. But global protocols like MONICA considered consistently the impact of seasonal variation on cardiovascular risk factors study. To examine and nullify the effect of seasonal variation an intervention study was done for two year with field trial for 18 continuous months. MONICA study protocol adopted some epidemiological techniques to avoid seasonal variation of some of the cardiovascular risk factors. The study addressed meticulously those factors during to minimize the effects of seasonal trends. The seasonal differences between the survey periods could be seen with different outcome measures. The *month difference*, between each pair of surveys by age group and sex, has been defined as the proportion-months needed to move the months of one survey completely on top of the months of the other survey. The maximum value of 6 is attained only in the case where both surveys were done within one month and exactly at the opposite ends of the year. The month difference is 0 (zero) when the proportional month distributions of the two surveys overlap completely.[125]

Demographic profile

Hypertension was found to be more prevalent at the most productive age group (Fig-3). Age was found to be a determining factor for developing high blood pressure which showed a steeping linear relationship with advancing age. As the age advances, stage-I hypertension prevalence increases up to 45 years of life. Then co-morbidity starts and unchallenged stage-I hypertension becomes stage-II hypertension after that age group. With advancing age-group, peoples develop more complications and additional sickness with hypertension like anxiety, stress, dyslipidaemia, impaired glucose tolerance or any form of degenerative, coronary or renovascular diseases. And these groups of patients were excluded from the present study. Testing hypertension against age with General Linear Model for Univariate variable, Levene's Test of Equality of Error Variance showed significant correlation and 25.8% predictive ability for systolic blood pressure and 34.2% for diastolic blood pressure by the change of age.

In this study male dominance was markedly high (196 male to 86 female i.e. 2.28:1). Females scarred to give written consent and participate in the follow-up counseling sessions as volunteer. Females were found very enthusiastic at the beginning but during consent they declined more than males. Many females could not be included because they used hormonal contraceptives and declined to quit pills without husband's direction. Pregnancy, lactation and other maternal morbid causes were reasons to cater reduced number of women in the study. Prevalence of hypertension was found more among males before 45 years of life (Fig-3). From that age group difference between male and female for hypertension reduced. After menopausal age significant relation could not be found between males and females. This can be explained by the protection of women at early age by serum oestrogen level.[126]

Married people showed more prevalence of stage-I hypertension (Table-3). It may be related to the increasing age and also partly might be to increased anxiety, tension and social burden after marriage. Male married showed more pevalence than the females.

Family history of hypertension, in first degree family members, was found positive among 63.1% (n=178) peoples which is inconformity to other studies (Fig-4).[127,36]One sample t-test result showed significant difference (t= 19.61 df 281 $p < 0.001$) between positive and negative responses for family history.

Socio-economic risk factors

Respondents did not feel free to disclose annual income during pretesting and hence annual family expenditure, owner of houses, possession of wealth and house rent with bills were adjusted for labeling the socioeconomic strata. Most of the peoples had moderate annual expenditure with average 4.5 ± 1.8 members in the family meaning satisfactory calorie intake (Fig-6). Average ability of the population to intake sufficient food or calorie is also reflected while BMI was calculated. This study showed more prevalence of stage-I hypertension among lower or middle class of respondednts (Fig-6). Rich peoples are more aware about hypertension and take their treatment earlier. Hence the scenario of middle-class respondents with hypertension was more reflected in this study.

The study area comprised about 47.8% respondents with higher education level. Low illiteracy rate of 8.6% represented mostly the housemaids and odd job assistants at domestic level. There are formally reported 07 universities, 07colleges, 10 English medium schools and 01 medical college in this locality.[105]Number of higher education institutes are rapidly increasing in this area referring higher educated groups in the locality.[128]

Service was the top ranking occupation (48.2%) among the respondents logically comparable to formal data of the area by the government census revealing service 32.91%, wage laborer 2.95%, industry 1.95%, commerce 22.11%, construction 3.67%, transport 16.29%, renting out 2.85% and others 17.27%. Current study conforms to the national census information and hence proves study accuracy.[105] Service holders posses more tension, anxiety and busy schedule challenging adverse environment in many a time. Hence they may suffer more from hypertension than members of the other professions.

Diet and salt

Dietary habit showed carbohydrate hypertension more common among fast food eaters (Table-5). This is common food transition habit specially among the relatively younger population. If this trend persists, it might be very difficult, if not impossible, to control hypertension and other non-communicable diseases.

Relationship between use of extra table salt and blood pressure was tested with multinominal regression analysis showing statistically significant association. The chi-square statistic obtained was the difference in -2 log-likelihoods between the final model and a reduced model. This reduced model was equivalent to the final model because omitting the effect did not increase the degrees of freedom. The reduced model was formed by omitting an effect from the final model. The null hypothesis was that all parameters of that effect were zero. This observation strongly indicated role of salt intake as causation of hypertension as was found in other studies.[30] This study also statistically proved that reduction of salt intake could significantly reduce both systolic and diastolic blood pressure (Fig-8). Salt was also found to be the best predictor for occurance and reduction of both systolic and diastolic blood pressure (Table-31).

Extra salt intake was reduced from 44% at beginning of intervention to 1.8% at the end of 18 month intervention. This change of reduced salt intake significantly influenced change of both systolic and diastolic blood pressure. And again when tested in reduced model by multiple regression analysis salt reduction was found to be best predictor (t=4.148; p=0.000 for sBP and t=2.462; p=0.015 for dBP) for reducing both systolic and diastolic blood pressure compared to other behavioural determinants. Salt reduction contributes more for systolic blood pressure reduction than comparable diastolic blood pressure reduction. In brief, salt intake is found significantly associated with causation of blood pressure and also reduction of salt intake significantly contributes to reversal of blood pressure.

Tobacco consumption

Data collection for tobacco consumption was a very tedious job. Almost all of the respondents were careful enough before confessing tobacco consumption because of the recent promulgation of anti-smoking act in the national parliament. Young respondents did not feel free to give information on smoking habit in front of the elder members of the family. However prevalence of 22.7% smoking tobacco (Table-9) is consistent with another study among residents of adjacent neighbouring zone in Mohammadpur. Studied in 2002 among peoples of 25-34 years age group, they found 21.1 % smokers in the adjecent area.[129]

Regression model analysis revealed relation of tobacco consumption with systolic blood pressure. Significant statistical value (F= 2.074, p=0.003) tends to be an estimate of how well the model fits the population and the adjusted r^2=0.081 closely reflects the goodness of fit of the model. In another hospital based study Haque found similar result of 52% smokers among 310 hypertensives studied in urban Dhaka.[130]

Smoking influenced diastolic blood pressure (t=0.340, p=0.735) more than systolic blood pressure (t=0.124, p=0.902). Smoking was not a significant predictor for reduction of blood pressure in this particular study, however smoking has many other deleterious and life threatening effects on human health and survival. So impact of smoking was not ethically highlighted here.

Physical activity

Only 4.3% respondents performed 60 min heavy physical activity in an average week and another 4.3% did 30 minute only. This is a typical scenario for a middle-class sedentary society.[131] Similar baseline study in 2002 among 988 residents of 25-64 year age group showed that only about 2.9% respondents perform heavy physical activity in an average week. The mean physical activity time in that study was 84 minute in an average week.[129]

Increment of physical activity influenced systolic blood pressure more than diastolic blood pressure (F=4.389; p=0.037 for change of METs). Moderate grade of physical activity influenced more for reversal of hypertension (F=1.956, p=0.052 and F=2.719, p=0.007 for change of METS for sBP; and F=2.032, p=0.043 for change of METS for dBP). Increment of physical activity was found to be an effective and efficient predictor for both systolic and diastolic blood pressure (Table-31).

Behavioural changes

An important issue was the quality of life of the respondents and reduction of behavioural risk. Subjective behaviour outcome of the respondents were evaluated and assessed after 6m, 12m and 18m of intervention. Reduction of stressful condition and tension about health or life events were reduced after intervention. Respondents felt well and compatible with the new health problem and could reduce anxiety and got improved in their

decision making ability after the counseling. Physical and mental relaxation training made them comfortable, habituated them to quit smoking, doing more physical activity, many of them started morning prayer or yoga and could reduce their blood pressure.

Indices of wellbeing and behavioural changes were quite satisfactory in this study. Reduction of anxiety, improvement of the depressive state of mind and hence the quality of life of the hypertensives were improved and hence blood pressure could be lowered without any adverse health hazard report from the respondents. Good patient compliance and adhering to the study also is a good indicator of good rapport and relationship between the researcher and the respondents. The respondents could maintain their trust and dependency upon the researcher about the beneficial effects of the study without doing harm. Group counseling was very much effective for changing the behaviour, especially the smoking or chewing tobaccos. All these factors contributed to reduction of blood pressure, reduction of weight, reduction of salt intake, reduction of smoking and increment of physical activities.

