

# A trial on the Effects of Life Style Interventions in High-Normal Blood Pressure

KN Choudhury, RS Mahmud, M Salehuddin, S Zareen, SN Uddin, SK Ghosh  
National Center for Control of Rheumatic and Heart Disease (NCCRF&HD)

## Abstract:

### Keywords:

High-normal blood pressure, Pre-hypertension, Life style modification, Non-pharmacological intervention.

**Background:** This experimental (Intervention) study was conducted with objective of evaluating the outcome of non-pharmacological approach (lifestyle intervention) through reducing the modifiable risk factors on high normal blood pressure or pre-hypertension (systolic blood pressure 130-139mm of Hg and diastolic blood pressure 85-89 mm of Hg). The study was provided risk reduction management intervention was given on subjects of high normal blood pressure through adequate physical activity, tobacco cessation, dietary advice for unhealthy to healthy diet, reduction of salt intake, reduction of over weight & stress management etc.

**Materials and methods:** The study was conducted among 434 respondents aged 30 -50 years during the period from June 2008 to May 2009 with intervention for 6 months. Random sampling, those cases were fulfilled the inclusion and exclusion. High-normal BP were found out through BP measurement & clinical examination then sample population were selected by randomization: odds numbers in study group (intervention group) and even numbers in control group (comparison group). After obtaining informed consent data were collected by interview, clinical examination, anthropometric measurement and investigations. It was three phases, first phase were case identification & intervention for study group, second phase was follow up and third phase was outcome measurement for both groups. Cases were hold a record card with contact number.

**Results:** After six month mean difference of blood pressure, lipid profile, weight were changed both the groups but changed was significant in the study group. Mean systolic blood pressure reduced  $4.1 \pm 6.0$  in the study group and  $1.2 \pm 6.4$  in the control group, ( $p < 0.001$ ). Mean diastolic pressure reduced  $3.5 \pm 4.9$  in study group and  $1.2 \pm 6.4$  in control group ( $p < 0.001$ ). Mean total cholesterol, LDL cholesterol and triglycerides decreased in the study group  $19.7 \pm 18.6$ ,  $10.6 \pm 14.6$  and  $15.4 \pm 21$  respectively and in control group mean of all these parameters decreased to  $11.5 \pm 16.5$ ,  $5.1 \pm 12.9$  and  $6.7 \pm 23.2$  respectively. Mean HDL cholesterol for men and women in the study group was raised to  $5.6 \pm 5.9$  and  $4.5 \pm 6.4$  respectively ( $p < 0.001$ ). Mean weight reduced  $1.94 \pm 1.59$  in study group and  $0.06 \pm 1.44$  in the control group ( $p < 0.001$ ).

**Conclusion:** The final outcome of the study was that mean high normal blood pressure was found to reduced due to intervention of non-pharmacological management. So, If we encourages subjects after 40 years for routine health check up in hospital setting & service for risk factor detection & management (preventive cardiology), we will reduce the risk factors of high normal blood pressure (pre-hypertension) & cardiovascular diseases to some extent. Encourages population to stay with normal blood pressure & healthy life style.

(Cardiovasc. j. 2010; 2(2) : 195-203)

## Introduction:

Epidemiological studies have established a strong association between hypertension and coronary artery disease (CAD). Hypertension is a major independent risk factor for the development of CAD, stroke & renal failure. The latest version of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High blood pressure recommendations has defined "hypertension" as a BP of  $>140/90$  mm Hg. At this

cutoff value, at least 65 million adult Americans or nearly one fourth of the adult population of the United States, have hypertension. Another one fourth of the population is in the "Prehypertension" range defined as an SBP of 120 to 139 mm Hg or a DBP of 80 to 89 mm Hg.<sup>1</sup>

Hypertension is a major risk factor for cardiovascular diseases and as such is one of the most important preventable causes of premature morbidity and mortality in developed and

developing countries. New epidemiological data have also demonstrated the likelihood that in a majority of people high-normal BP will lead to hypertension with ageing.<sup>2</sup>

