(Draft –not to be quoted)

REPORT OF THE PROJECT

Community Based Detection and Monitoring Of Hypertension in Kumarakom Panchayat, Kottayam

K R Thankappan -Principal Investigator [1]

S Sivasankaran- Co-Investigator [2]

S Abdul Khader-Co-Investigator[3]

P G Padmanabhan –Co-Investigator[4]

R S Vasan- Honorary Consultant[5]

Financial Support provided by Kerala Research Program for Local Level Development, Centre for Development Studies, Ulloor, Trivandrum 695011.

---

1. Additional Professor and Head, Achutha Menon Centre for Health Science Studies of Sree Chitra Tirunal Institute for Medical Sciences and Technology Trivandrum – 695011 Tel: 0471-2524231 email: thank@sctimst.ac.in
2. Additional Professor, department of Cardiology Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum – 695011 Tel: 0471-2443152 email: siva@sctimst.ac.in
3. Associate Professor, department of Cardiology Medical College Kottayam 686008 Tel: 0481-2598827 email: thonderky@sify.com
4. Ward Member, Kumarakom Panchayat and Advocate, Kumarakom, Kottayam – 686563 Tel: 0481-2524302

5. Associate Professor of Medicine, Boston University School of Medicine, Framingham Heart Study, Framingham, MA 01702-5803 USA. Tel: 508-935-3450 email: Vasan@fram.nhlbi.nih.gov

INTRODUCTION

Kerala state has the largest proportion of elderly population in India (Rajan et al). Life expectancy in the state has reached 76 years for women and 70 years fro men. These figures are close to the developed countries. Increase in life expectancy and changes in life style of Kerala population have led to the emergence of a large proportion of non-communicable disease in the state. The major non-communicable diseases in Kerala are cardiovascular disease, cancer, diabetes mellitus and chronic obstructive pulmonary disease. The risk factors of these non-communicable diseases are common. Hypertension, tobacco use, alcohol use, overweight and obesity, lack of physical activity, increases stress levels, high levels of cholesterol in the blood are the major risk factors. In Kerala the onset of many of these diseases is at an early age compared to many developed countries. This is due to the increasing levels of risk factors among the population. Hypertension is considered as a risk factor as well as a disease. A few studies on hypertension in the state showed high prevalence among Kerala population (Kalavathy et al, Hypertension study group, Manu Zacharia et al). What is required is community level intervention for controlling risk factors for non-communicable diseases. Kumarakom panchayat, which has done a lot of work in the people's campaign program, came forward to undertake such an intervention. Relationship between hypertension and a few established risk factors is given below.

Elevated blood pressure (BP) is probably the most important public health problem in many countries today. Hypertension has been identified as one of the risk factors for cardiovascular morbidity and mortality. Hypertension prevalence is increasing in all the countries and the rate of increase depends on the epidemiological transition the country is passing through. It is common, asymptomatic, readily detectable, usually easily treatable and often leads to lethal complications if left untreated. BP like height and weight is a biological characteristic of the individual. Like other characteristics, BP shows wide inter individual variability. The BP of some

individuals lies above the mean while others have a BP below the mean. The distribution curve is slightly asymmetrical with a tail to the right, which becomes more pronounced with age. The analogy with height and weight is a close one. The spread of values reflects the influence of genetic and environmental factors. Patients with high BP and no definable cause are said to have Primary Hypertension, Essential Hypertension or Idiopathic Hypertension. In more than 95% of cases a specific underlying cause of hypertension (HTN) is not found. In the remaining 5%, HTN can be shown to be a consequence of a specific disease or abnormality such as renal diseases, endocrine disease drugs or pregnancy. BP shows great variability. Exposure to pain, mental stress, exercise or sexual intercourse give rise to rapid elevation of BP. BP also changes over the 24hr period, reaching its nadir during the early hours of the morning and a maximum on rising. This rhythm is dependent on environmental factors. Thus when workers change from a day to night shift this circadian rhythm changes immediately.

Risk factors for hypertension:

A World Health Organization (WHO) scientific group has reviewed risk factors for essential HTN (WHO TRS). They may be classified into non-modifiable and modifiable risk factors.

The **non-modifiable** risk factors are:

- **Age:** 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 until the 7^{th} decade in men and the 6^{th} in women.
- **Genetic factors:** Based on twin and family studies BP levels appear to be genetically determined with polygenic inheritance (WHO TRS) The children of two normotensive parents have a 3% possibility of developing HTN whereas this possibility was 45% in children of two hypertensive parents (Biauchi G etal)

The **modifiable** risk factors are:

- **Overweight and obesity:** There is no question that a positive correlation exists between obesity and BP (Stamler R etal) A gain in weight is associated with an increased frequency

of HTN in subjects with normal BP and weight loss in obese subjects with a decrease in HTN levlels

- **Salt intake:** There is an increasing body of evidence that high salt intake (i.e. 7-8g/day) increases BP proportionately while low sodium intake has been found to lower BP (Beard T C et al)
- **Environmental factors:** HTN is a disorder initiated by tension or stress where psychological factors operate through mental processes.
- **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 (Gupta SP et al)
- **Presence of other diseases:** Those having other diseases like diabetes mellitus are at higher risk of high BP.
- **Other factors:** Consumption of saturated fat, sedentary life style and tobacco consumption are other risk factors for HTN.

Complications of Hypertension:

The adverse effects of HTN involve the cardiovascular system, central nervous system, eye and the kidneys. This may result in a multitude of disorders like stroke, carotid atheroma, transient ischemic attacks, hypertensive encephalopathy, central retinal vein thrombosis, left ventricular hypertrophy, left ventricular failure, aortic aneurysms, aortic dissection and progressive renal failure.

The Prevalence of Hypertension:

The prevalence of HTN depends upon the criteria used to define HTN. The lower the criterion selected, higher the apparent prevalence.. BP normally falls with repeated measurements as patients become habituated to the procedure. Thus definition of HTN based on a single BP measurement yields a much higher prevalence than the average BP taken over several occasions. Taking the average of BP measurements on the 2nd and 3rd occasion can halve the

apparent prevalence of HTN. Estimates based on the NHANES III survey indicate that approximately 50 million or one in every four adults in the USA has high BP. This diagnosis of HTN is based on a single observation using criteria of SBP≥ 140 mm Hg or DBP ≥ 90 mm Hg or on antihypertensive therapy. This number however becomes much smaller to about 30 to 40 million if JNC criteria are used (High BP measurements confirmed at two or more subsequent visits). The prevalence of HTN rises progressively with increasing age (Gupta R 1997) In youth and middle age, men have a higher prevalence of HTN than women do but the reverse is true in later life. Each year approximately 2 million new hypertensive patients are added to the pool of patients requiring treatment for HTN in the USA alone (Mathur K S 1963)

One of the earliest studies done in the general population was by Chopra in 1942 (Dubey VD 1954) since then a number of studies have been published. A summary of few of the studies, which have been conducted mostly in urban areas, is given below (Dubey, Padmavathi, Gupta SP, Wasir HS, Sarma BK, Gupta R, Padmavathy S Gupta S, Hypertension study group, Kalavaty, Manu G Zacharia). One of these studies was conducted in India and Bangladesh (Hypertension study group)

It can be seen from the previous studies that over a period of time there was a steady increase in the prevalence of hypertension in India.

The prevalence of HTN defined by the JNC V criteria also shows a steep increase from 6.2% in 1959 to 30.9% in 1995 (Gupta R) The International Clinical Epidemiology Network (INCLEN) which used old WHO criteria showed that the prevalence of HTN was more than 20% among 6 of the 12 community studies in different parts of Asia and Latin America. The cause of the increase in prevalence of HTN is multifactor. However age and increase in body mass index were consistently shown to be associated with increased prevalence of hypertension. (Dash et al) reported a prevalence of 0.44% in tribal Orissa population but subjects who moved to cities showed an increased prevalence of 2.56%.

Table 1. Selected studies on Hypertension Prevalence in India with author, year of study, age group, criteria, sample size and proportion of hypertensives.