Among the scales for evaluating behavioural component of respondents, subjective perception of mental health is measured by both the GHQ-28 and the MH 1–5 scale of the SF-36. MH 1–5 questionnaire is shorter and administratively easier to introduce into routine cardiological practice. But SF-36 does not take into consideration a sleep variable and has a low response rate in the population with age more than 65 year. On the other hand, PHQ-9 score $\geq$10 had a sensitivity of 88% and a specificity of 88% for major depression and can even be used over the telephone. But PHQ-9 is not suitable for community intervention research. Hence cognitive, behavioural, affective, physiological, social and motivational domains were assessed before and after intervention by better fitting GHQ-28.[109-111]

Behavioural models emphasized sympathetic, empathetic and supportive relationship with respondents, non-confrontational approach, explaining reliably benefits of behavioural change and counseling respondents to choose consciously adaptable behavioural changes for reducing blood pressure. Theories of learning and changing behaviour were adopted for effective outcome. Psychoanalytic, humanist and cognitive approaches were adopted for changing towards healthy behaviour of the respondents with stage-I hypertension.

Relaxation exercise comprised of *progressive muscular relaxation, breathing relaxation, and imagery relaxation*. The study ended with ensuring better quality of life through reduction of subjective behaviour rating consistently and also reduction of GHQ-28 scoring after counseling.

Anthropometric measurement

Statistical association of height with both systolic and diastolic blood pressure was significant. The r^2 value of 0.375 meant that 37.5 % cases of the relationship between height and sBP can be explained with this test and similarly r^2 value is 0.224 means that 22.4 % cases of the relationship of height with dBP can be explained (Table-20). Regression analysis depicted significant direct linear correlation of body weight increment independently with both systolic and diastolic blood pressure. Dependency of the variance of diastolic blood pressure on body weight is more than systolic blood pressure (adjusted r^2 =0.267 for sBP vs adjusted r^2 =0.305 for dBP).

About 65.2% of the 282 respondents were found to be of normal by BMI. Mean BMI in this study was 19.7 ± 2.4 kg/m^2 (Male 19.6 ± 2.2, female 19.9 ± 2.8). Zaman (2003) studied on 669 peoples in a rural area near Dhaka city and found mean BMI 19.4 for male and 19.7 for females.[132] Present report also resembles to reports of Ahmed (1998) where 19.0

was the mean BMI in urban slum.[133] This result reflects the study area with relatively good nutrition, education level and socio-economic parameters. In this study, like other studies in Bangladesh, females were found more obese than males (8.9% female vs 7.5% male). Ali (1987) worked among 332 Dhaka University teachers and also found that obesity was present more in female (14.8%) than in male (4.4%).[134]

The underweight component of the sample was 18.4% which can be compared to 21.18 Kg/m^2 (n=4,150) in a large study finding by Mascie-Taylor.[135]This comparative observation homogeneity recommends degree of reliability, precision, acceptability and generalizabilty of the current data set as well as the analytical procedures.

Change of mean body weight is significantly reduced from 63.2 kg at baseline to 62.6 kg after 6 month, 61.5 kg after 12 month and 61.1 kg after 18 month intervention. Change of body weight significantly induced change of both systolic and diastolic blood pressure ($F=3.129$, $p=0.000$, $r^2=0.378$ for sBP and $F=3.129$, $p=0.000$, $r^2=0.378$ for dBP). Impact of isolated weight reduction is found more on systolic blood pressure but when checked after reduction of influence of other factors by multiple regression analysis the scenario changed. Percent contributors for change of body weight ranked second for diastolic blood pressure and ranked third for systolic blood pressure as predictors to influence blood pressure.

Post-intervention outcome

Drop-out rate during intervention was acceptable (8.5% at 6m, 12.1% at 12 months and 4.9% at 18 month follow-up) in respect to any community trial for 18 month duration in a developing country perspective. Duff (2003) started similar intervention at specialized hospital with 80 patients. After 6 month 42 cases attended monthly follow-up clinic and 38 patients attended only one follow-up at the end of 6 month meaning a 40.5% drop-outs.[32] This comparison with Duff study indicates good rapport between researcher and respondents, confidence of respondents on researcher and effective motivational approaches in this study.

Mean change of systolic/ diastolic blood pressure was -4.3/-3.6 mmHg after 6 month intervention, -6.6/-6.2 mmHg after 12 month and -9.1/-8.4 mmHg after 18 month. This is consistent and comparable to study outcome of Apple (1997)[16,17,89] who could reduce BP by -11.4/-5.5 mmHg on 133 respondents in 3 weeks and -5.5/-3.0 mmHg on 459 respondents in 11 weeks by DASH plus intervention comparing to controlled diet. Canadian study by Hill [95] studied on 309 hypertensives over a period of 24 months and could reduce BP -7.2/-14.3 mmHg by non-pharmacological approaches only.

UK researcher Aucott (2005) reviewed literature published during the period 1966 to 2001 describing regarding reversal of high blood pressure through reduction of body weight. After analysis, he concluded that every 10 kg reduction of body weight can cause reduction of -4.6/-6.0 mmHg BP during a period of 24 month.[88]

STEPS study in the Department of Community and Family Medicine, University of Missouri- Kensas City, USA[136] and NICE, UK[91] recommended that low calorie diet can reduce 5-6 mmHg sBP (40% people can reduce sBP 10mmHg in 1 year), exercise can reduce 3-5 mmHg sBP (30% people can reduce sBP 10mmHg over 1 year) and these factors in

combination can reduce 4-5 mmHg sBP and up to 25% people can reduce sBP by 10mmHg in 1 year.[136]

Premier Study jointly conducted intervention follow-up on 810 individuals at Duke Hypertension Centre, the Sarah W Stedman Nutrition and Metabolism Centre along with Duke University Medical Centre at Durham. NC, USA to find impact of Dietary Approaches to Stop Hypertension (DASH) plan to lower BP. That study reported reduction of -6.0 mmHg systolic BP (cf. present study -4.3 mmHg) after 6 month established life style interventions.[17]

A similar study, the Trials of Mild Hypertension Study (TOMHS) was a four-year trial on 902 stage-I hypertensives (62 % males, 80 % non-Black, mean age of 55 years). That study tested the effects of multi-factorial intervention like weight loss, reduction of sodium intake, increment of physical activity, and reduction of alcohol intake. Average within-group BP changes were 10.6 mmHg reduction in sBP and 8.1mmHg reduction in dBP. This study results are very close to this present study outcome.[137]

Percent reduction of blood pressure in this study is encouraging (7.0% sBP vs 9.9% dBP after 18 month intervention). Mean sBP reduced more than mean change of dBP (-9.1/-8.4 mmHg). But percent reduction of blood pressure was less in case of dBP. This is due to the lower baseline value of dBP than sBP and also the low range value of dBP than sBP (dBP 33 mmHg Vs sBP 48 mmHg).

The Trials of Hypertension Prevention-Phase II (TOHP2), multicentre 2x2 factorial designs, study conducted to test the long-term effects of weight loss and/or a reduced salt intake on hypertension. The study was done on 2,383 overweight middle-aged adults.[138]After six months intervention, the incidence of hypertension was lowest in the combined weight loss/reduced sodium group (2.7 percent), intermediate in the weight loss (4.2 percent) and

sodium reduction (4.5 percent) groups, and highest in the usual care group (7.3 percent). At 18 months, same scenario persisted. Through the entire 36-48 months follow-up, the incidence of hypertension significantly reduced in each lifestyle intervention group than in the matched usual care group. In spite of the complex TOHP2 interpretation, the pattern of hypertension gradient at 6 and 18 months suggests additive effects of the weight loss and reduced sodium intake interventions.[138]

Another aspect of the study outcome was the reversal of respondents suffering from hypertension. In this study 56.7% of repondents could become non-hypertensive after 18 months. Some 7.8% of them became normal by blood presure after an intervention period of 18 month over-crossing the prehypertensive range. This is really an encouraging outcome. Duff (2003) gave intervention for 6 months and followed for one year and found reversal of 28% hypertensives to normal at the end of six month and 26% at the end of 1 year through life style modification counseling.[32] His result was much influenced by number of drop-out cases since it was a hospital based study. Careful inclusion of the respondents at the beginning, routine follow-up, quality information and holistic health care support to the respondents and their families made the drop-out to reduce at the present study. The total outcome of the study was statistically significant and consistent with other national or overseas studies in different perspectives.

Chapter VI

Conclusion
Recommendation

Conclusion

Prevalence of hypertension in Bangladesh has been increasing silently but significantly. This study found association of elevated blood pressure with sedentary life style, increased intake of fat-rich fast food and unhealthy behaviour pattern. After 18m follow-up, important and significant determinants for reversal of blood pressure were found to be reduction of extra table salt intake, increment of physical activity and reduction of body weight through healthy balanced dietary habit. This study also showed that reduction of blood pressure through repeated structured behavioural counseling resulted better quality of life of the respondents with high blood pressure. Combined and co-ordinated behavioural risk reduction efforts could reverse hypertension from stage-I to prehypertension or normal level in 56.7% cases in 18 month.