Hypertension is an emerging for developing countries. Economic transition, urbanization, industrialization and globalization bring about lifestyle changes that promote cardiovascular diseases like hypertension. These risk factors include tobacco use, physical inactivity and unhealthy diet. Life expectancy in developing countries is rising sharply and people are exposed to these risk factors for longer periods. The prevalence and incidence of hypertension in developing countries is rising rapidly.<sup>3</sup>

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.<sup>4</sup> Lack of physical activity causes reduced mobilization of body fat and carbohydrate with also reduced utilization resulting hypertension through different mechanisms. Obesity is common among hypertensive patients and its prevalence increases with age. In fact, obesity may be what determines the increased incidence of high blood pressure with age. It has been estimated that the blood pressure can be decreased 0.32 mmHg for every 1 Kg (2.2 pounds) of weight loss.<sup>5</sup>

Dyslipidaemia comprising altered ratio of high to total cholesterol level and isolated elevation of the low density lipoprotein or triglycerides is usually associated with rising blood pressure level. There are strong and continuous relations between total and LDL cholesterol concentrations and coronary heart disease risk. Association of high TG and low HDL-C as an independent predictor of CHD. In Bangladesh. Consumption of saturated fat and red meat is injurious to health and a known risk factor for CVD especially hypertension. There are increasing evidences that high intake of salt (i.e. more than 5g/day) increases blood pressure proportionately while low sodium intake has been found to lower BP.<sup>6</sup>

Environmental and occupational stress is a risk factor for hypertension. Stress control can also make a big difference in lowering high blood pressure. One study, which used a controlled trial

of yoga and biofeedback, demonstrated a significant reduction of blood pressure with stress control treatments. Chronic stress exposes our body to unhealthy, persistently elevated levels of stress hormones like adrenaline and cortisol. Chronic stress can also lead to poor eating habits, alcohol consumption, smoking and lack of exercise—all of which are risk factors for hypertension.<sup>7</sup>

Lifestyle modification offer the potential for preventing hypertension, have been shown to be effective in lowering blood pressure, and can reduce other cardiovascular risk factors at little cost and with minimal risk. Patients should be strongly encouraged to adopt these lifestyle modifications, particularly if they have additional risk factors for premature cardiovascular disease, such as dyslipidemia or diabetes mellitus. Even when lifestyle modifications alone are not adequate in controlling hypertension, they may reduce the number and dosage of antihypertensive medications needed to manage the condition. Although the difficulty in achieving and maintaining lifestyle changes is recognized, a systemic team approach utilizing health care professionals and community resources when possible can assist in providing the necessary education, support and followup.<sup>8</sup>

Weight reduction of as little as 10 pounds (4.5 kg) reduces blood pressure in a large proportion of overweight persons with hypertension.<sup>9</sup> Because hypertension can often be remedied in this population by weight loss, it should be the cornerstone of any lifestyle modification effort designed to decrease BP. Other lifestyle modifications that decrease BP levels include reductions in sodium intake, moderation of alcohol intake, consumption of an adequate amount of potassium and increase in physical activity<sup>10</sup>. Collectively, a decreased intake of calories, sodium and alcohol along with increased physical activity, is associated with a 50% reduction in the 5-year incidence of hypertension.<sup>12,13</sup> Lifestyle modification can also lessen the need for antihypertensive agents and decrease the occurrence of side effects while reducing the cost of treatment. As a result, the JNC 7 the WHO and the International Society of Hypertension<sup>14,15</sup> all support lifestyle modification as an important component of treatment of hypertension.<sup>16</sup>

**Materials and Methods:**

It was an experimental (intervention) study. The study was conducted among 434 respondents aged 30-50 years during the period from June 2008 to May 2009 with intervention for 6 months. Respondent of high-normal blood pressure (BP) were collected from patients of National Center for Control of Rheumatic Fever and Heart Diseases, Dhaka. Random sampling, those cases were fulfilled the inclusion and exclusion. High-normal BP were found out through BP measurement & clinical examination then sample population were selected by randomization: odds numbers in study group (intervention group) and even numbers in control group (comparison group). After obtaining informed consent data were collected by interview, clinical examination, anthropometric measurement and investigations. It was three phases, first phase were case identification & intervention for study group, second phase was follow up and third phase was outcome measurement for both groups. Cases were hold a record card with contact number.