Author	Year	Age group.	Criteria	Sample			HTN %		
				T	M	F	T	M	F
Chopra	1942	18-70	130/?	1000	*	*	21.4	*	*
Dotto	1949	18-50	?	2500	2500	nil	1.24	1.24	-
Padmavati	1959	20-75	140/90	679	659	20	6.19	*	*
Mathur	1963	20-80	160/95	1634	1408	226	4.35	3.98	6.64
Malhotra	1971	20-58	160/95	4232	4232	Nil	9.24	9.24	*
Gupta	1978	20-69	160/95	2023	1151	872	6.43	5.99	6.99
Wasir	1984	20-60	160/95	2455	1767	688	3.18	3.85	1.45
			140/90	2455	1767	688	6.15	7.42	2.9
Sharma	1985	20-75	160/95	1008	803	205	14	15.4	8.78
Gupta	1995	20-85	160/95	2212	1415	797	10.9	10.3	12.2
			140/90	2212	1415	797	30.9	29.5	33.5
Kalavathy et al	2000	>60	140/90	133	58	75	59	*	*
Hypertension study group	2001	>60	140/90	1203	533	670	65	63	66
Manu Zacharia et al	2003	40-60	140/90	314	163	151	54.5	56.3	52.3

Physical Activity and Hypertension:

Technological progress in industrialized countries has generally led to decreasing physical activity in most jobs (Koplan) In the USA an estimated 56% of men and 62% of women fail to engage in regular leisure-time physical activity (i.e. at least three times per week for 20 minutes

per session), and 25% of men and 30% of women perform no leisure-time physical activity (Casperson) it has been shown that regular physical activity confer a protective effect against HTN. Blood pressure can be lowered with moderately intense physical activity (40-60% of maximum oxygen consumption) such as 30 to 45 minutes of brisk walking most days of the week (Abbot RD) when compared with their more active and fit peers sedentary individuals with normal blood pressure have a 20 to 50% increased risk of developing HTN (Salmon JT Pushka P etal) in a community based study in Taiwan (Paffenberg RS etal) physical activity especially low sports activity was an independent risk factor for age, sex and body mass index. Regular aerobic physical activity, adequate to achieve at least a moderate level of physical fitness can enhance weight loss and functional health status and reduce risk for cardiovascular disease and all cause mortality (Johnson SE et al 1999) since HTN is a risk factor for stroke and cardiovascular disease, benefits of physical activity are automatically extended to these conditions. Moderate levels of physical activity were associated with a reduced risk of fatal and nonfatal stroke (Caspersen CJ et al) the effects of physical activity persisted in the absence of HTN, diabetes mellitus and left ventricular hypertrophy. The results of a study based on the Swedish Annual Level of Living Survey shows physical inactivity as a strong risk for poor health. They conclude that physical activity protects against poor health irrespective of an increased body mass index and smoking (Mikhail N) A joint statement by the WHO and the International Society and Federation of Cardiology have recommended that along with the three major risk factors for coronary heart disease- high serum cholesterol, smoking and high blood pressure, physical inactivity should be considered as an important risk factor (Rose GA)

Over weight, obesity and Blood Pressure:

Obesity refers to excessive storage of energy in the form of fat. The most common method to assess the degree of obesity is Body Mass Index (BMI). BMI is calculated by dividing the body weight (in kilograms) by height (in meters) square. BMI has been classified by WHO (Rose) into the following groups; $>25kg/m^2$ is considered overweight while $>30kg/m^2$ is considered as obese. The NHANES data (Kuczmarski) indicate that the prevalence of obesity

has increased dramatically in all race/age groups. An estimated increase of 8% between 1976-80 and the 1988-91 surveys was reported.

The association between obesity and HTN has been documented by a large number of cross-sectional and longitudinal studies. The nationwide community HTN Evaluation Clinic (CHEC) screening which included one million Americans showed that the prevalence of HTN was 0.5 to 3 times higher in those who reported being overweight compared with those who classified themselves as normal or low weight (Stamler) Data from NHANES III, which comprised more than 30,000 people showed that systolic and diastolic BP increased with, increased BMI. The Framingham study, a longitudinal study involved more than 5000 men and women aged 30 to 59 at entry reported that those who have higher blood pressure levels, although not hypertensives, have a higher chance of getting hypertension in later years (Vasan R S). The prevalence of HTN was noted to increase with greater the degree of obesity. After 8 years, the risk of developing HTN and cardiac hypertrophy in the most obese group was about 3 fold and 10 higher than those with average weight, respectively. (Paffenberg et al) who followed 7,685 males for over 30 years recorded an increase in incidence of HTN with increasing ponderosa. In San Antonio Heart Study the 8-year incidence of HTN was greater with higher BMI. Further some studies show that weight loss even with salt intake kept unchanged is followed by a decrease in BP. It is often difficult to determine precisely the temporal relation between obesity and HTN. Results from the Framingham study show that there is increased prevalence of obesity in subjects who have established HTN as well an increase in BP in established obesity. Thus the relationship between obesity and HTN may operate in both directions, where hypertensive subjects have more of a tendency towards obesity and obese subjects are more prone to HTN.

Dietary Salt and Blood Pressure:

High dietary salt intake has been related to high BP and its target organ damage for over 4000 years (intersalt) in early 1900's (Ambard and Beaujard) performed a study on several patients with HTN and heart failure and concluded that there was a positive relationship between salt

and BP. They also discovered the phenomenon of "salt resistance", where there was no decline in the BP even after achieving a negative chloride balance on a salt restricted diet. (Kempner) in the 1940's reconfirmed the BP lowering effect of salt restriction. (Dahl) later popularized the notion that salt intake in a population is related to HTN by showing a dramatic positive correlation between average salt intake and the percentage of hypertensive subjects in five populations. A subsequent review of 27 ecological studies by (Gleibermann et al) confirmed a direct linear relationship between salt and BP. The (INTERSALT study), the most rigorous observational study of the relationship between dietary salt on BP has yielded results that are controversial. In the primary analysis, no significant relationship between 24 hr urinary sodium excretion and BP could be demonstrated among 48 acculturated populations. Only on inclusion of 4 populations with low salt and alcohol intake as well low BMI and BP did a significant relation emerge. A re-analysis (Weinberger MH) of the data yielded an even stronger relationship but has been criticized on grounds of assumptions unsupported by data and questionable statistical methods (Chrysant) The Scottish Heart Health study (Potter JF) also found no correlation between sodium and BP after correcting for confounding variables including BMI and alcohol consumption. A meta- analysis of 32 trials (Klatsky AL) showed mean BP reduction of 4.8/2.5 mm Hg in hypertensive subjects and 1.9/1.1 mm Hg in normotensive subjects (SBP/DBP). it has been reported that reduction of dietary sodium lowers BP in at most 30%-60% of hypertensive subjects and 25%-50% of normotensive subjects. However studies have shown that sodium intake may be linked with target organ damage including left ventricular hypertrophy and renal disease independent of BP. Dietary sodium reduction may prevent these complications (Dyer) Thus individual response of BP to salt intake differs widely. African -Americans, older people and patients with HTN or diabetes mellitus are more sensitive to changes in dietary sodium than are others in the general population (Elliot P) The BP lowering effects of decreasing sodium intake are greater for older persons. A diet with moderately reduced intake of sodium may be associated with other favorable effects on factors such as ability to reduce the need for antihypertensive medications, possibly regress left ventricular hypertrophy and protect from osteoporosis and renal stones.

Alcohol intake and blood pressure:

Various studies have concluded that excessive alcohol intake is an important risk factor for high BP (Marmot MG, Wannamethee G, Frezza, US department of Agriculture, Puddey IB). Alchol has an acute presser effect. Abrupt alcohol withdrawal in heavy drinkers may also result in a significant rise in the BP, which recedes in a few days. In the INTERSALT study it was observed that heavy drinkers had a higher BP than non-drinkers. This was irrespective of whether they had consumed alcohol over the previous 24 hours (possible acute effect) or had not (withdrawal effect). The effect of alcohol on BP also depends on the pattern of ingestion (Rose G) Heavy drinkers with low variability of alcohol intake had small non-significant mean BP differences in comparison with non-drinkers, in contrast with more episodic drinkers. Alcohol's association with BP is independent of that of sodium, potassium, BMI and smoking.
Alcohol intake per day should be limited to 30 ml of ethanol, 720 ml of beer, 300mlof wine or 60ml of 100 proof whiskies. Women (Stamler J) (who absorb more ethanol than men) and lighter weight people are more susceptible to the effects of alcohol. They should limit their intake to no more than 15 ml of ethanol per day. Such amounts do not raise BP and have been associated with a lower risk for coronary heart disease.
Alcohol is not only a risk factor for high BP but can also cause resistance to antihypertensive therapy and is a risk factor for stroke (Bolinder GM). If the effect of alcohol is indeed continuous and causal, reducing the mean alcohol consumption level may reduce the prevalence of heavy consumption, with consequent favorable effect on BP in the general population which could have a significant impact on morbidity and mortality. If favorable life style changes could be induced, with consequent reduction in population BP, coronary mortality would be reduced by 9% and stroke mortality by 14% for an average reduction in population systolic BP of 5 mm Hg.

Tobacco use and Blood Pressure:

Systemic absorption levels of nicotine are similar in users of smokeless tobacco and cigarette smokers (Mikkelson KN). Healt

h hazards associated with the use of tobacco were evaluated in a large Swedish study involving 97,586 construction workers. Both smokeless tobacco users and smokers showed higher prevalence of circulatory and respiratory disorders. HTN was most common in smokeless tobacco users (Bolinder). (Hashimoto) studied the acute changes in BP during cigarette smoking and concluded that SBP and DBP increased significantly more in elderly subjects. In another study, daytime ambulatory DBP was significantly elevated in both smokeless tobacco users and smokers. These were most likely due to effects of nicotine. A strong positive relationship was found between cotinine (a nicotine metabolite) and BP in smokeless tobacco users. On the other hand an inverse relation was found in smokers indicating additional and more complex influences on vascular tone in smokers. In a Danish study (Stamler J) smokers seemed to have a diminished white coat effect, as well as a lower ambulatory BP throughout the day (diastolic) and at night (systolic and diastolic), when compared to nonsmokers. In a study conducted on normotensive male habitual smokers by Minami the 24-hour ambulatory BP is significantly lower in the non-smoking period than in the smoking period. The plasma nor-epinephrine and epinephrine concentrations were significantly lower in the non-smoking period than in the smoking period. To resolve the paradox of smokers having the same or lower BP than those of non smokers, (Mann SJ) compared the office and 24 hour ambulatory BP and concluded that in white hypertensive above the age of 50 years, smokers maintain a higher daytime ambulatory SBP than non smokers even though BP measured in the office is similar.