This study was conducted on a middle class community of Dhaka city and indicated trend of high blood pressure directed towards middle class population rather than the richer portion of the society or community. Increased body weight, excess extra sodium chloride consumption, and lack of physical activity were found out as statistically proven modifiable risk factors for rising of blood pressure. After decreasing body weight, reducing salt intake and increasing physical activity, blood pressure could effectively be lowered down. Definite relation of increased weight has been found in this study. Smoking habit quitting has a supportive effect on controlling hypertension.

Only 14.9% respondents with stage-I hypertension could not get benefit from lifestyle modification in 18 months as they developed stage-II hypertension and required pharmacological drugs. Hence in clinical care settings, uncomplicated stage-I hypertension can be followed for 18 months without drugs if there is no compelling indication.

This study quantifies the grade and degree of blood pressure reduced with modification of the common behavioural risk factors. Control of these risk factors needs awerness campaign, social motivation, political desire and institutional care. Eighteen month intervention is a brief period for such a vital life saving or threatening issue and hence prolonged intervention with cohort follow-up with 'cross-over' model can better explain relative risk of the individual factors. In one phrase this study endorsed the need for a CVD risk assessment and management package to facilitate hypertension care in under-resourced settings with the nation-wide long-term goal. The study concludes with expectation that blood pressure treating clinicians shall pay attention to this study finding and consider these findings as essential tools while managing hypertensive patients.

Recommendation

At the end of this study, it is statistically and clinically evident that blood pressure is reduced and reversed by 56.7% through modification of life style and adopting healthy behaviour or dietary practices. Inferences from this study might be-

1. Clinicians can use tools/outcomes of this study for managing stage-1 hypertension at their own clinical care settings.
2. A state-based STOP-HYPERTENSION type national campaign should be started right now as primordial or primary prevention against early occurrence of high blood pressure. Hypertension study and follow-up period to be increased with more resource allocation.
3. Study needs multicentre approach for more elaborate and more representative research outcome. Meta-analysis and if possible network analysis of different study outcomes should be attempted.
4. Promotion should be started for taking healthy balanced diet with reduction of saturated fats at diet, rather encouraging diet containing monounsaturated fatty acids for calorie, reduced animal fat intake and no extra salt intake.
5. Increment of daily walking habit should be campaigned. Ten minutes of move-around after every main meal in addition to the regular physical activity can be advocated. Work place and leisure time physical activity should be encouraged for sedentary working people.
6. Consumption of tobacco in any form must be censored and discouraged along with putting bar on promotion and trading of tobacco with high taxation.

7. Authentic legislation and implementation tools have to be ensured by the state machinery for reduction of tobacco consumption.
8. Health education can be given to the people regarding general health awareness and high-risk group vulnerability focusing on childhood obesity at school or family health level.
9. Finding of this study recommends further research with more time, more resources and larger number of data set.

These are the measures government of Bangladesh may give more focus to build a healthy next generation.

Chapter-VII

References

Reference

1. WHO Regional Office for South-East Asia. Non-communicable diseases. Geneva, 2009 http://www.searo.who.int/en/Section1174/Section1459.htm accessed on 26 March, 2009.
2. Ghaffar A, Reddy KS, Singhi M. Burden of non-communicable diseases in South Asia. BMJ 2004;328:807-810 (3 April), doi:10.1136/bmj.328.7443.807
3. Vasan RS, Benjamin EJ, Sullivan LM, D'Agostino RB. The burden of increasing worldwide cardiovascular disease. In: Fuster V, Alexander RW, O'Rourke RA, editors. Hurst's The Heart. 11th ed. New York: McGraw-Hill; 2004:15
4. WHO. Integrated management of cardiovascular risk. Geneva: WHO, 9-12 July 2002:36-37. http://www.who.int/cardiovascular_diseases/media/ accessed on 02-06-2008
5. Malik A. Congenital and acquired heart diseases. Bangladesh Med Res Council Bull 1976;11:14
6. Haque KMHSS. Prevention and control of cardiovascular diseases- Bangladesh perspective. Proceedings of Japan-Bangladesh Joint Conference on Cardiovascular Diseases, Dhaka; 2002; 17 : 23-24
7. Hussain A. Cardiovascular diseases in the rural community of Bangladesh. Paper presented at Japan-Bangladesh Joint Conference on Cardiovascular Diseases, 31 Jan-01 Feb 1984; Hotel Sonargaon, Dhaka.
8. Ali SMK, Chowdhury MMH, Halim A, Quazi S, Islam N, Rahman M, Mohiduzzaman M, Malek MA. Pattern of cardiovascular disease among Dhaka University teachers. Bang J Nutr Dec 1987;1(1):26-33.
9. Ullah W. Hypertension in a mixed community. Bangladesh Med Res Counc Bull. Dec 1976; 2(2): 95-99.
10. Islam N, Janan FAJ, Chowdhury A, Ahmed Z, Mathura KC. Hypertension in secretariat population of Bangladesh. Bangladesh Med Res Counc Bull, June 1979; 5(1):19-24.
11. Chowdhury AKMN, Alam MN, Ali SMK. Dasherkandi Project Studies: Demography, morbidity and mortality in a rural community of Bangladesh. Bangladesh Med Res Council Bull 1981;7: 22–39.

12. Islam N, Khan M, Latif ZA. Hypertension in the rural population of Bangladesh- a preliminary survey. Bangladesh Med Res Counc Bull, June 1983; 9(1):11-14.
13. Begum JA, Shahidullah M, Saiduzzaman AF, Zaman S. Comparative study of hypertension in three different places of Bangladesh. JOPSOM. Dec 1984; 3(2): 17-22.
14. Sayeed MA, Banu A, Haq JA, Khanam PA, Mahtab H, Khan AKA. Prevalence of hypertension in Bangladesh: effect of socioeconomic risk factor on difference between rural and urban community. Bangladesh Med Res Counc Bull. 2002 Apr;28(1):7-18.
15. Haque KMHSS, Ali SMK, Alamgir AKM. Prevalence and reversal of hypertension in an urban community in Bangladesh. In: Adhikary AB, editor. Bangladesh Heart Research Association. Proceedings of National Cardiac Conference and 9th Annual General Meeting; 2008 April 25; Radisson Water Garden Hotel, Dhaka:20-21.
16. Appel LJ, Champagne CM, Harsha DW, Cooper LS, Obarzanek E, Elmer PJ, et al. Writing group of the PREMIER Collaborative Research Group. Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA. 2003 Apr 23-30; 289(16):2083-93.
17. Svetkey LP, Erlinger TP, Vollmer WM, Feldstein A, Cooper LS, Appel LJ, Ard JD, Elmer PJ, Harsha D, Stevens VJ. Effect of lifestyle modifications on blood pressure by race, sex, hypertension status, and age. J Hum Hypertens, 2004 Sept 23. doi:10.1038/sj.jhh.1001770 viewed on 06 Oct, 2006.
18. Bobak M, Hertzman C, Skodova Z, Marmot M. Socioeconomic status and cardiovascular risk factors in the Czech Republic. Int J Epid 1999;28:46-52.
19. Tezcan S, Altintas H, Sonmez R, et al. Cariovascular risk factor levels in a lower middle-class community in Ankara, Turkey. Trop Med Int Health 2003 Jul;8(7):660-7. [PubMed]
20. Sheikholeslam R, Mohamad A, Mohammad K, Vaseghi S. Non communicable disease risk factors in Iran. Asia Pac J Clin Nutr. 2004;13(Suppl):S100.
21. Harris GD, White RD. Lifestyle modifications for the prevention and treatment of cardiovascular disease: an evidence-based approach. Mo Med. 2004 May-Jun; 101(3): 222-6.

22. Chowdhury NA, Hayee MA, Alam N. Study of complications in hypertensives patients having irregular treatment. Bangladesh Med Res Counc Bull, 1993; 19(1):86-93.

23. Rahman AKMF, Haque KMHSS, Hossain N, Chowdhury AHK, Uddin MJ, Ali M. Acute myocardial infarction in hypertensive patients: a comparison of clinical outcome in hypertensive and normotensive patients. Chest and heart journal, 2000;14(2):69-76.

24. Das PK, Mohsin K. Isolated systolic hypertension and cardiovascular risk: an update. J Comilla Med coll Teach, 2003; 5(1): 38-40.

25. World Health Organization, International Society of Hypertension Writing Group. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. Journal of Hypertension 2003, 21:1983–1992.