Inclusion criteria were having High-normal blood pressure (systolic blood pressure 130-139 mm of Hg and diastolic blood pressure 85-89mm of Hg). Those who have contact number (cellphone/landphone). Those who were permanent residents of the city and can communicate with our center easily. Patients were excluded those already on medication of anti hypertensive drugs.

*Data collection methods and phasing of the study-*  
The whole study were divided into 3 phases. The phases were-

*Phase-1 Case identification and Intervention Phase:* High-normal BP were found out through BP measurement and clinical examination after that face to face interview, anthropometric measurement and laboratory investigations were done. After that started intervention in the study group and respondent were holded a record card with contact number. The total intervention were non-pharmacological (change of life style) adequate physical activity, cessation of smoking and modification of dietary habit from unhealthy to healthy dietary pattern and also stress management following British Hypertension Society and World Health Organization International society of hypertension(WHO-ISH)

approved these intervention. But control group did not get intervention.

*Life-style intervention:**Cessation of tobacco use-*

All smokers were encouraged to permanently stop smoking of tobacco in all forms :

The 5 A's can help:

- A- *ASK* : Systematically identify all smokers at every opportunity.
- A-*ASSESS* : determine the person's degree of addiction and his/her readiness to cease smoking.
- A-*ADVISE* : Unequivocally urge all smoker to quit.
- A-*ASSIST* : Agree on a smoking cessation strategy including behavioural counselling
- A-*ARRANGE* : a schedule of follow-up visits.

*Physical activity-*

- Progressively increase moderate physical activity such as brisk walking, cycling to at least 30-45 minutes per day.
- Move around for 10 minutes after every meal.
- Make your working hours more heart healthy
- Plan a heart healthy resting or leisure plan.

*Dietary Counselling -*

- Salt (Sodium Chloride) Take less than 5 gram (1 teaspoon) per day. Reduce salt when cooking.
- Fruits and vegetables : 5 servings (400-500gr) of fruits and vegetables per day. One 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 tablees per day)
- Limit processed and fast foods.

- Replace other meat with chicken (without skin).

#### Stress Councelling-

- First, identify any source of stress, and try to reduce it.

#### *Relaxing methods to reduce blood pressure:*

- Breath deeply and relax muscles through stretching, exercise, yoga. People with mild hypertention who practiced these healing techniques daily, for 2 to 3 months experienced a significant decreases of blood pressure, had lower levels of stress hormones (adrenaline and cortisol) and were less anxious.
- Daily use of RESPeRATE – guided slow breathing (15 minutes a day for eight weeks) brought about a substantial reduction in blood pressure.

#### Advices-

- Regular sleeping and eating habits can make a major contriburion to stress reduction.
- Try take a short nap during the day.
- Whenever you feel anxious- get things off your chest, Talk to some one you trust.
- Maintain a regular exercise routine, but do not exercise with in two or three hours of bedtime.
- Avoid caffeine
- Use beedroom for sleeping only; do not work or watch TV there.

*Phase-2 Follow up Phase (after 3 month from the first intervention):* Follow-up and intervention according to need for study group.

*Phase-3 Evaluation Phase (after 6 months from the first intervention):* At the end of 6 months blood pressure, anthropometric measurement and other Laboratory investigation were done again in both groups. Investigations did laboratory of NCCRF&HD & follow standared methods.

#### **Results:**

We started with a total of 434 individuals which was randomly selected into two groups. Sixteen participant were lost to follow up at the end of sixth month. The socio-demographic characteristics of both the groups. Mean age of the population was around just over 40 years in both the groups and both for men and women. Most of the study population was at the age 30 to 50 years, around just below 80%. Monthly income varies from 2000 TK to 30,000 TK.