Thus tobacco in any form is a significant risk factor for cardiovascular disease. Those who continue to use tobacco may not receive the full degree of protection against cardiovascular disease from antihypertensive therapy (Greenberg). The cardiovascular benefits of discontinuing tobacco use can be seen within a year in all age groups (US dept)

Diet and Blood Pressure:

Apart from dietary salt, potassium, calcium, magnesium, fats, caffeine, proteins, carbohydrate, garlic and onion have been associated at various times with BP.

High dietary potassium intake may protect against developing HTN and improve BP control in patients with HTN (Macmohan). Inadequate potassium intake may increase BP. Thus adequate potassium intake (about 90 mmol per day) preferably from food sources such as fresh fruits and vegetables should be maintained (Appel)

Low dietary calcium intake is associated with an increased prevalence of HTN (Cappucio). Low magnesium intake appears to be associated with a higher BP. However there is currently no rationale for recommending calcium and magnesium supplements to lower BP. Although caffeine acutely increases BP, no direct relationship with elevated BP has been found in most studies. No consistent relationship between dietary proteins, carbohydrates, garlic, onion and HTN have been established. In a study conducted in urban Trivandrum, total and saturated fat intake, consumption of coconut oil, butter, flesh foods, milk, yogurt, sugar and jaggery were significantly associated with HTN (Beggom). Dyslipedemia is a major independent risk factor for coronary heart disease and thus diet therapy and if necessary drug therapy for dyslipedemia are an important adjunct to antihypertensive therapy. In a systematic review of dietary intervention trials to lower blood total cholesterol in free living subjects (Tang). It was observed that targets for dietary change were seldom achieved due to poor compliance.

Education, Socio-Economic Status (SES) and Blood Pressure:

In a cross sectional study conducted in rural Rajasthan (Gupta R) illiteracy and low educational status were associated with less "prestigious" occupations like agriculture and farm laboring and inferior housing. Further, uneducated and less educated people showed a higher prevalence of HTN. Educational level showed a significant inverse correlation with SBP and DBP. In another study from North India, higher SES was associated with a higher prevalence of HTN (Malhotra P). Data from the Harlem Household survey revealed that income and education were inversely related to HTN. (Sorel et al) initiated a study to examine the validity of education for predicting BP. They found an inverse association between education and blood pressure for whites and

blacks (but not for Mexican Americans) which after adjustment for age and BMI persist only in whites. They conclude that education may be of more value in design and implementation of appropriate interventions than identifying at risk groups for high BP.

Women and Hypertension:

By 2025, it is likely that there will be about 604 million older women in the world. 70% of these will be in the developing countries and 70% of these older third world women will be living in rural poverty. The life expectancy at the age of 65 years is 14.6 years for males and 16.9 for females. The biological advantage that females have over males is seen even in India in the 70 plus group with the percentage of old women being 50.9 beyond the 7th decade (Dandekar). The prevalence of HTN in women is closely related to age, with a substantial increase occurring after age 50. This increase is presumably related to the hormonal changes of menopause. Thus the ratio of HTN frequency in women versus men increases from 0.6 - 0.7 at age 30 top 1.1-1.2 at age 65. In one study (Malhotra), women had a significantly higher prevalence of HTN than males. In other studies urban values of both SBP and DBP were significantly higher than rural values (Rao PS, Singh R). In a five city Indian study of women (Singh), the overall prevalence of HTN was 25.6% and isolated diastolic HTN was the most common form of HTN. (Wegner) reported that SBP peaks in the middle age for men but continues to increase in women even beyond 80. Women also incur more complications than men from HTN. Diabetes mellitus imparts a greater risk for women than men. Further the decrease in coronary risk factors has been less pronounced in women than in men in the last 2-3 decades. (Quan) reported that in women aged 55 years or older, HTN treatment resulted in a 38% risk reduction in fatal and non fatal cerebrovascular events, a 25% reduction in fatal and non fatal cardiovascular events and a 17% reduction in cardiovascular mortality. Large long-term clinical trials of antihypertensive treatment, which have included both men and women, have not demonstrated clinically significant sex differences in BP response and outcomes (Gueyffier). Recent trials of older persons support a similar approach to HTN management in men and women.

Mortality and Morbidity associated with high Blood Pressure:

HTN is a major risk factor for stroke, cardiovascular disease and death from cardiovascular causes. It causes 150,000 deaths a year in USA alone. The risks are magnified in the elderly, probably because of the prevalence of associated cardiovascular risk factors and the overall higher likelihood of cardiovascular events. In a rural African study (Kaufmann), the risk of death increased by over 60% for a 20 mm Hg increase in DBP. The population attributable risk or the reduction in mortality that would have been observed if HTN were not present in this community was estimated as 7%. (Voko et al) found a continuous increase in stroke incidence with increasing BP in non treated subjects. In treated subjects, they found a J shaped relation between BP and risk of stroke. (Tzourio et al) concluded in their study that high BP was associated with cognitive decline, which occurred in a relatively short time period with the risk being highest in untreated hypertensive. In studies done in populations of 85 year olds, an inverse relation between BP and all cause mortality was found; higher BP was associated with lower mortality (Boshuien, Rajala S). The relation between low BP and mortality may be because people with low BP may have co-morbidity, fragility and poor health (Glynn). The Seven Countries Research Group observed that the relative risk of death due to coronary heart disease in association with increments in SBP and DBP did not differ significantly among the populations but that the absolute risk of death at the same level of BP varied substantially. These findings may have implications for antihypertensive therapy in different parts of the world.

Awareness Treatment and Control of Hypertension:

One study investigated and quantified the extent to which variations in guidelines influence the assessment of control of HTN (Fahey). The study applied recommendations of guidelines from New Zealand, Canada, the United States, Britain and the WHO. The proportion with

controlled HTN varied between 17.5% and 84.6% depending on the set of guidelines followed. Overall, the five sets of guidelines agreed for 31% of the patients. Thus HTN guidelines are inconsistent in their recommendations and unclear about absolute benefits of treatment.

Need for this study

There has been a steady rise in the non-communicable diseases in Kerala because of various reasons like increasing proportion of elderly population, changes in life styles like use of more motor vehicles resulting in decreasing physical activity, increasing use of alcohol, increasing levels of overweight and obesity and increasing levels of stress due to unemployment and changes in the family system. Many studies in India and a few in Kerala have shown that detection rate of hypertension is comparatively low and there is a lack of awareness regarding the problems due to an elevated blood pressure in the population. Although the detection and awareness levels of hypertension in Kerala is comparatively better in Kerala compared to other Indian states the rates are very low and needs a lot of improvement. The reason for inadequate treatment is lack of awareness and probably lack of drug supply. Most of antihypertensive drugs are not supplied through the primary health centres. A higher body mass index (BMI) has been found to be associated with the prevalence of HTN in all studies conducted in Kerala and other parts of India. No community-based effort has been done so far in Kerala to reduce the prevalence of HTN and to attain adequate control of HTN by pharmacological and non-pharmacological means. Therefore this study was planned as a research study combined with community level action.

Background of Project Area

Kumarakom is 10 km west of Kottayam district, located along the eastern banks of Vembanad Lake. This falls under the lowland zones of Kerala and is part of Greater Kuttanad region. The total area of the Panchayat is 51.67 sq.km. but 46.7% of the area is under water. The population of Kumarakom was 22,232 according to 1991 Census (Male 11,022, female

11210, S.C.-1020, S.T.90) There are 4841 families holding ration cards, out of these 3305 are living below poverty line. The 14 health care institutions in the panchayath include the P.H.C, Government Ayurvedic dispensary, Government Homeo dispensary, 3 private nursing homes, 3 private Homeo dispensaries and 5 private Ayurvedic dispensaries. Labor participation rate is 37.4 %. It is 51.2% among men and 25.4% among women. Major opportunities are in agriculture and allied areas. 1156 men and 1777 women are agricultural workers. 1209 men and 53 women are engaged in animal husbandry and fishing. Construction industry employ 134 persons, but commerce employ 857 persons. The Kumarakom panchayath Vikasana Samithy (KPVS) and 98 neighbourhood groups (NHGs) have a profound influence among all sections of people in this village. The participation of people for this project was ensured through these NHGs..