26. Ramsay LE, Williams B, Johnston GD, et al. BHS Guidelines. Guidelines for management of hypertension: report of the third working party of the British Hypertension Society. Journal of Human Hypertension (1999) 13, 569–592

27. Williams B, Poulter NR, Brown MJ, Davis M, McInnes GT, Potter JF, Sever PS, Thom SMcG. British Hypertension Society Guidelines. Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society, 2004—BHS IV. Journal of Human Hypertension, 2004; 18: 139–185.

28. US Department of Health and Human Services. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7). NIH Publication No. 03-5233; May 2003: 2-3.

29. Kastarinen MJ, Puska PM, Korhonen MH, Mustonen JN, Salomaa VV, Sundvall JE, Tuomilehto JO, Uusitupa MI, Nissinen AM; LIHEF Study Group. Non-pharmacological treatment of hypertension in primary health care: a 2-year open randomized controlled trial of lifestyle intervention against hypertension in eastern Finland. J Hypertens. 2002 Dec;20(12):2505-12. [Pubmed] [Abstract]

30. Sacks FM, Svetkey LP, Vollmer WM, et al. The DASH–Sodium Collaborative Research Group. Effects on blood pressure of reduced dietary sodium and the dietary approaches to stop hypertension (DASH) diet. *N Engl J Med,2001;* 344 (1):3-10.

31. National Institute for Clinical Excellence (NICE). Clinical Guideline18- Hypertension: management of hypertension in adults in primary care. London: NHS, August 2004:12.

32. Duff EM, Wilks R. Six-month hypertension intervention study. One year follow-up. West Indian Med J. 2003 Sep;52(3):219-22.

33. Shaheen S. Lifestyle modification as a means to treat stage-I hypertension [Dissertation]. Dhaka: Dhaka University, June 2004.

34. Akhteruzzaman S. Molecular Genetics of Human Hypertension: New Treatment Approach. BJMS, March 2003;9(1): 51-57.

35. Beilin L. Epidemiology of hypertension. Medicine International 1993;21(9):351-354.

36. McCusker ME, Yoon PW, Gwinn M, Malarcher AM, Neff L, Khoury MJ. Family history of heart disease and cardiovascular disease risk-reducing behaviors. Genet Med. 2004 May-Jun;6(3):153-8.

37. Chakraborty B. Risk factors for coronary artery disease for Bangladeshis: Do they differ from western population. J Bangladesh Coll. Phys Surg. 2000;18:44-46.

38. Saha SK. Diabetes and coronary atherosclerosis: The Tale of a Twin Disease. BJMS 2000;6(2):38-41.

39. Masuo K, Mikami H, Ogihara T, Tuck ML. Weight gain-induced blood pressure elevation. Hypertension, May 2000;35:1135-1140.

40. Julius S, Valentini M, Platini P. Overweight and hypertension A 2-way Street? Hypertension, 2000;35:807-813

41. Khatun H. Managing psychological problems of patients with essential hypertension [thesis]. Dhaka: Dhaka University (Dept. of Clinical Psychology), March 2009: 12-16.

42. Lijing LY, Kiang L, Mathews KA, Daviglus ML, Ferguson TF, Kiefe CI. Psychosocial factors and risk of hypertension: The coronary artery risk development in young adults (CARDIA). JAMA, 2003;290: 2138-2148.

43. Vrijkotte TGM, van Doormen LJP, de Geus Eco JC. Effects of work stress on ambulatory blood pressure, heart rate, and heart rate variability. Hypertension, 2000; 35:880-886]

44. WHO. The World Health Report 2002. Reducing risks, promoting healthy life. World Health Organization, Geneva, Switzerland, 2002.

45. Hypertension Study Group. Prevalence, awareness, treatment and control of hypertension among the elderly in Bangladesh and India: a multicentre study. Bulletin of the World Health Organization, 2001;79(6):492-3.

46. Basnyat B, Rajapaksa LC. Cardiovascular and infectious diseases in South Asia: the double whammy. innovation, political commitment, and new partnerships are needed. [Editorial] BMJ 2004;328:781.

47. Vasan RS, Benjamin EJ, Sullivan LM, D'Agostino RB. The Burden of increasing worldwide cardiovascular disease. In: Fuster V, Alexander RW, O'Rourke RA, editors. Hurst's The Heart. 11th ed. New York: McGraw-Hill; 2004:16.

48. Silverman ME, Wooley CF. A History of the Heart. In: Fuster V, Alexander RW, O'Rourke RA, editors. Hurst's The Heart. 11th ed. New York: McGraw-Hill; 2004:12.

49. 1999 World Health Organization International Society of Hypertension Guidelines Subcomittee. J Hypertens, 1999;17:151-183.

50. WHO global Strategy on diet, physical activity and health: Western Pacific regional consultation meeting report. Kuala Lumpur. 9-11 June 2003.

51. Aboderin I, Kalache A, Ben-Shlomo Y, Lynch JW, Yajnik CS, Kuh D, Yach D. Life course perspectives on coronary heart disease, stroke and diabetes: key issues and implications for policy and research. Geneva, WHO, 2002.

52. Yach D. Progress in addressing risk to health: implications for mega-countries. Proceedings: Mega-Country Meeting, Geneva: December 2002. WHO. http://www.who.int/hpr/mega/Docs/Mega2002DerekYach.pdf accessed on 05-03-2006

53. Ministry of Planning. Population Census 2001: National report. Dhaka. Bureau of Statistics, July 2003: 719.

54. Baecke JA, Burema J, Frijters JE. A Short questionnaire for the measurement of habitual physical activity in epidemiological studies. Am J clinic nutri 1982; 36:936-942.

55. Evenson KR, Rosamond WD, Cai J, et al. Physical Activity and Ischemic Stroke Risk. Stroke 1999;30:1333-1229.

56. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ). Version 2.0. Revised April 2004. www.ipaq.ki.se.

57. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000; 320:1240.

58. Vasan RS, Benjamin EJ, Sullivan LM, D'Agostino RB. The Burden of Increasing Worldwide Cardiovascular Disease. In: Fuster V, Alexander RW, O'Rourke RA, editors. Hurst's The Heart. 11th ed. New York: McGraw-Hill; 2004:17

59. WHO BMI criteria for Asian. https://www.halls.md/bmi/asianwho.htm viewed on 12/04/08

60. Grassi G. Antihypertensive combination treatment & new European Guidelines. E-journal of Cardiology Practice, 19 Feb 2008;6(24). http://www.escardio.org accessed on 24-09-2008

61. Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, Jones DW, Kurtz T, Sheps SG, Roccella EJ. Recommendations for blood pressure measurement in human and experimental animals - Part 1: blood pressure measurement in human: A statement for professionals from the subcommittee of professional and public education of the American Heart Association Council on high blood pressure research. Hypertension. 2005;45:142-185.

62. WHO. STEPS Field manual guidelines for field staff. WHO/NMH/CCS/03.05. Geneva: WHO 2004:30-31.

63. Brueren MM, Petri H, Weel CV, Ree JWV. How many measurements are necessary in diagnosing mild to moderate hypertension? Family Practice, 1997; 14: 130-135

64. Barker DJ, Gluckman PD, Godfrey KM, Harding JE, Owens JA, Robinson JS. Fetal nutrition and cardiovascular disease in adult life. Lancet. 1993 Apr 10;341(8850):938-41.

65. Barker DJP. Fetal origins of coronary heart disease. BMJ 15 July 1995;311:171-174.

66. Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, et al. Hypertension Prevalence and Blood Pressure Levels in 6 European Countries, Canada, and the United States. JAMA, May 14, 2003; 289(18):2363-2369.

67. Grace SL, Fry R, Cheung A, Stewart DE. Report: Cardiovascular Disease. BMC Women's Health 2004, 4(Suppl.1):S15. http://www.biomedcentral.com/ viewed on 23/07/06.

68. McAlister FA, Campbell NRC, Zarnke K, Levine M, Graham ID. The management of Hypertension in Canada: a review of current guidelines, their shortcomings and implications for the future. CMAJ, February 20, 2001; 164 (4):517-522.

69. Standing P, Deakin H, Norman P, Standing R. Hypertension - Its detection, prevalence, control and treatment in a quality driven British General Practice. Br J Cardiol. 2005;12(6):471-476.

70. Craig R, Mindell J, editors for National Centre for Social Research. The Health Survey for England 2006. http://www.ic.nhs.uk/ viewed 12-08-06.

71. Psaltopoulou T, Orfanos P, Naska A, Lenas D, Trichopoulos D, Trichopoulou A. Prevalence, awareness, treatment and control of hypertension in a general population sample of 26,913 adults in the Greek EPIC study. Int J Epid 2004; 33(6):1345-1352; doi:10.1093/ije/dyh249.