More than 50% of men of both the groups were current smoker at the time of enrolment. Among the women 7% in the study group and 3% in the control group were current smoker. On around 20% of men and women in both groups were tobacco chewer. The study population was moderately active at the time of enrolment. Less than 10% of the cases in both groups were vigorously active with exception of men in the study group (13%). More than 50% of the women and in both the groups were not used to brisk walking. On the other hand 38% of the men of study group and 48% of the men of the control group did not have habit of brisk walking. Less than 10% of study population used to do 60 minutes of brisk walking but 13% of the men of study group did brisk walking. More than 50% of the population consumed 5 servings (400-500 gr) of fruits and vegetables with an exception of the women of control group, only 38% of them consumed 5 servings of fruits and vegetables.

We also recorded any accidents in the family just prior to enrolment in the study. Accident rate was higher in study group for both in men and women with compare to the men and women of control. Around 60% of the men and women of both the groups were in stress. In both the groups men were more ambitious then women.

Mean weight, BMI of men and women of both the group were comparable. Mean weight for men was around 70 kg and mean weight for women was around 61 kg respectively for both the groups. Mean BMI is slightly higher in women than men in both the groups and around 26kg/m<sup>2</sup> and 25 kg/m<sup>2</sup> respectively. In study group 46% of the men and 59% of the women had BMI more than 25 kg/m<sup>2</sup> and in the control group 49% of the men and 64% of the women had BMI more than 25 kg/m<sup>2</sup>.



Mean systolic blood pressure for men in both groups was around 126 mm of Hg and in women it was around 124 mm of Hg in the study and 127 mm of Hg in the control group. Though the mean was same for men in both group at baseline but 55% of the men in study group and 50% of the men in control group had high normal systolic blood pressure. In case of women 41% of the study group and 50% of the control group had high normal systolic blood pressure at the time of enrolment. Diastolic blood pressure was around 84 mm of Hg for both the groups and for both men and women and around 60% had high normal blood pressure at the time of enrolment.

Mean total cholesterol differs slightly between groups. It was around 191 mg/dl for men in study group and 196 mg/dl in men in the control group. In women of study group had much higher mean total cholesterol (195 mm/dl) than women in control group (189 mm/dl). In study group 44% of the men and in the control group 50% of the men are above cut off value. In case women it was 58% and 54% respectively for both the groups. Mean HDL for men and women were below cut off in both the groups at the time of enrollment. Mean LDL cholesterol was around 139 mm/dl in both groups but in case of women in study group it was around 145mm/dl and naturally highest percentage (57%) of women of study group were above the cut off. In case triglycerides, women of the control group had highest mean of triglycerides (186 mm/dl) and took

the highest percentage above the cut off value (73%). Women of the control group took the lowest percentage above the cut off for triglycerides (65%)

Independent sample t-test is given for variable of interest or outcome variable to see the mean differences between two groups. At degree of freedom 432 assuming equal variance independent sample t-test was done for weight, BMI, waist circumference, blood pressure and blood cholesterol.

Table I below describes the mean difference of anthropometric measurements, blood pressure and blood cholesterol in the before and after intervention (outcome changes) in paired sample t-test.

Differences of means of all parameters in study group is significant before and after intervention.

Table II above describes the differences of means in variables of interests in control group by paired sample t-test. Mean differences of the out come variables was true in the control group also except in case waist circumference of men.

Table III describes the differences variables of means after six months of intervention between both groups by independent sample t-test. True differences of means were not found in weight, waist circumference for men and women, HDL cholesterol, LDL cholesterol and BMI. On the other hand there were true differences of means

**Table-I**

*Mean differences of the variable of interest before and after intervention in study group*

Variable	Mean	Std. Deviation	95% CI		Two tailed significance
			Lower	Upper	
Weight (kg)	1.94	1.59	1.73	2.16	0.00
Waist circumference for men (cm)	0.89	2.30	0.58	1.20	0.00
Waist circumference women (cm)	0.79	2.56	0.44	1.14	0.00
Systolic BP (mm of Hg)	4.10	6.00	3.28	4.92	0.00
Diastolic BP (mm of Hg)	3.45	4.78	2.80	4.10	0.00
Total cholesterol (mg/dl)	19.69	18.60	17.16	22.22	0.00
HDL cholesterol for men (mg/dl)	-5.63	5.88	-6.74	-4.53	0.00
HDL cholesterol for women (mg/dl)	-4.49	6.41	-5.77	-3.22	0.00
LDL cholesterol (mg/dl)	10.56	14.59	8.58	12.55	0.00
Triglycerides (mg/dl)	15.42	21.17	12.54	18.30	0.00
BMI ( kg/m <sup>2</sup> )	0.75	0.61	0.67	0.83	0.00