OBJECTIVES

1. To measure Blood Pressure and detect hypertension among the entire population above the age of 30 years of Kumarakom Panchayat
2. To monitor the hypertensives every 15-30 days and ensure regular treatment and control of hypertension
3. To develop local level capacity in controlling hypertension and other risk factors for non-communicable diseases in Kumarakom Panchayat.

METHODS

The newly published voters list for the panchayat was used as the source of information on the population above the age of 18 years. From this list all people above the age of 30 years was identified. Total population of the panchayat was 22321 (1991 census). We expected that the total population above the age of 30 years will be around 50%. Therefore the eligible population

for the initial survey was estimated to be around 12000. This population was distributed in 12 wards of the panchayat. There is a neighborhood group (NHG) for every 50 houses in each ward. In each ward there are around 8 NHGs. In each NHG there we anticipated 100 to 125 eligible subjects to be surveyed. Each NHG was to organize these people in one centre and the trained volunteers provided by the *Kumarakom Panchayat Vikasana Samithi* (KPVS) would measure BP, weight and height of the eligible subjects. The KPVS made necessary arrangements in consultation with the respective ward members to identify at least two volunteers per ward and give them sufficient training so that they could measure BP, weight and height. The volunteers were provided with a BP apparatus, weighing scale, and graduated plumb line to measure weight and height. The volunteers retained the BP apparatus, stethoscope, weighing scale and the plumb line to continue monitoring of these measurements after the completion of the project. The WHO criterion (JNC VI) was used to identify hypertensives. As per this criterion hypertension is defined as those with systolic BP more than or equal to 140 mm of Hg and / or diastolic BP more than or equal to 90 mm of Hg or those who are taking medication for hypertension.

Measurement of hypertension was done as per the standard protocol. Two readings were taken and if the difference between the two readings was more than 10 mm of mercury a third reading was taken. The average of the readings was taken as the blood pressure reading of the individual. Although it has been reported by many researchers that the blood pressure reading taken in a single visit will be an overestimate of the actual blood pressure two visits could not be undertaken in this study because of resource constraints. Moreover such readings will be taken in the monthly monitoring of blood pressure. Those readings are not considered for analysis in this report.

Monitoring of BP

The identified hypertensives will be requested to visit NHG once in 15-30 days to measure their BP. All hypertensives were directed to the community health centre Kumarakom or appropriate

health institutions to initiate treatment for hypertension or continue treatment in case of subjects who are already on treatment. The individual could select the system of treatment of his /her preference and convenience. He/she could also choose not to take any medication but to control BP by natural methods. Literature in local language was supplied to all the people attending the screening program in the initial camp. Drugs were not supplied by the NHGs. However they were advised to take regular medication from the appropriate treatment agency. Whatever information is collected during the first visit will be entered in to the computer, which is available in the grama Panchayat. From the available literature it is estimated to have around 40 percent of the population to have hypertension.

Involvement of other systems of medicine

Each hypertensive will be allowed to select his or her own preferred system of medicine, naturopathy, yoga or any other method of their choice for treatment. However their BP will be monitored by the project.

Initiation of the project activities

Meeting of the elected Panchayat leaders:

A meeting of all the elected panchayat members was called by grama panchayat president on May 2001. The panchayat decided to wholeheartedly support the project. This was discussed in the general council of the Panchayat Vikasana Samithi which is an apex body of 98 neighborhood groups. Panchayat members were authorized by the KPVS to identify two young volunteers from each ward of the Panchayat in consultation with the NHGs. The minimum qualification for the volunteers for this project was decided to be higher secondary level (12 years of schooling). Details of the initially selected volunteers are given in appendix 1. It was also decided to call a meeting of the NHGs and enlighten them on this program. An organizing

committee headed by the chairperson AG Ushakumari vice chairman P A harichandran program coordinator PG Padmanabhan and other Panchayat members.

Training of volunteers

The first training camp was organized on 10/06/2001 at Regional Agricultural Research Station (RARS) conference hall. All the volunteers and Panchayat members and some representatives fo KPVS attended the full day training camp. Each volunteer was provided with medical equipments such as BP apparatus (mercury sphygmomanometer), stethoscope, weighing scale and a plumb line, and a measuring tape. The training program was inaugurated by the panchayat president Smt AG Ushakumari. The details of the project were described in the meeting by the Investigators and program coordinator of the project. The training was provided by all the investigators and the Primary health center medical officer from the local PHC. The training was given by the investigators of the project. Both theoretical and practical training was imparted. The practical training was given by taking all measurements including blood pressure, height weight, waist circumference etc. The practical training was led by a scientist working at the Achutha Menon Centre. A printed note on how to take all measurements was also distributed to the volunteers. The interview schedule for collecting information was circulated and each item in the schedule was discussed in detail regarding collection of data. 23 out of 24 selected volunteers attended the training camp. The one that did not attend the training was given training by a qualified nurse who was one of the volunteers.

A detailed printed note on the project was distributed to all households through NHGs.

Inaugural function of the project

The project was inaugurated on 17/06/2001 at SKM high school hall. The project was inaugurated by the district panchayat president Smt Lathika Subash. Before this meeting information from all the adults above the age of 30 years was collected through household

survey in ward 11 by the volunteers. All the volunteers participated in this survey of ward 11. All people above the age of 30 years were invited to attend the formal inauguration of the project. Dr S Abdul Khader, Dr PV Priya, Dr S Sivasankaran, panchayat vice president MR Harichandran DR K R Thankappan and P G Padmanabhan also spoke on that occasion. A term of doctors and nurses from SCTIMST, medical college Kottayam and primary health center Kumarakom participated in the full day camp which followed the inaugural function. The people who participated in the camp were examined by the medical team and all the measurements were recorded and a general medical examination was also conducted. Those who required medications were given prescriptions. Although the participants were mainly from ward 11 all panchayat members and activists of KPVS participated in the medical camp.

Subsequent camps were conducted in ward 1, 2 and 12. People from other wards were examined in various NHG centers. A notice was printed on behalf of the organizing committee of the panchayat for inviting the eligible subjects on a particular time and date to the NHG centers. These notices were distributed by the NHG activists. The trained volunteers recorded all the measurements. Interview schedule was canvassed at the households by the trained volunteers. In case some people for whom the interview schedule was not administered during house visits this was done when they reported to the NHG center.

Referral system.

If someone was identified to have severe hypertension they were referred to the nearest community health center or the medical college. If some one wanted to go to a different medical system other than the allopathic system they were referred to those places.

Drop out of volunteers

Some of the initially selected volunteers dropped out due to various reasons like marriage to other places, shifting residence due to new employment, joining for higher studies etc. No one dropped out because of lack of interest. The volunteers that dropped out were replaced by their relatives in consultation with the concerned ward members. The training was also given by them during handing over the charge of the volunteers. Out of the initially trained volunteers 18 are still continuing and they provide health education services and monitoring of various risk factors including blood pressure measurements.

Economic incentives

One completed form was given an amount of Rs 2. This was only nominal incentive. The total amount paid to the volunteers was only around Rs 10000 ie Rs 1000 per volunteer for the entire data collection over a period of one year. In addition when they attended training camps and medical camps they were reimbursed actual expenses. Some of the volunteers received small amounts of Rs 5-10 per every blood pressure examination from the subjects. This was an voluntary contribution for the services rendered by the volunteer.

Non-economic benefits for the volunteers

Contact with specialist doctors like cardiologists, who helped them to receive useful advisees regarding their health problems and in some times their relatives. They could interact with them freely during the medical camp and at other times. An acceptance in the community was another non-economic incentive for the trained volunteers of this project. The community felt that these volunteers are providing some useful services to the society. Increase in knowledge on cardiovascular risk factors was another incentive for the volunteers.

Health education

Health education was provided in two ways. One was in the form of interpersonal communication during survey, during physical measurements and during monitoring of BP. A printed note and subsequently a printed booklet adapted from one that was published by the All India institute of Medical science New Delhi was distributed to all of them.

Health education camps: Many health education camps were conducted during the period of the project. Three medical camps, training camps for volunteers, training camp for health workers and anganwadi workers were all used for health education activities.

A video film on heart health was shown during the training camps. This film was produced by the initiative for cardiovascular health research in developing countries at New Delhi. Although the film is produced in Delhi it is in Malayalam and every one could follow it well.

MAJOR FINDINGS OF THE STUDY

The study sample characteristics are given in table 2. A total of 5018 adults above the age of 30 years were contacted by the trained volunteers. The expected number of adults above the age of 30 years from all the 12 wards of the panchayat was around 10000. Therefore we could collect over 50 percent of the target population in the Panchayat. The socioeconomic status of the individuals were assessed on a subjective basis by the volunteers. This was based on the housing conditions, occupation of family members and other assets. Since the volunteers belonged to the same ward, we thought this would be a better way of assessing the socioeconomic status of the subjects. Large majority of the study subjects belonged to the middle category which is a usual pattern observed in Kerala in many previous studies as well (KSSP 1 and 2). The main difference here was that the rich category was only around 3 percent, which was around 8-10 percent in some other surveys. Similarly the people belonging to the lowest SES group were 26% which was close to the NSS figure of 29% of below poverty line. However this lowest category in the KSSP survey of 1987 was only 14%. Type of house was classified into Katcha, semi pukka and Pukka. This was the classification criteria

used for many other surveys like the NFHS. Therefore we used the same criteria in order to compare our findings with those studies. The proportion of current smokers among the male subjects was 39% and among females it was only 1.6%. These figures were less than previous figures reported in KSSP survey of 1987 although the age group is not comparable. Our sample consists of older subjects compared to the KSSP sample, which included all people above the age group of 15 years.