72. Fuchs SC, Petter JG, Accordi MC, Zen VL, Pizzol-Jr AD, Moreira LB, Fuchs FD. Establishing the prevalence of hypertension. Influence of sampling criteria, Arq Bras Cardiol., June 2001;76(6)

73. Metcalf CA, Hoffman MN, Steyn K, Katzenellenbogen JM, Fourie JM. Design and baseline characteristics of a hypertension intervention program in a South African village. J Hum Hypertens, Jan 1996; 10(1): 21-6.

74. Ibrahim MM, Rizk H, Appel LJ, Aroussy WE, Helmy S, Sharaf Y, et al, for the NHP Investigative Team. Hypertension prevalence, awareness, treatment, and control in Egypt: Results from the Egyptian National Hypertension Project (NHP). Hypertension, 1995;26:886-890.

75. Cappuccio FP, Micah FB, Emmett L, Kerry SM, Antwi S, Martin-Peprah R, et al. Prevalence, detection, management, and control of hypertension in Ashanti, West Africa. Hypertension. 2004;43:1017.

76. Edwards R, Unwin N, Mugusi F, Whiting D, Rashid S, Kissima J, et al. Hypertension prevalence and care in an urban and rural area of Tanzania. J Hypertens., 2000;18(2):145-152.

77. Gu D, Reynolds K, Wu X, Chen J, Duan X, Muntner P, et al, for the InterASIA Collaborative Group. Prevalence, awareness, treatment, and control of hypertension in China. Hypertension, 2002;40:920.

78. Jafar TH, Jessani S, Jafary FH, Ishaq M, Orkazai R, Orkazai S, et al. General practitioners' approach to hypertension in urban Pakistan disturbing trends in practice. Circulation 2005;111:1278-1283.

79. Safdar S, Omair A, Faisal U, Hasan H. Prevalence of Hypertension in a low income settlement of Karachi, Pakistan. Journal of the Pakistan Medical Association, 2004; 54(10): 506-509.

80. Abolfotouh MA, Abu-Zeid HAH, Aziz MA, Alakija W, Mahfouz AA, Bassuni WA. Prevalence of hypertension in South-Western Saudi Arabia. Eastern Mediterranean Health Journal, 1996;2(2):211-218.

81. Thankappan KR, Sivasankaran S, Khader SA, Padmanabhan PG, Vasan RS. Community Based Detection and Monitoring Of Hypertension in Kumarakom Panchayat, Kottayam. Project report. Kerala Research Program for Local Level Development. Centre for Development Studies, Ulloor, Trivandrum.

82. Ajay VS, Gupta R, Panniyammakkal J, Chaturvedi V, Prabhakaran D, Reddy KS. National Cardiovascular Disease Database. IC HEALTH. Sticker No: SE / 04 / 233208. Supported by Ministry of Health & Family Welfare, Government of India and World Health Organization. http://www.whoindia.org accessed on 18-02-2009

83. National Cardiovascular Disease Database. Ministry of Health & Family Welfare. Government of India, 2008. Sticker No. SE/04/233208.

84. Bharucha NE, Kuruvilla T.Hypertension in the Parsi community of Bombay: a study on prevalence, awareness and compliance to treatment. BMC Public Health 2003. 3:1. http://www.biomedcentral.com/1471-2458/3/1.

85. Karim SR, Ferdousi SF, Mahmood AR, Morshed M, Hoque GMS. Hypertension and the related factors among the low socio-economic group of people. Bangladesh Med J, 2004; 33(3):86-89.

86. Alamgir AKM, Akhter SFU. Hypertension Prevalence and Related Factors in an Urban Affluent Community in Bangladesh. Bang J Med Sci , March 2005 ; 11(1): 22-25.

87. Whitworth J. 2003 World Health Organization (WHO)/ International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens, 2003 Nov;21(11):1983-92.

88. Aucott L, Poobalan A, Smith WCS, Avenell A, Jung R, Broom J. Effects of weight loss in overweight/obese individuals and long-term hypertension outcomes. Hypertension. 2005;45:1035.

89. Appel LJ, Moore TJ, Obarzanek E, et al. A clinical trial of the effects of dietary patterns on blood pressure. NEJM, 1997;336: 1117-1124.

90. Svetkey LP. Management of prehypertension. Hypertension. 2005;45:1056.

91. NICE Technology Appraisal No. 39, March, 2002. Developed by the Newcastle Guideline Development and Research Unit. National Institute for Clinical Excellence. Clinical Guideline 18. Hypertension: management of hypertension in adults in primary care. August 2004:12-15. http://www.nice.org.uk/ viewed on 15-08-2006

92. Hu G, Barengo NC, Tuomilehto J, Lakka TA, Nissinen A, Jousilahti P. Relationship of physical activity and body mass index to the risk of hypertension: A prospective study in Finland. Hypertension. 2004;43:25-30.

93. Baak MA van, Mil E van, Astrup AV, Finer N, Gaal LFVan, Hilsted J, Kopelman PG, Rössner S, James WP, Saris WHM for the STORM Study Group. Leisure-time activity is an important determinant of long-term weight maintenance after weight loss in the Sibutramine Trial on obesity reduction and maintenance (STORM trial). Am J Clin Nutr, 2003 August; 78(2): 209-214.

94. Herrera PS. Comparison between two intervention programs for hypertensive patients. Blanca Patricia Ballesteros de Valderrama.2007;6(2):383-397 www.fukl.edu/suma viewed on 19-06-2008.

95. Hill MN. HBP Care : Comprehensive HBP care in young urban black men. Clin Cardiol 2000;23:56-58.

96. Campbell NRC, Drouin D, Feldman RD for the Canadian Hypertension Recommendations Working Group. The 2001 Canadian hypertension recommendations: take-home messages. CMAJ 2002 September 17;167(6):661-668.

97. Jiang H, Streiffer RH, Muntner P, Krousel-Wood MA, Whelton PK. Effect of dietary Fiber intake on blood pressure: a randomized, double-blind, placebo-controlled trial. J Hypertens 2004 January; 22(1):73-80.

98. Bowen DJ, Orlandi MA, Lichtenstein E, Cummings KM, Hyland A, for the COMMIT Research Group. Intervention effects on youth tobacco use in the Community Intervention Trial (COMMIT). J Epid. Comm. Health 2003;57:159-160.

99. Hypertension and Smoking. http://www.blood-pressure-updates.com/ viewed 15-02-09.

100. Bowman TS, Gaziano JM, Buring JE, Sesso HD. A Prospective Study of Cigarette Smoking and Risk of Incident Hypertension in Women. JACC, November 2007;50(21): 2085-2092.

101. Family Practice Note book. http://www.fpnotebook.com accessed on 12.03.2009

102. Voter list. http://www.ecs.gov.bd Election Commission of Bangladesh accessed on 06.02.2005.

103. Ageing. Banglapedia. National Encyclopedia of Bangladesh 1st ed. Dhaka: Asiatic Society of Bangladesh, February 2004.

104. World Health Organization. STEPS Field manual guidelines for field staff. The WHO STEPwise approach to Surveillance of noncommunicable diseases (STEPS). WHO/NMH/CCS/03.05. Geneva 2003:38-39.

105. Ahmed SS. In: Banglapedia. National Encyclopedia of Bangladesh 1st ed. Dhaka: Asiatic Society of Bangladesh, February 2004

106. Bennett S, Parpia T, Hayes R, Cousens S. Methods for the analysis of incidence rates in cluster randomized trials. Int J Epid. 2002;31:839-846.

107. Lwanga SK, Lemeshow S. Sample size determination in health studies: A practical manual. Geneva: WHO 1991: 1-5.

108. Grassi G. American and European guidelines for hypertension management: agreements and disagreements. Eur Soc Card. E-Journal -2005;3(20). http://www.escardio.org/ viewed on 14.08.2007

109. Willmott SA, Boardman JAP, Henshaw CA, Jones PW. Understanding General Health Questionnaire (GHQ-28) score and its threshold. Soc Psychiatry Psychiatr Epidemiol 2004,39(8):613-617.

110. Ramos FI, Fernandez-Palacín F. Comparison between the GHQ-28 and SF-36 (MH 1–5) for the assessment of the mental health in patients with ischaemic heart disease. Euro J Epidemiol. 2000;16(4):311-316.

111. Zigmond AS, Snaith RP: The hospital anxiety and depression scale. Acta Psychiatr Scand 1983, 67:361-370.

112. Baecke JA, Burema J, Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. Am J clinic nutri 1982; 36:936-942.

113. Evenson KR, Rosamond WD, Cai J, Toole JF, Hutchinson RG, Shahar E, et al. Physical activity and ischemic stroke risk. The atherosclerosis risk in communities study. Stroke 1999;30:1339-1339.

114. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ). Revised April 2004. www.ipaq.ki.se viewed on 12.02.09.

115. Mascie-Taylor CGN, Rahman M. Training Course in Epidemiology, Biostatistics & Use of SPSS for Widows Version 10 & 11.5. Cambridge: DFID, 2004.