**Table-II**  
*Mean differences of the variable of interest before & after intervention in control group*

Variable	Mean	Std. Deviation	95% CI		Two tailed significance
			Lower	Upper	
Weight (kg)	0.60	1.44	0.40	0.80	0.00
Waist circumference for men (cm)	0.15	1.89	-0.11	0.41	0.26
Waist circumference for women (cm)	0.69	2.86	0.30	1.08	0.00
Systolic BP (mmof Hg)	1.19	6.04	0.36	2.01	0.00
Diastolic BP (mm of Hg)	1.21	6.41	0.33	2.08	0.00
Total cholesterol (mg/dl)	11.45	16.47	9.20	13.70	0.00
HDL cholesterol for men (mg/dl)	-5.87	5.49	-6.92	-4.82	0.00
HDL cholesterol for women (mg/dl)	-4.68	7.74	-6.21	-3.16	0.00
LDL cholesterol (mg/dl)	5.11	12.90	3.34	6.87	0.00
Triglycerides (mg/dl)	6.67	23.24	3.50	9.85	0.00
BMI ( kg/m <sup>2</sup> )	0.23	0.61	0.15	0.32	0.00

**Table-III**  
*Mean differences of variable of study & control groups at the end of the six month*

Variables	Mean Difference	95% CI		Two tailed significance
		Lower	Upper	
Weight (kg)	-1.22	-3.14	0.70	0.21
Waist circumference for men (cm)	-0.43	-1.70	0.84	0.51
Waist circumference for women (cm)	-1.34	-2.83	0.16	0.08
Systolic BP (mmof Hg)	-3.63	-5.48	-1.78	0.00
Diastolic BP (mm of Hg)	-2.22	-3.54	-0.89	0.00
Total cholesterol (mg/dl)	-5.94	-11.49	-0.39	0.04
HDL cholesterol for men(mg/dl)	0.07	-1.17	1.31	0.91
HDL cholesterol for women (mg/dl)	0.14	-1.88	2.16	0.89
LDL cholesterol (mg/dl)	-3.70	-8.37	0.97	0.12
Triglycerides (mg/dl)	-8.18	-16.35	-0.01	0.05
BMI ( kg/m <sup>2</sup> )	-0.65	-1.28	-0.03	0.04

of systolic blood pressure, diastolic blood pressure, total cholesterol and triglycerides since the significance level is  $< 0.05$ .

There was no significant difference in mean systolic and diastolic blood pressure at the time of enrolment between intervention and control. After intervention mean systolic and diastolic blood pressure had significant decreases in both groups.

There was significant difference in mean systolic blood pressure after intervention in the study group

and control group. But the changes was much more in the study group and the mean changes were  $4.1 \pm 6.0$  in the study and only  $1.1 \pm 6.0$  in the control group at the level of significance  $p < 0.001$ .

Mean diastolic blood pressure also significantly changes in both the groups after intervention. The changes were much more in the study group is also. The mean changes were  $3.5 \pm 4.9$  the study group and only  $1.2 \pm 6.4$  in the control group ( $p < 0.001$ ).

**Table-IV**  
*Changes in systolic & diastolic blood pressure after intervention in both group.*

	Systolic blood pressure mm of Hg		Diastolic blood pressure mm of Hg	
	Intervention	Control	Intervention	Control
At the time of enrolment	125.9±9.7	126.9±8.8	83.9±4.9	83.3±4.6
After six month	122.0±9.0	125.6±10.2	80.4±6.6	82.3±7.2
Mean changes at six month	4.1±6.0	1.1±6.0	3.5±4.9	1.2±6.4
Level of significance	p<0.001			