With regards to the marital status the proportion of widows in the sample was over 13 percent and among males it was only around 4 percent significantly lower compared to males. Widowhood was reported to be one of the risk factors of hypertension in some of the previous studies. Increasing rates of divorces has not been seen in this study probably because of the subjects in out study were above the age of 30 years.

Over weight or obesity was found in over 20% of the subjects. As reported in previous studies the prevalence of over weight and obesity was slightly more among women compared to men.

History of Diabetes mellitus was reported by 8.5 percent of the subjects. Considering the proportion of undetected diabetes mellitus in the population the actual proportion of diabetes mellitus in this population will certainly be much more than what is reported by

Table2. Study Sample Characteristics (Figures in brackets are parentages)

Characteristics	Total	Men	Women
Age group			
30-44	2046 (41.3)	863 (40.0)	1183 (42.3)
45-60	1594 (32.2)	718 (33.3)	876 (31.3)
60 +	1315 (26.5)	578 (26.8)	737 (26.4)
Total	4955 (100.0)	2159 (100.0)	2796 (100.0)
Socioeconomic Status			
SES 1	1313 (26.2)	556 (25.6)	757 (26.6)
SES 2	3547 (70.7)	1557 (71.7)	1990 (70.0)
SES 3	155 (3.1)	60 (2.8)	95 (3.3)
Total	5015 (100.0)	2173 (100.0)	2842 (100.0)
Type of House			

Kacha	831 (16.6)	350 (16.1)	481 (16.9)
Semi Pakka	4007 (79.9)	1744 (80.3)	2263 (79.6)
Pakka	175 (3.5)	77 (3.5)	98 (3.4)
Total	5013 (100.0)	2171 (100.0)	2842 (100.0)
Marital Status			
Married	4044 (87.8)	1859 (93.2)	2185 (83.7)
Never Married	91 (2.0)	41 (2.1)	50 (1.9)
Divorced	39 (0.8)	13 (0.7)	26 (1.0)
Widowed	433 (9.4)	82 (4.1)	351 (13.4)
Total	4607 (100)	1995 (100)	2612 (100)
Educational status			
< 10 years of schooling	3574 (71.2)	1486 (68.3)	2088 (73.4)
>= 10Years of schooling	1444 (28.8)	689 (31.7)	755 (26.6)
Total	5018 (100.0)	2175 (100)	2843 (100.0)
Smoking status			
Non smokers	4095 (82.2)	1315 (61.0)	2780 (98.4)
Current smokers	886 (17.8)	842 (39.0)	44 (1.6)
Total	4981 (100.0)	2157(100.0)	2824 (100.0)
Body Mass Index			
< 25	3962 (79.1)	1796 (82.7)	2166 (76.3)
25-29	865 (17.3)	317 (14.6)	548 (19.3)
> = 30	184 (3.7)	60 (2.8)	124 (4.4)
Total	5011 (100.0)	2173 (100.0)	2838 (100.0)
History of Diabetes Mellitus			
No	4504 (91.5)	1936 (90.8)	2568 (92.0)
Yes	421 (8.5)	197 (9.2)	224 (8.0)
Total	4925 (100.0)	2133 (100.0)	2792 (100.0)

the study subjects. Since detection of diabetes mellitus requires estimation of fasting blood glucose this could not be included in this study. Such studies require more technically qualified people, laboratories and much more resources. One of the demands of the Panchayat was to do a study on diabetes mellitus. Since we got a substantial proportion of diabetes mellitus in the study subjects a detailed study on this is warranted in this Panchayat.

Table 3. Prevalence of Hypertension and mean blood pressure levels in selected study subgroups

Variable	Sex			Age group			
Hypertension (%)	Men	Women	P value	30-44	45-60	> 60	p value
	37.6	38.8	0.4	23.8	41.7	57	< 0.001[a]
Mean systolic BP ± SD mm of Hg)	128±18	126 ± 19	0.031	121± 15	128±18	135±22	<0.001[b]
Mean Diastolic BP ± SD mm of Hg)	82 ±11	81 ±11	< 0.001	79 ± 10	82±11	83±12	<0.001 [b]

[a] **Chi square test**

[b] **One-way ANOVA**

Prevalence of hypertension and the mean systolic blood pressure an diastolic blood pressure are given in table 3. The overall prevalence of hypertension of 38% seems to be much higher than that of many previous studies on hypertension prevalence. One of the reasons for this could be the higher age group of our study sample compared to the previous studies which included younger age group of 20-30 years also. The prevalence in the elderly population (> 60 years of age) is similar to that reported in earlier studies in Kerala (Hypertension study group) The hypertension prevalence was not different between men and women as in many previous studies.

However there was a strong association between hypertension prevalence and age. Even in the younger age group of 30 to 44 years nearly a one fourth of the sample had hypertension. The relation between age and hypertension was reported in many previous studies even in Kerala (Manu Zacharia). In our study also this linkage was found to be highly significant. The mean systolic and diastolic blood pressure values were higher among males compared to females.

Alcohol use among men was significantly higher than women as reported in many studies in India. It has to be noted here that 30% of men in our sample reported that they use alcohol (see table 4). Reported figures of alcohol use is generally lower than actual use. When we looked at the alcohol use by age group nearly 50% of the subjects in the age group of 30-44 years reported using alcohol compared to only 16% in the elderly age group of over 60 years. This shows a recent trend of increasing use of alcohol among the population even in rural areas. This could be much higher in urban areas.

Table 4. Prevalence of select risk factors of Hypertension in selected study subgroups

Variable	Sex			Age group			
Alcohol use (%)	Men	Women	P value	30-44	45-60	> 60	p value
	29.8	0.7	< 0.001	49.8	33.8	16.4	< 0.001*
Current smokers (%)	39.0	1.6	< 0.001	39.5	46.0	30.2	< 0.001*

* Only for men

Proportion of smokers is slightly lower in the age group of 30-44 years compared to that of 45-60 years which seems to be a good trend. Overall proportion of smokers in the sample is lower than that reported in earlier studies in Kerala (KSSP). Here again the rates are not really comparable because of the difference in age group studied. If we look

Table 5. Association between Hypertension prevalence and selected variables (Results of Bivariate analysis)

Variables	**Hypertension**		**P value**
	Present	**Not present**	
Body Mass Index (n=4939)			
< 25	**1359 (34.9)**	**2535 (65.1)**	**< 0.001**
25-29	**432 (50.1)**	**430 (49.9)**	
> = 30	**100 (54.6)**	**83 (45.4)**	
Age Group (n=4883)			
30-44	**479 (23.8)**	**1530 (6.2)**	

45-59	**654 (41.7)**	**913 (58.3)**	
> = 60	**745 (57)**	**562 (43)**	**< 0.001**
Sex (n=4946)			
Men	**809 (37.6)**	**1340 (62.4)**	
Women	**1084 (38.8)**	**1713 (61.2)**	**0.443**
Socioeconomic Status (n=4943)			
SES 1	**561 (43.9)**	**717 (56.1)**	
SES 2	**1238 (35.3)**	**2274 (64.7)**	
SES 3	**91 (59.5)**	**62 (40.5)**	**< 0.001**
Smoking status (n=4926)			
Current smokers	**309 (35.3)**	**567 (64.7)**	
Non smokers	**1571 (38.8)**	**2479 (61.2)**	**0.052**
Alcohol Use (n=4926)			
Current users	**232 (35.5)**	**422 (64.5)**	
Non Users	**1646 (38.5)**	**2626 (61.5)**	**0.142**
Coconut Oil (n=4931)			
Coconut Oil users	**1789 (38.0)**	**2918 (62.0)**	
Non users of coconut oil	**96 (42.9)**	**128 (57.1)**	**0.144**
Fish Eating (n=4940)			
Fish Eaters	**1824 (38.0)**	**2973 (62.0)**	
Non eaters of fish	**66 (46.2)**	**77 (53.8)**	**0.049**
History of Diabetes Mellitus (n= 4862)			
History of Diabetes	**262 (62.4)**	**158 (37.6)**	
No History of Diabetes	**1583 (35.6)**	**2859 (64.4)**	**< 0.001**
Education status (4946)			
< 10 years of schooling	**1388 (39.5)**	**2126 (60.5)**	
>= 10 years of schooling	**505 (35.3)**	**927 (64.7)**	**0.005**
Marital Status (n= 4556)			
Currently married	**1476 (36.9)**	**2523 (63.1)**	
Never Married	**30 (33.7)**	**59 (66.3)**	
Divorced	**18 (46.2)**	**21 (53.8)**	
Widow	**220 (51.3)**	**209 (48.7)**	**0.001**

at the trend of use of tobacco and alcohol it seems that the alcohol use is increasing in the population and tobacco use is decreasing.