116. Haque KMHSS, Khandaker RK, Malik A, Islam S. Declaration of national observance of world hypertension day 2008. Dhaka: NHF. 17 May 2008.

117. Asgari F, Aghajani H, Haghazali M, Heidarian H. Non-communicable diseases risk factors surveillance in Iran. Iranian J Publ Health, 2009;38 (Suppl. 1):119-122.

118. Agyemang C, van Valkengoed I, Van den Born BJ, Stronks K. Prevalence and Determinants of Prehypertension among African Surinames, Hindustani Surinamese, and White Dutch in Amsterdam, the Netherlands: the SUNSET study. European J of Cardiovascular Prevention & Rehabilitation 2007;14(6):775-781.

119. Ferguson TS, Younger NOM, Tulloch-Reid MK, Wright MBL, Ward EM, Ashley DE, Wilks RJ. Prevalence of prehypertension and its relationship to risk factors for cardiovascular disease in Jamaica: Analysis from a cross-sectional survey. BMC Cardiovascular Disorders 2008, 8:20 doi:10.1186/1471-2261-8-20.

120. Ishikawa1 Y, Ishikawa J, Ishikawa1 S , Kayaba K, Nakamura Y, Shimada K, Kajii E, Pickering TG, Kario K, for JMS Cohort Investigators Group. Prevalence and determinants of prehypertension in a Japanese general population: The Jichi Medical School Cohort Study. Hypertension Research 2008;31:1323–1330.

121. Grotto I, Grossman E, Huerta M,Sharabi Y. Prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli Adults. Hypertension 2006;48:254.

122. Erem C, Hacihasanoglu A, Kocak M, Deger O, Topbas M. Prevalence of prehypertension and hypertension and associated cardiovascular risk factors among Turkish adults: Trabzon Hypertension Study. JPH 2009;31(1):47-58.

123. Sun Z, Zheng L, Wei Y, Li J, Zhang X, Zhang X, et al. The Prevalence of prehypertension and hypertension among rural adults in Liaoning province of China. Clin cardiol 2007;30(4):183-187.

124. Wang Y, Wang QJ. The prevalence of prehypertension and hypertension among US adults according to the new Joint National Committee Guidelines: new challenges of the old problem. Arch Intern Med 2004 Oct 25; 164(19):2126-34.

125. Kuulasmaa K, Tolonen H, Ferrario M, Ruokokoski E, for the WHO MONICA Project3. Age, Date of Examination and Survey Periods in the MONICA Surveys. WHO, Geneva 1999. http://www.ktl.fi/publications/monica/age/ accessed 12-02-09.

126. Fisman EZ., Tenenbaum A, Pines A. Systemic hypertension in postmenopausal women: A clinical approach. Current Hypertension Reports, 2002;4(6):464-470.

127. Stamler R, Stamler J, Riedlinger WF, Algera G, Roberts RH. Family (parental) history and prevalence of hypertension. Results of a nation wide screening program. JAMA.1979; 241(1).43-46.

128. Population Census Wing, BBS. Archived from the original on 2005-03-27. Retrieved on November 10, 2006.

129. Rahman M, Meerjady SF, Akhter SFU, Hossain S, Mascie-Taylor CGN. Behavioural risk factors of non-communicable diseases in Bangladesh (STEPS survey). http://www.who.int/infobase Ref 102410 accessed on 12-08-2007.

130. Siddique MA, Sultan MAU, Haque KMHSS, Zaman MM, Ahmed CM, Rahim MA, Salman M. Clustering of metabolic factors among the patients with essential hypertension. BMRC Bull, 2008;34(3):71-75.

131. Lakka TA, Venalainen JM, Rauramaa R, Salonen R, Tuomilehto J, Salonen JT. Relation of leisure-time physical activity and cardiorespiratory fitness to the risk of acute myocardial infarction in men. New Eng J Med. 1994; 330(22):1549-1554.

132. Zaman MM, Yoshiike N. Prevalence of overweight defined by Body Mass Index in a rural adult population of Bangladesh. Journal of Health, Population and Nutrition, 2003;21(2):162-163.

133. Ahmed SM, Adams A, Chowdhury AM, Bhuiya A. Chronic energy deficiency in women from rural Bangladesh: some socioeconomic determinants. J Biosoc Sci 1998;30:349-58.

134. Quazi S, Mohiduzzaman M, Halim A, Chowdhury MMH, Ali SMK, Akhteruzzaman M, Malek MA. Hyperglycaemia and its association with body mass index among teachers of university of Dhaka. Bang J Nutr, Dec 1987;1(1):34-41.

135. Mascie-Taylor CGN. Analysing cross-sectional anthropometric data. www.unu.edu/ viewed 16-07-2008.

136. Harris GD, White RD. Lifestyle Modifications for the Prevention and Treatment of Cardiovascular Disease: an Evidence-based Approach. Mo Med. 2004 May-Jun;101(3):222-6.

137. TOMHS. The Treatment of Mild Hypertension Research Group. The treatment of mild hypertension study: A randomized, placebo-controlled trial of nutritional-hygienic regimen along with various drug monotherapies. Arch Intern Med 1991: 151:1413-1423.

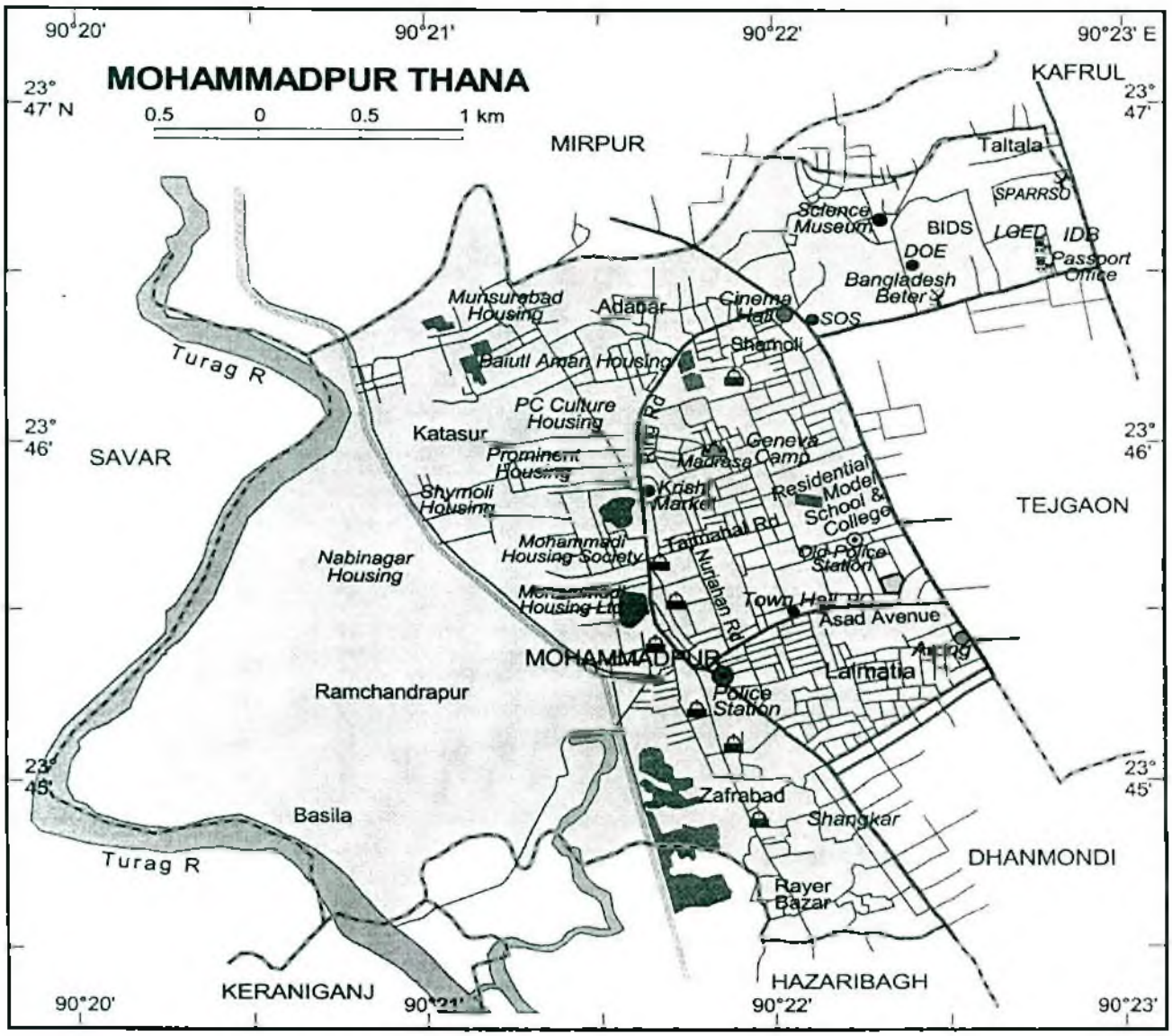
138. TOHP2. The Trials of Hypertension Prevention Collaborative Research Group. Effects of weight loss and sodium reduction intervention on blood pressure and hypertension incidence in overweight people with high-normal blood pressure: The Trials of Hypertension Prevention, Phase II. Arch Intern Med 1997; 157:657-667.