### Discussion:

Mean age of intervention and control group was 42.8±8.2 and 42.5±8.2 respectively. Mean age of the population was around just over 40 years in both the groups and both for men and women. Most of the study population was at the age 30 to 50, around 80%. Service, business and housewife were the major occupation both in study group and control group. Around 21% of the study population is illiterate in both group. This picture represents to the population composition in Bangladesh.<sup>17</sup>

After intervention at sixth month, there was around 5% reduction of smoking habit in the intervention group and around 2% reduction in the control group. Experiment of Duff and Okuda also concluded in a similar way, change of smoking habit also contributed significantly to the reduction of blood pressure among the subjects under investigations in this particular study. Vigorous level activity rose from 11% to 16% for intervention group and 07% to 12% in the control group. International Physical question (IPAQ) scoring, modified Minnesota leisure time physical activity questionnaire and baseline examination with the use of the Baecke questionnaire was consulted and adopted for measurement of physical activity. also other protocols supported by WHO for its MONICA protocol were also consulted. Most of the samples 79.97% were found to be physically inactive or less active. This is a typical scenario for middle-class sedentary society in Dhaka.<sup>19</sup>

Standard food serving increased from 52% to 60% in the intervention group and 48% to 50% in the control group. Habit of taking extra salt was reduced overall 20% in the both group. This observation indicated role of salt intake with causation of hypertension.<sup>21</sup>

In the both groups mean difference of weight, blood pressure, and lipid profile were changes but the changes is much more in intervention group.

Mean weight changes 1.94±1.59 in intervention group and 0.06±1.44 in the control group at the level of significance <0.001. As a result of intervention for 6 months. more than 1 kg of the mean weight was reduced in the current study. This finding could be compared to the Shiga University of Medical Science study on a total of 45 obese hypertensive men and to evaluate the effectiveness of a weight- control intervention for 3 months. Subjects had two counselling sessions and received 4 personal letters in the three months. Mean body weight changes from november 2001 to november 2002 were -2.3kg (SD3.3kg) for the intervention group and + 0.3 kg (SD 1.5 kg) for the control group, the difference being significant (p= 0.013). For the intervention group mean body weight change from july to october 2002 was -1.5 kg (SD2.4kg).<sup>22,23</sup>

Mean systolic blood pressure change 4.1±6.0 in the intervention group and 1.2±6.4 (p < 0.001). Mean diastolic pressure decreased 3.5±4.9 in intervention group and in control group it was 1.2±6.4, p <0.001. Mean total cholesterol, LDL cholesterol and triglycerides lowered in the intervention group to 19.7±18.6 10.6±14.6 and 15.4 ±21.2 respectively and in control group mean all these parameters dropped down to 11.5±16.5, 5.1±12.9 and 6.7±23.2 respectively. Mean HDL cholesterol for men and women in the intervention group was raised to 5.6±5.9, 4.5± 6.4 (3.2, 5.8) respectively (p<0.001). In control group mean HDL cholesterol was elevated to 5.9± 5.5 for men and 4.7±7.7 for women (p<0.001) This result can be compared to the result of Duff where 28% (11/39) casso and 22% control were declared to be

normotensive at the end of the six-month non-pharmacological intervention.<sup>24,25</sup>

### Conclusion:

The final outcome of the study was that mean high normal blood pressure was found to decrease due to intervention of non-pharmacological management (lifestyle intervention). So, if we encourage subjects after 40 years for routine health check up in hospital setting for risk factor detection & management (preventive cardiology), we will reduce the risk factors of high normal blood pressure (pre-hypertension) & cardiovascular diseases to some extent. Encourages population to stay with normal blood pressure & healthy life style.

### Study Limitation:

Duration of intervention was short. It was a hospital based study so control group got some extent intervention and interaction after investigation and got indirect advice from hospital environment. So, mean changes occur both the groups but significant in the study group.