These are two major risk factors identified by the World Health Organization recently (WHO report 2002).

We looked at the association between selected variables and prevalence of hypertension (see table 5). There was a significant association between body mass index and prevalence of hypertension. This relationship has been reported in many previous studies (References) Prevalence of hypertension in the normal BMI group was 35% and that in the obese group was 55 %. Thirty five percent prevalence of hypertension even in the normal BMI group is not a good sign. Some researchers argue that the guidelines for BMI for the south Asian population has to be revised considering the high prevalence of morbidity and mortality due to cardiovascular diseases among people with borderline BMI. There is a recent recommendation that the normal BMI should be less than 23 for the South Asian Population.

With regards to Socio economic status and prevalence of hypertension the relationship was not straight. The middle SES group has the lowest prevalence of hypertension compared to the low SES and high SES groups. The assessment of SES was done on a subjective basis looking at the house type, occupation of the members of the household and assets. We also looked at the association of hypertension prevalence with the reported income after grouping the per capita monthly income in to tertiles and the house types separately. All these analysis produced similar results (results of these analysis not included here). Non smokers had a slightly lower prevalence of hypertension compared to current smokers which has been reported in many previous studies (Kalavathy). There was no significant difference between the hypertension prevalence of alcohol users and non-users, although we expected higher hypertension prevalence among alcohol users. This could be due to the misclassification of groups due to false reports on alcohol use by subjects due to cultural reasons.

We looked at the linkages of coconut oil use on the prevalence of hypertension. In our sample 95.5% used coconut oil and the rest used other oils. Among coconut oil users hypertension prevalence was 38% compared to 43% among non-users of coconut oil. However this difference was not statistically significant. We did not find out the quantity of oil used by each person which was not possible in this study. It is important to find out the quantity of oil use rather than the type of oil. The quantity of oil and other food consumed will be reflected in the body mass index of the individual. We also looked at the relationship between eating fish and

prevalence of hypertension. Fish is supposed to be a protective food for most cardiovascular diseases including hypertension. In our sample 97.1% were fish eaters. Hypertension prevalence was 46% among non-eaters of fish compared to 38% in fish eaters. This difference was statistically significant.

The Kumarakom Panchayat leaders were really concerned about the high prevalence of diabetes among their population. This was one of the issues that prompted them to approach an academic institute like Achutha Menon Centre for Health Science studies to conduct a study on non-communicable diseases in the panchayat. It was only for convenience that we studied the hypertension prevalence and prevalence of other risk factors. Diabetes Mellitus could not be studied as mentioned earlier due to logistic and technical reasons. However we collected information on reported diabetes mellitus. In our sample 8.6% reported diabetes mellitus which is a high proportion in any population. If we add the undetected diabetes mellitus it would be a higher proportion. Among those who reported a history of diabetes mellitus 62.4% had hypertension compared to 35.6% among those who did not report a history of diabetes mellitus. This difference was highly significant and persisted even in the multiple logistic regression analysis. It is a well established fact that Diabetes mellitus is a major risk factor for most cardiovascular diseases including hypertension. In fact the level of blood pressure recommended for diabetic patients is lower than non-diabetics (JNC VII)

Relationship between education status and hypertension prevalence was analyzed. We divided our sample into two groups the first group with less than 10 years of schooling and the second group of subjects with 10 years or more of schooling. In our sample 29% of the sample reported that they 10 years or more of schooling. Hypertension prevalence was 39.5% among the lesser educated group compared to 35.3% in the other group. This difference was statistically significant.

Table 6. Correlates of Hypertension Prevalence among the study subjects : results of multiple logistic regression analysis.

Variable	Reference group	Odds Ratio (95% confidence Interval)	P value
Body Mass Index			
BMI 25-29	**BMI < 25**	**2.2 (1.8-2.5)**	**< 0.001**
BMI > = 30	**BMI < 25**	**2.3 (1.6-3.1)**	**< 0.001**
Age Group			
45-60 Years	**30-44 years**	**2.3 (1.96-2.7)**	**< 0.001**
> = 60 years	**30-44 years**	**4.4 (3.7-5.3)**	**< 0.001**
Socio-economic Status			
SES 2	**SES 1**	**0.72 (0.62-0.84)**	**< 0.001**
SES 3	**SES 1**	**1.4 (0.96-2.13)**	**0.075**
Marital Status			
Never Married	**Currently married**	**1.4 (0.7-2.7)**	**0.349**
Divorced	**Currently married**	**1.1 (0.9-1.4)**	**0.424**
Widow	**Currently married**	**0.98 (0.6-1.6)**	**0.962**
Other variables			
Sex	**Male**	**1.04 (0.9-1.2)**	**0.593**
Smokers	**Non smokers**	**0.94 (0.77 -1.14)**	**0.529**
> = 10 years schooling	**< 10 years schooling**	**1.09 (0.9 -1.3)**	**0.285**
History of Diabetes	**No history**	**2.3 (1.8-2.8)**	**< 0.001**

We also looked at the relationship between marital status and hypertension prevalence. Hypertension prevalence was higher among widows (51.3%) and divorced subjects (46.2%) compared to the prevalence among currently married subjects, who had a hypertension prevalence of 36.9%. This difference was statistically significant. This kind of increased hypertension prevalence among widows was reported in earlier studies also (Kalavathy et al). Stress could be an important reason for this higher prevalence of hypertension among these group of people.

Results of a multiple logistic regression analysis to find out the correlates of hypertension prevalence are given in table 6. Overweight subjects (BMI 25-29) had 2.2 (95% confidence interval 1.8-2.5) times more risk of having hypertension compared to normal weight (BMI < 25) subjects in our study and obese subjects (BMI >=30) had 2.3 (95% Confidence interval 1.6-3.1) times more risk of having hypertension prevalence. A positive association between higher body mass and hypertension was reported in several studies earlier (References). Even after adjusting for other confounding variables BMI was found to be one of the determining factors associated with a higher prevalence of hypertension in our sample.

Hypertension prevalence increased with age in our study subjects. Compared to the age group of 30-44 years subjects with in the age group of 45-60 years had 2.3 times more risk of having hypertension prevalence (95% Confidence interval 1.96-2.7) and subjects of 60 years or older had 4.4 times more risk of having hypertension prevalence (95% Confidence interval 3.7-5.3). Age turned out to be another independent risk factor of hypertension prevalence in our study. This has been reported in many previous studies also. Measures need to be taken to control the blood pressure levels as age advances. This could be done with lifestyle modifications or a combination of lifestyle modifications and drugs.

In the early phase of epidemiological transition life style related diseases like hypertension is reported to be more among higher socioeconomic status groups of people. This has been the finding of many previous studies from the developing countries. In our study also this was seen to some extend. SES 3 group of subjects which constitutes only a small proportion of our sample (3.1%) had 1.4 times more risk of having hypertension compared to SES 1 group of people (95% Confidence interval 0.96-2.13) which is not significant. SES 2 group of people, which forms 70% of the population in the study, had a significantly lower risk (OR 0.72, 95% Confidence interval 0.62-0.84) of having hypertension prevalence compared to that of the SES 1 group. This could be due to a life style change occurring in this group of population similar to that of the western countries.

History of diabetes mellitus was another independent variable that was associated with hypertension prevalence. Diabetes mellitus is an established risk factor for cardiovascular diseases. Reported Diabetes mellitus of over 8% of the study subjects warrants a detailed investigation of diabetes in this population. Those who reported diabetes mellitus had a 2.3 times higher risk of having hypertension (95% confidence interval 1.8-2.8) compared to those who did not report such a history.

CONCLUSIONS

In Kumarakom Panchayat we tried to detect and monitor hypertension with the help of trained volunteers selected from the different wards of the panchayat. Hypertension was identified as a marker of several risk factors for non-communicable diseases in general and cardiovascular disease in particular. In this study we have used local level resources to detect hypertension and monitor it along with other risk factors mainly looking at the sustainability of the program. Hypertension detection is not a difficult task and it can be done by trained volunteers. Twenty four volunteers were identified, two from each of the twelve wards of the panchayat, and trained by experts in this area to detect hypertension and other risk factors for non-communicable diseases. The volunteers were given a BP apparatus, stethoscope, weighing scales, measuring tape, and a plumb line to measure weight, height, waist circumference, and blood pressure. After the initial measurement they continue to take measurements and provide health education to all the people during repeat visits for the above measurements on an individual basis and during group meeting in the respective neighborhood groups. The trained volunteers have been accepted in the community because of various reasons. Hypertension is one of the common risk factors which is also considered as a diseases and people want to measure their BP quite often. The facility is not available in the government health centre because of lack of availability of time for the medical officers and non-availability of functioning BP apparatus. Taking BP is not a priority for the health centre medical officer. Due to the long queue of patients in the health centre the medical officer does not want to measure blood pressure which takes away some time of the doctor during the busy outpatient hours. In the private hospitals and clinics payment

is necessary for blood pressure measurement. These are some of the reasons why the people approach the trained volunteers for BP measurement.