Annexure

Annexure-I

Map of the study area

[Source: Google Earth]



Annexure-II

Informed Consent Form

Dear Respondent,

You have been randomly selected to be part of this study **EVALUATION OF BEHAVIOURAL RISK REDUCTION ON STAGE–I HYPERTENSION** as a part of my PhD course under Dhaka University. This survey has been and being safely conducted in many parts of the world with fruitful outcome and with no physical or psychological harm.

The information you provide is totally confidential and will not be disclosed to anyone. It will only be used for academic purposes. Your name, address, and other personal information will be removed from the questionnaire, and only a code will be used to connect your name and your answers without identifying you. You may be contacted by the Survey Team again only if it is necessary to complete the information on the survey.

Your participation is voluntary and you can withdraw from the survey after having agreed to participate. You are free to refuse to answer any question that is asked in the questionnaire. If you are injured as a result of being part of the study during study period or immediate thereafter, the total treatment cost will be paid by the current researcher. If you have any questions about this survey you may ask me or contact me through 01911 386 760 cell number or my address – Prof.Dr. AKM Alamgir, Professor & Head, Department of Community Medicine, Dhaka National Medical College, 53/1, Johnson Road, Dhaka-1100 Tel: 7163853 ext 1524, E-mail:dr.akmalamgir@hotmail.com.

Signing this consent indicates that you understand what will be expected of you and are willing to participate in this survey.

I hereby provide INFORMED CONSENT to take part in the Study.

Read and signed by/ finger impression (with witness) by-

Respondent [	]	Interviewer [	]
Agreed [	]	Refused [	]

Annexure –III Questionnaire

EVALUATION OF BEHAVIOURAL RISK REDUCTION ON STAGE-I HYPERTENSION

Id No. ☐☐☐☐ **Date of Interview:** ☐☐-☐☐-☐☐☐☐
(dd – mm - year)

1. Name .....
2. Father's /Husband's name.....
3. Age in completed years (At last birth day) ☐☐
4. Sex : ☐ 1 = male; 2= female; 2= others
5. Address with Telephone & Email (if any) .....
   ---
6. Religion : ☐ 1 = Islam; 2= Hindu; 3= Christianity, 4= Buddhism; 5= Others,
   1. 9= missing/ No reply
7. Marital status : ☐ 1 = married; 2= never married; 3= widowed ; 4= separated or divorced; 5 = others Specify..... ; 9= Missing
8. What is the highest level of education you have completed?" ☐☐
   0 = illiterate; 30= Others----------, 99 = missing
9. What is your average family income per year? ----------
10. You live in ☐ 1= Own house ; 2= Rented house; 3= Others ; 9= Missing
11. No. of your family members living in this same house ☐☐
12. Your main profession ☐
    1= Service (Skilled); 2= Daily labourer ; 3= Business/ Industry, 4= House wife;
    5= Student; 6= Self-employed; 7= Unemployed; 8= Others (Specify)----------
    9= No response/ missing
13. If hypertensive- ☐☐☐
    Stage-II hypertension/ Positive history of Heart attack/ angina/ TIA/Stroke/Cardiac Failure/Peripheral Vascular diseases/Family history of premature CVD (First degree relative < 50 years) / Renal failure/ Pregnancy/ Secondary hypertension / Patient on HTN medication /OCP/Treatable Diabetes Mellitus 0 = No ; 1= Yes ; 2= others
14. Any Family History of Hypertension ☐ 0 = No ; 1= Yes ; 2= Do not know.

Tobacco Consumption

15. Do you smoke tobacco now? ☐

    0= No ; 1 = Yes ; 9= No response/ missing

16. What do you smoke? ☐

    1= cigarette; 2= Bidi; 3= Cigarette + Bidi, 4= Hubble bubble, 5= Others, specify.....

17. On average, how many times do you smoke a day? ☐☐

18. How many days a week do you smoke usually? ☐

    1 = one day or less ; 2 = Two to 4 days; 3 = almost every day; 4= Occasionally

19. For how many hours, on average each day, are you closely subjected to other people's tobacco smoke? ☐☐

20. Did you ever smoke cigarettes regularly in the past? 0 = No ; 1 = yes ☐

21. How many times you smoked per usual week? ☐☐

22. How many years you smoked ? ☐☐

23. When did you stop smoking cigarettes regularly? --------- Year Back ☐

    1 = < 1 month ago; 2 = 1-6 months ago , 3 = 6-12 months ago

24. Do you use/ take chewing tobaccos? ☐

    0= No; 1 = Yes. Please name the type ---------- e.g. Jarda, Gul, inhalants etc.

25. Quantity of tobacco used daily. 1= non-significant, 2= moderate, 3= significant ☐

26. How many times a day you consume non-smoking tobacco? ☐☐

27. How many years you are taking these? ☐☐

28. Do you know that tobacco is strongly related to high blood pressure? ☐

    0 = No; 1 = Yes.

29. Are you ready to stop tobacco consumption and when, if yes? ☐

    0 = No; 1 = Yes, right now; 2 = Yes, gradually; 3 = Yes, after ---- weeks/ months.

Physical Activity

In order to correlate relation of physical activity with the level of hypertension, I would like to know the status of your physical labour. I am going to ask you about the time you spend being *Physical Active* in a usual week. My questions will be about activities you do at work, to get from place to place, as part of your house and yard work, and in your spare time for recreation, exercise or sport.

30. Now think about all the *vigorous activities*, which take hard physical effort that you might do during a usual week. Vigorous activities make you breathe much harder than normal and may include *heavy weight lifting, digging, aerobics, swimming, fast bicycling, pulling rickshaw/van, pull cart, washing clothes, sweeping floor, carrying water or pumping tube well, grinding spices etc* Think about only those physical activities that you do for at least 10 minutes at a time.

Question: How much time (in minute) in total would you spend for such activity in a usual week? ☐☐

31. Now think about activities, which take moderate physical effort that you feel somewhat harder than normal and may include carrying light loads, bicycling at a regular pace, or cleaning house, ironing etc. *Do not include walking*. Again, thank about only those physical activities that you do for at least 10 minutes at a time.

Question How much time (in minute) in total would you spend in a usual week? ☐☐

32. ***Now think about the time you spend walking during a usual week.***
This includes walking at work and at home, walking to travel from place to place and any other walking that you might do solely for recreation sport, exercise or leisure. ☐☐

Question : How much time in total (in minute) would you spend walking in a usual week?

33. The last question in this section is about the time you spend sitting each day while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television.

Question: How much time in total (in minute) did you usually spend sitting on a week? ☐☐

Food Intake

34. Which type of diet you take most of the time? ☐
    1 = CHO rich, 2 = Protein Rich, 3 = Fat rich, 9= Missing / No response
35. What is the usual timing for your diet? ☐
    0 = No system, 2 = When hungry, 3 = Fixed time, 9= Missing / No response
36. Which type of oil / fat do you use most often in cooking? ☐
    1 = Soya bean Oil, 2 = Mustard Oil, 3 = Sesame (Teal) Oil, 4 = Palm Oil,
    5 = Sunflower Oil, 6 = Corn Oil, 7 = Ghee/ Butter, 8 = Other (Specify .....)
    9= missing value
37. Do you take extra salt at table for your meal? ☐
    0 = No ;1 = Yes, 9= No response.

38. How often do you eat foods from each of the following categories?

Food Type	**Never or Occasionally monthly**	**Weekly (Times)**
Beef		
Mutton		
Chicken		
Fish		
Egg		
Rice		
Bread		
Sweetmeat/ Cake		
Milk/ milk product		
Dal/ beans		
Fruits		
Vegetables		

39. Treatment Seeking Behaviour

Treatment Taken	**Regularity**	**Treatment type**	**Physician type (If modern)**	**Site of treatment**
0 = No 1 = Yes	0 = Irregular 1 = Regular	1 = Modern 2 = Traditional	1=Physician 2=Quack 3=Self 4=Compounder/Nurse/ Phamacist	1=Government 2= Private 3=Others Specify--------

Measurement

Description	Baseline Measurement	After 06 month Intervention	After 12 month Intervention	After 18 month Intervention
Height (in cm)				
Weight (in Kg)				
Pulse				
Systolic Blood Pressure (mmHg)				
Diastolic Blood Pressure (mmHg)				
Smoking Quantity/wk				
Physical Activity Minutes				
Random Blood Sugar (mmol/L)				
Fasting Blood Sugar (mmol/L)				
Serum Creatinine (mg/dL)				
Urine Albumin				
ECG: 12 lead				
Total Cholesterol				
HDL Cholesterol				
LDL Cholesterol				
Triglycerides				
Other				

Normal Blood Pressure	Pre-hypertension	Stage-I Hypertensive	Stage-II Hypertensive	Under Rx Hypertensive

Signature of the Supervisor : .....
Signature of the Interviewer : .....