### References:

1. Treatment of Hypertension in the Prevention and Management of Ischemic Heart Disease: A scientific statement from the American Heart Association Council for High Blood Pressure Research and the Councils on Clinical Cardiology and Epidemiology and Prevention. 2007;115:2761-2788. <http://www.circulationaha.org> World Health Organization International Society of Hypertension Guidelines Subcommittee. *J Hypertens* 1999;17:151-183.
2. WHO. Integrated management of cardiovascular risk. Geneva: WHO report 9-12 July 2002. [http://www.who.int/cardiovascular\\_diseases/media/en/635.pdf](http://www.who.int/cardiovascular_diseases/media/en/635.pdf). viewed on 16 October, 2004.
3. Beilin L. Epidemiology of Hypertension. *Medicine International* 1993; 21 (9): 351-354.
4. MedicineNet. High Blood Pressure. [http://www.medicinenet.com/high\\_blood\\_pressure/pages5.htm](http://www.medicinenet.com/high_blood_pressure/pages5.htm). viewed on Nov, 2004.
5. Ramsay LE et al. Guidelines for management of Hypertension: report of the third working party of the British Hypertension Society. *J Human Hypertens* 1999; 13: 269-592.
6. Appel LJ, Moore TJ, Obarzanek E, et al. for the DASH Collaborative research group. A clinical trial of the effects of dietary patterns on blood pressure. *N Engl J Med* 1997; 336: 1117-1124.
7. Neaton JD Grimm RH Jr, Prineas RJ et al. for the treatment of mild hypertension study research group. Treatment of mild hypertension study, final result. *JAMA* 1993; 270: 713-724.
8. 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.
9. WHO. The world health report 2002. Reducing risks, promoting healthy life. World Health Organization, Geneva, Switzerland, 2002.
10. Chobanian AV, Bakris GL, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. 2003;42:1206-1252.
11. Guidelines subcommittee. 1999 World Health Organization-International Society of Hypertension guidelines for the management of hypertension. *J Hypertens*.1999;17:151-183.
12. Hypertension control: report of a WHO Expert Committee. *World Health Organ Tech Rep ser*. 1996;862: 1-83.
13. Stamler R, Stamler J Gosch FC, et al. Primary prevention of hypertension by nutritional-hygienic means: final report of a randomized controlled trial. *JAMA*1989;262:1801-1807.
14. Leiter LA, Abbott D, et al. Lifestyle modifications to prevent and control hypertension. *CMAJ* 1999; 160(9suppl): S7-S12.
15. Yusuf S, Hawken S, et al (INTERHEART Study Investigators) Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004;364:937-952.
16. Ahmed SS. Bangladesh. National Encyclopedia of Bangladesh 1st ed. Asiatic Society of Bangladesh, Dhaka: February 2004.
17. Salt, sodium & high blood pressure. <http://www.dietitian>.
18. Sack FM, Svetkey LP, Vollmer WM, et al. The DASH-sodium collaborative research group. Effects on blood of reduced dietary sodium and the dietary approaches to stop hypertension (DASH) diet *N Engl J Med* 344 (1): 3-10.
19. Baecke JA, Burema J, Frijters. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr* 1982; 36: 936-942.
20. Law M, Tang JL. An analysis of the effectiveness of interventions intended to help people stop smoking. *Arch Intern Med* 1995; 155: 1933-1941.



21. Okuda N, Okamura T, Kadowaki T, Tanaka T. Weight control intervention in overweight subjects at high risk of cardiovascular disease: A trial of a public health practical training program in a medical school. *Nippon Koshu Eisei Zasshi* 2004 Jul (7): 552-60.
22. Primatesta P, Falaschetti E, Gupta S, Marmot MG, Poulter NR. Association between smoking and blood pressure: evidence from the health survey for England. *Hypertension* 2001; 37: 187-193.
23. 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.
24. Hypertension prevention trial research group. The hypertension prevention trial: three-year effects of dietary changes on blood pressure. *Arch Intern Med* 1990; 150: 153-162.
25. Trials of Hypertension prevention collaborative research group. The effects of nonpharmacologic interventions on blood pressure of persons with high normal levels: results of the trials of hypertension prevention phase I. *JAMA* 1992;267: 1213-1220.
26. Trials of Hypertension prevention collaborative research group. Effect of weight loss and sodium reduction intervention on blood pressure and hypertension incidence in overweight people with high normal blood pressure: Trials of Hypertension prevention phase II. *Arch Intern Med* 1997; 157: 657-667.