The trained volunteers with the help of doctors from Sree Chitra Tirunal Institute for Medical Sciences and Technology, Medical College Kottayam, and from the Primary health centre Kumarakom collected data from over 5000 individuals above the age of 30 years from the panchayat. This constitutes approximately 50 percent of the eligible population in this age group. They also measured height, weight, waist circumference, and blood pressure of these individuals. The study findings show that 38% of the population had hypertension. The correlates of hypertension were identified as higher body mass index, age, history of diabetes mellitus and a poor socioeconomic status. Based on these findings health education measures targeted at life style modifications are suggested at the grass root level. The trained volunteers located at ward level of the panchayat and working in the neighborhood groups will be extremely useful to for providing health education to the people and to monitor the risk factors of the population. Health education materials prepared and supplied to the volunteers will be useful for imparting health education to the community. Those with diabetes mellitus need to be monitored a little more closely and be provided with adequate drugs from the hospital in the Panchayat. Measures are being taken to link the volunteers with existing health care system. In addition to the trained volunteers health workers and anganwardi workers could also be trained to monitor the risk factors of non-communicable diseases in the community. Gradually the risk factor surveillance will have to be made a part of the primary health care system in the panchayat.

References:

1. Abbott RD, Rodriguez BL, et al. Physical activity in older middle aged men and reduced risk of stroke: The Honolulu Heart Program. Am J Epidemiol 1994;139:881-93
2. American College of Sports Medicine. Guidelines for graded exercise testing and prescription. Philadelphia, PA, Lea and Febiger, 1988.
3. Appel LJ, Moore TJ, et al, for the DASH Collaborative Research Gropu. A clinical trial of the effects of dietary patterns on blood pressure. N Engl J Med 1997;336:1117-1124
4. Bali AP. Ageing and social care: trends and policies. In: Ramchandran CR, Shah B. Ed. Public Health implications of ageing in India, New Delhi: Indian Council of Medical Research, 1994;195-204
5. Beegom R, Singh RB. Association of higher saturated fat intake with higher risk of hypertension in urban population of Trivandrum in South India. Int J Cardiol 1997 Jan 3; 58(1):63-70
6. Beard TC et al. Randomized control trial of a no added sodium diet for mild hypertension. Lancet 1982;2: 455-458.
7. Bennet NE. Hypertension in the elderly. Lancet 1994; 344:447-449.
8. Bhattacharya A, Das P. Hypertension in elderly- an overview. J Indian Med Assoc 1999 Mar; 97(3): 96-101
9. Birkett NJ. The effect of alternative criteria for hypertension on estimates of prevalence and control. . J Hypertens 1997 Mar;15(3):236-44.
10. Biauchi G et al. A renal abnormality as a possible cause of "Essential Hypertension". Lancet 1979;1:173-177
11. Blair SN, Goodyear NN, et al. Physical fitness and incidence of hypertension in healthy normotensive men and women. JAMA 1984; 252:487-490.
12. Bolinder GM, Ahlborg BO, et al. Use of smokeless tobacco: Blood pressure deviation and other health hazards found in a large scale population survey. J Intern Med 1992; 232(4):327-34.

13. Bolinder G, de Faire U. Ambulatory 24 h blood pressure monitoring in healthy, middle aged smokeless tobacco users, smokers and non tobacco users. Am J Hypertens 1998 Oct;11(10):1153-63.
14. Burt VL, Cutler JA, et al. Trends in the prevalence, awareness, treatment and control of hypertension in the adult US population: data from the health examination surveys, 1960 to 1991. Hypertension 1995; 26: 60-69
15. Caspersen CJ, Christenson GM, Pollard RA. Status of the 1990 physical fitness and exercise objectives- evidence from NHIS 1985. Public health reports 1986;101:587-592.
16. Chadha SL, Radhakrishnana S, et al. Prevalence, awareness and treatment status of hypertension in urban population of Delhi. Indian J Med Res 1990; 92:233-40.
17. Chopra RN, Chopra GS. A study of normal blood pressure in Indians. Indian Med Gazette 1942; 77:21-22
18. Dash SC, et al. Hypertension Epidemiology in an Indian tribal population. J Assoc Physicians India 1986; 34: 567-570.
19. Dash SC, et al. Blood pressure profile, urinary sodium and body weight in the Oraon rural and urban community. J Assoc Physicians India 1994; 42: 878-880.
20. Dandekar K. The elderly in India. New Delhi: Sage Publications.1996.
21. Davey Smith G, Phillips AN. Inflation in epidemiology : The proof and measurement of association between two things revisited. BMJ 1996;312:1659-64.
22. Dotto BB. Studies on blood pressure, height, weight, chest and abdominal measurements of 2500 members of the Calcutta police with short notes on their medical impediments. Indian Med Gazette 1949; 84: 238-243.
23. Dubey VD. A study of blood pressure amongst industrial workers of Kanpur. J Indian Med Assoc 1954; 23: 495-498.
24. Dyer AR, Stamler J, et al. Alcohol consumption, cardiovascular risk factors and mortality in two Chicago epidemiologic studies. Circulation 1977;56:1067-74.

25. Elliot P, Stamler J, et al, for the INTERSALT Cooperative Research group: INTERSALT revisited: Further analysis of 24 hour sodium excretion and blood pressure within and across population. BMJ 1996;312:1249-53.
26. Elliot P, Fehily AM, et al. Diet, alcohol, body mass, and social factors in relation to blood pressure: the Caerphilly heart study. J Epidemiol Community Health 1987;41:37-43.
27. Evans I. Commentary. Lancet .1994;344:8
28. Fahey TP, Peters TJ. What constitutes controlled hypertension ? Patient based comparision of hypertension guidelines. BMJ 1996; 313:93-96.
29. Greenberg G, Thompson SG, et al. The relationship between smoking and the response to anti-hypertensive treatment in mild hypertensives in the Medical Research Council's trial of treatment. Int J Epidemiol 1987;16:25-30.
30. Gill JS, Shipley MJ, et al. Alcohol consumption a risk factor for haemorrhagic and non-haemorrhagic stroke. Am J Med 1991;90:489-497.
31. Gupta R. Meta analysis of prevalence of Hypertension in India. Indian Heart J 1997; 49: 43-48.
32. Gupta R, Gupta S, et al. The prevalence and determinants of hypertension in the urban population of Jaipur in western India. J hypertens 1995; 13: 1193-1200.
33. Gupta SP et al. Epidemiology of Hypertension based on total community survey in the urban population of Haryana. Ind Heart J 1978;30:315-322.
34. Gupta SP, et al. Epidemiology of hypertension based on total community survey in an urban population of Haryana. Indian Heart J 1978; 30: 315-322.
35. Gupta R, Gupta VP, et al. Educational status, coronary heart disease and coronary risk factor prevalence in a rural population of India. BMJ 1994 Nov;309(6965):1332-6.
36. Hart JT (1980) Hypertension. Library of General Practitioner Series, Churchill Livingstone
37. Hypertension Study Group. Prevalence, Awareness, Treatment and Control of Hypertension in the Elderly in Bangladesh and India: a Multicentric Study. *Bulletin of the World Health Organization* 2001; 79 (6): 490-500.

38. INCLEN Multicentre Collaborative Group. Risk factors for cardiovascular disease in the developing world. A multi centric collaborative study in the International Clinical Epidemiology Network (INCLEN). J Clin Epidemiol 1992; 45: 841- 847.
39. INTERSALT Cooperative Research Group: INTERSALT: An international study of electrolyte excretion and blood pressure. Results for 24 hour urinary sodium and potassium excretion. BMJ 1988;297:319-328.
40. Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP. The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP. Arch Inter Med. 1997; 157:2413-2446.
41. Kalavathy MC, Thankappan KR, Sarma PS, Vasan RS. Prevalence, awareness, treatment and control in an elderly community based sample in Kerala, India. The National Med J of India 2000; 13(1): 9-15.
42. Kannel WB, Brand M, et al. The relation of adiposity to blood pressure and development of hypertension. The Framingham study. Ann Intern Med 1967; 48-59.
43. Kan MZ. Services for elderly in India. Res Develop J 1995;1:30-37.
44. Kaufmann JS, Rotini CN, et al. The mortality risk associated with hypertension: preliminary results of a prospective study in rural Nigeria. J Hum Hypertens 1996 Jul;10(7):461-64.
45. Kokkinos PF, Narayan P, et al. Effects of regular exercise on blood pressure and left ventricular hypertrophy in African-American men with severe hypertension. N Engl J Med. 1995;333:1462-1467.
46. Kuczmaraski RJ, Flegal KM, et al. Increasing prevalence of overweight among US adults. The National Health and Nutrition Examination Surveys, 1960 to 1991. JAMA 1994;272:205-211.
47. Koplan JP, Powell KE. Physicians and the Olympics. JAMA 1984;252:529-30.
48. Klatsky AL, Freidman GD, et al. The relationship between alcoholic beverage use and other traits to blood pressure: a new Kaiser Permanente study. Circulation 1986;73:628-36.