Annexure- iv

Patient Health Questionnaire (PHQ-9)

This easy to use patient questionnaire is a self-administered version of the PRIME-MD diagnostic instrument for common mental disorders.[1] The PHQ-9 is the depression module, which scores each of the 9 DSM-IV criteria as "0" (not at all) to "3" (nearly every day). It has been validated for use in Primary Care.[2]

Patient Health Questionnaire (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems?

Little interest or pleasure in doing things?	Not at all Several days More than half the days Nearly every day
Feeling down, depressed, or hopeless?	Not at all Several days More than half the days Nearly every day
Trouble falling or staying asleep, or sleeping too much?	Not at all Several days More than half the days Nearly every day
Feeling tired or having little energy?	Not at all Several days More than half the days Nearly every day

Poor appetite or overeating?	Not at all Several days More than half the days Nearly every day
Feeling bad about yourself - or that you are a failure or have let yourself or your family down?	Not at all Several days More than half the days Nearly every day
Trouble concentrating on things, such as reading the newspaper or watching television?	Not at all Several days More than half the days Nearly every day
Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual?	Not at all Several days More than half the days Nearly every day
Thoughts that you would be better off dead, or of hurting yourself in some way?	Not at all Several days More than half the days Nearly every day
Total= /27	

Depression Severity: 0-4 None, 5-9 mild, 10-14 moderate, 15-19 moderately severe, 20-27 severe.

Validity has been assessed against an independent structured mental health professional (MHP) interview. PHQ-9 score ≥10 had a sensitivity of 88% and a specificity of 88% for major depression.[1,2] It can even be used over the telephone.[3]

Annexure - V

Name:
Date:

THE GENERAL HEALTH QUESTIONNAIRE GHQ28

David Goldberg

Please read this carefully.

We should like to know if you have had any medical complaints and how your health has been in general, *over the past few weeks*. Please answer ALL the questions on the following pages simply by underlining the answer which you think most nearly applies to you. Remember that we want to know about present and recent complaints, not those that you had in the past.

It is important that you try to answer ALL the questions.

Thank you very much for your co-operation.

Have you recently

A1	been feeling perfectly well and in good health?	Better than usual	Same as usual	Worse than usual	Much worse than usual
A2	been feeling in need of a good tonic?	Not at all	No more than usual	Rather more than usual	Much more than usual
A3	been feeling run down and out of sorts?	Not at all	No more than usual	Rather more than usual	Much more than usual
A4	felt that you are ill?	Not at all	No more than usual	Rather more than usual	Much more than usual
A5	been getting any pains in your head?	Not at all	No more than usual	Rather more than usual	Much more than usual
A6	been getting a feeling of tightness or pressure in your head?	Not at all	No more than usual	Rather more than usual	Much more than usual
A7	been having hot or cold spells?	Not at all	No more than usual	Rather more than usual	Much more than usual

---

B1	lost much sleep over worry?	Not atall	No more than usual	Rather more than usual	Much more than usual
B2	had difficulty in staying asleep once you are off?	Not at all	No more than usual	Rather more than usual	Much more than usual
B3	felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
B4	been getting edgy and bad-tempered?	Not at all	No more than usual	Rather more than usual	Much more than usual
B5	been getting scared or panicky for no good reason?	Not at all	No more than usual	Rather more than usual	Much more than usual
B6	found everything getting on top of you?	Not at all	No more than usual	Rather more than usual	Much more than usual
B7	been feeling nervous and strung-up all the time?	Not at all	No more than usual	Rather more than usual	Much more than usual

Please turn over

Have you recently

C1	**been managing to keep yourself busy and occupied?**	More so than usual	Same asusual	Rather less than usual	Much less than usual
C2	**been taking longer over the things you do?**	Quicker than usual	Same as usual	Longer than usual	Much longer than usual
C3	**felt on the whole you were doing things well?**	Better than usual	About the same	Less well than usual	Much less well
C4	**been satisfied with the way you've carried out your task?**	More satisfied	About same as usual	Less satisfied than usual	Much less satisfied
C5	**felt that you are playing a useful part in things?**	More so than usual	Same as usual	Less useful than usual	Much less useful
C6	**felt capable of making decisions about things?**	More so than usual	Same as usual	Less so thanusual	Much less capable
C7	**been able to enjoy your normal day-to-day activities?**	More so than usual	Same as usual	Less so than usual	Much less than usual

---

DI	**been thinking of yourself as a worthless person?**	Not at all	No more than usual	Rather more than usual	Much more than usual
D2	**felt that life is entirely hopeless?**	Not atall	No more than usual	Rather more than usual	Much more than usual
D3	**felt that life isn't worth living?**	Not at all	No more than usual	Rather more than usual	Much more than usual
D4	**thought of the possibility that you might make away with yourself?**	Definitely not	I don't thinkso	Has crossed my mind	Definitely have
D5	**found at times you couldn't do anything because your nerves were too bad?**	Not atall	No more than usual	Rather more than usual	Much more than usual
D6	**found yourself wishing you were dead and away from it all?**	Not at all	Nomore than usual	Rather more than usual	Much more than usual
D7	**found that the idea of taking your own life kept coming into your mind?**	Definitely not	I don't think so	Has crossed my mind	Definitely has

A	B	C	D	Total

Annexure -VI

Gantt Chart / Work Schedule

Month	Literature review	Protocol preparation	Questionnaire pre-testing & finalization	Field work	Data sorting & analysis	Report writing & Seminar	Submission
August'05 to April'06							
May'06							
May'07 to February'09							
February'09 to March'09							
April'09							
April'09 to July'09							

Annexure – vii

BMRC

বাংলাদেশ মেডিকেল গবেষণা পরিষদ
Bangladesh Medical Research Council

Ref: BMRC/ERC/2007-2010/92(1-3) Date: 15-01-08

Ethical Review Committee

Dr. AKM Alamgir
Associate Professor
Deptt. of Community Medicine
Dhaka National Medical College
53/1, Johnson Road, Dhaka.

Subject: Ethical Clearance

With reference to your application on the above subject, this is to inform you that your Research Proposal entitled **"Outcome Evaluation of Behavioural Risk Reduction Intervention on Stage- I Hypertension"** has been reviewed and approved by the Ethical Review Committee of Bangladesh Medical Research Council (BMRC).

You are requested to please note the following ethical guidelines as mentioned at page 2 (overleaf) of this memo-

(Prof. Harun-Ar-Rashid)
MD, MSc, MPH, PhD, FRCP Edin
Director

Mohakhali, Dhaka-1212, Bangladesh, Phone : 8811395, 8828396, Fax : 880-2-8828820
E-mail : bmrc@citechco.net

Table 2.--Examples of Common Physical Activities for Healthy US Adults by Intensity of Effort Required in MET Scores and Kilocalories per Minute*

Light (<3.0 METs or <4 kcal/min)	Moderate (3.0-6.0 METs or 4-7 kcal/min)	Hard/Vigorous (>6.0 METs or >7 kcal/min)
Walking, slowly (strolling) (1-2 mph)	Walking, briskly (3-4 mph)	Walking, briskly uphill or with a load
Cycling, stationary (<50 W)	Cycling for pleasure or transportation (<=10 mph)	Cycling, fast or racing (>10 mph)
Swimming, slow treading	Swimming, moderate effort	Swimming, fast treading or crawl
Conditioning exercise, light stretching	Conditioning exercise, general calisthenics	Conditioning exercise, stair ergometer, ski machine
...	Racket sports, table tennis	Racket sports, singles tennis, racketball
Golf, power cart	Golf, pulling cart or carrying clubs	...
Bowling	...	...
Fishing, sitting	Fishing, standing/casting	Fishing in stream
Boating, power	Canoeing, leisurely (2.0-3.9 mph)	Canoeing, rapidly (>=4 mph)
Home care, carpet sweeping	Home care, general cleaning	Moving furniture
Mowing lawn, riding mower	Mowing lawn, power mower	Mowing lawn, hand mower
Home repair, carpentry	Home repair, painting	...

*Data from Ainsworth et al,(69) Leon,(70) and McCardle et al.(71) The METs (work metabolic rate/resting metabolic rate) are multiples of the resting rate of oxygen consumption during physical activity. One MET represents the approximate rate of oxygen consumption of a seated adult at rest, or about 3.5 mL per min per kg. The equivalent energy cost of 1 MET in kilocalories per minute is about 1.2 for a 70-kg person, or approximately 1 kcal per kg per hour.