49. MacMahon S et al. The effects of blood pressure reduction in older patients: an overview of five randomized clinical trials in elderly hypertensives. Clin Exp Hypetens 1993;15:967-978
50. Madhavan S et al. Relation of pulse pressure and blood pressure reduction to the incidence of myocardial infarction. Hypertension: 1994;23:395-401.
51. Mikhail N, Golub MS, et al. Obesity and Hypertension. Progress in Cardiovascular Diseases 1999 July-August;42(1):39-58.
52. Malhotra P, Kumari S, et al. Prevalence and determinants of hypertension in an unindustrialized rural population of Nort hIndia. J Hum Hypertens 1999;13(7):467-72.
53. Mann SJ. Systolic hypertension in the elderly. Arch Intern Med 1992;152:1977-84
54. Manu G Zachariah, K R Thankappan, Shiney C Alex, PS Sarma, RS Vasan. Prevalence, Correlates, Awareness, Treatment and Control of Hypertension in Middle – aged Urban Population in Kerala. *Indian Heart Journal* 2003; 55: 245-251
55. Marmot MG, Elliot P, et al. Alcohol and blood pressure: the INTERSALT study. BMJ 1994;308:1263-67.
56. Messerli FH. Oslers maneuver, pseudo hypertension and true hypertension in the elderly. Am J Med 1986;80:906-910.
57. Mikkelsen KN, Wiinberg N, et al. Smoking related to 24 h ambulatory blood pressure and hear t rate: a study in 352 normotensive Danish subjects. Am J Hypertens 1997 May;10(5 pt 1):483-91.
58. Minami J, Ishimitsu T, et al. Effects of smoking cessation on blood pressure and heart rate variability in habitual smokers. Hypertension 1999 Jan;33(1 pt 2):586-90.
59. Mann SJ, James GD, et al. Evaluation of ambulatory systolic blood pressure in hypertensive smokers.A case-control study. JAMA 1991 May 1;265(17):2226-8.
60. Murray CJL, Lopez AD. Global and regional cause of death patterns in 1990. Bull World Health Organ 1994;72:467-80.
61. Mathur KS, et al. Blood pressure studies in adult population of Agra, India. Am J Cardiol 1963; 11: 61-65.

62. National Health and Nutrition Examination Survey (NHANES III), 1988-91. Reported in :The fifth report of the Joint National Committee on Detection, Evaluation and treatment of High Blood Pressure. Arch Intern Med 1993;153:154-83.
63. National High Blood Pressure Education Program Working Group. National High Blood Pressure Education Program Working Group report on hypertension in the elderly. Hypertension 1994;23:275-285.
64. National High Blood Pressure Education Program Working Group Report on Primary Prevention of Hypertension. Arch Intern Med 1993;153:186-208.
65. Padmavati S, Gupts S, et al. Dietary fat, serum cholesterol levels and incidence of atherosclerosis and hypertension in Delhi. Indian J of Med Res 1958; 46: 245-260.
66. Padmavati S, Gupta S. Blood pressure studies in rural and urban groups in Delhi. Circulation 1959; 19: 395-405.
67. Poulter NR, et al. The Kenyan Lou migration study: Observations on the initiation of a rise in blood pressure. BMJ 1990; 300: 967- 972.
68. Paffenberg RS Jr.,Hyde RT, et al. The association of changes in physical activity level and other lifestyle characteristics with mortality among men. N Engl J Med. 1993;328:538-545.
69. Potter JF, Beevers DG. Pressor efffect of alcohol in hypertension. Lancet 1984;1:119-22.
70. Puddey IB, Parker M, et al. Efeects of alcohol and calorie restriction on blood pressure and serum lipids in overweight men. Hypertension 1992;20:533-541.
71. Quan A, Kerlikowske K, et al. Efficacy of treating hypertension in women. J Gen Intern Med 1999 Dec;14(12):718-29.
72. Rose GA, Blackburn H, et al. Cardiovascular survey methods. Geneva: World Health Organization, 1982.
73. Rose G. Strategy of preventon: lessons learnt from cardiovascular disease. BMJ 1981; 282: 1847-51.
74. Rajan IS, Mishra US, Sarma PS. Indias Elderly Burden or Challenge. Sage publications. New Delhi. 1999; 44-45.

75. Sharma BK, Arora OP, et al. Hypertension amongst the industrial workers and professional classes in Ludhiana, Punjab. Indian Heart J 1985; 37; 380-385.
76. Stamler R et al. Weight and Blood Pressure. Findings in Hypertension screening of 1 million Americans. JAMA 1978;240:1607-1610.
77. Srivastav M et al. Knowledge, attitude and practices regarding nutrition in patients attending geriatric clinic at AIIMS. In: Kumar V Ed. Ageing -Indian perspective and global scenario. New Delhi: All India Institute of Medical Sciences 1996;407-9.
78. Sung K. Family centered informal support networks of Korean elderly. The resistance of cultural traditions. J Cross Cult Gerontol 1991;6:4.
79. Shankardas MK, Kumar V. A sociological analysis of support networks in old age in India. In: Kumar V Ed. Ageing -Indian perspective and global scenario. New Delhi: All India Institute of Medical Sciences 1996;195-7.
80. Sharma SD, Agarwal S. Ageing: The Indian perspective. In: Kumar V Ed. Ageing - Indian perspective and global scenario. New Delhi: All India Institute of Medical Sciences 1996;12-19.
81. Setaro JF et al. Management of patients with hypertension: a hypertension clinic model. Mayo Clin Proc 1994;69:997-999.
82. SHEP cooperative research group. Prevention of stroke by antihypertensive drug treatment in older patients with isolated systolic hypertension: final result of the systolic hypertension in the elderly program (SHEP) JAMA 1991;265:3255-3264.
83. Smith WCS, Crombie IK, et al. Urinary electrolyte excretion, alcohol consumtion and blood pressure in the Scottish Heart Health study: cohort study. BMJ 1997;315:722-729.
84. Stamler J, Rose G, et al. INTERSALT study findings: public health and medical care implications. Hypertension 1989;14:570-77.
85. Stamler J, Cagginula Aw, et al. Chapter 12: relation of body mass index and alcohol, nutrient, fiber and caffeine intake to blood pressure in the special intervention and usual care groups in the Multiple Risk Factors Intervention Trial. Am J Clin Nutr 1997;65(suppl):338S-365S.

86. Singh RB, Rastogi SS, et al. Blood pressure trends, plasma insulin levels in and risk factors in rural and urban elderly populations of North India. Coro Artery Dis 1997 Jul;8(7):463-8.

87. Singh RB, Beegom R, et al. Prevalence and risk factors of hypertension and age specific blood pressure in 5 cities: A study of Indian women. Int J Cardiol 1998;63:165-173.

88. US Dept. of Agriculture and US dept. of Health and Human Services. Nutrition and your health: Dietary guidelines for Americans. 4th ed. Washington, DC:US Dept. of Agriculture;1995. Home and Garden Bulletin No. 232.

89. US Dept. of Health and Human Services. The health benefits of smoking cessation: A report of the surgeon general;1990.DHHS publication . (CDC) 90-8416.

90. US Department of Health and Human Services. Physical activity and Health: A report of the Surgeon General. Atlanta, Ga: Centres for Chronic Disease Prevention and Health Promotion;1996.

91. Voko Z, Bots ML, et al. J shaped relation between blood pressure and stroke in treated hypertensives. Hypertension 1999 Dec;34(6):1181-85.

92. Van de Hoogen PCW, Feskens EJM, et al, for the Seven Countries Study Research Group. The relation between Blood pressure and mortality due to coronary heart disease among men in different parts of the world. N Engl J Med 2000;342:1-8.

93. Vasan RS, Larson MG, Leip EP, Kannel WB, Levy D. Assessment of frequency of progression to hypertension in non-hypertensive participants in the Framingham Heart Study: a cohort study. The Lancet 2001; 358 (17): 1682-86.

94. Vasan R S, Larson M G, Leip E P, Evans J C, O'Donnell C J, Kannel W B, Levy D. Impact of high-normal blood pressure on the risk of cardiovascular disease. The New England Journal of Medicine 2001; 345 (18): 1291-97.

95. Vasan R S, Beiser A, Seshadri S, Larson M G, Kannel W B, D'Agostino RB, Levy D. Residual lifetime risk for developing hypertension in middle-aged women and men: The Framingham Heart Study. JAMA 2002; 287 (8): 1003-10.

96. WHO (1983). Tech Rep Ser, No 686.

97. Wasir HS, Ramchanran R, et al. Prevalence of hypertension in a closed urban community. Indian Heart J 1984; 36: 250-253.
98. Wasir HS. Ayurveda and modern medicine. In: Traditional Wisdom for Heart Care. Vikas Publishing House. New Delhi. 1995; 10-19.
99. Wegner NK. Hypertension and other cardiovascular risk factors in women. Am J Hypertens 1995 Dec;8(12pt2):94s-99s.