PREVALENCE AND CORRELATES OF HYPERTENSION AMONG THE MIDDLE AGED POPULATION IN URBAN THIRUVANANTHAPURAM, KERALA

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Dissertation submitted in partial fulfilment of the requirements for the award of the degree of Master of Public Health

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DECLARATION

I hereby certify that the work embodied in this dissertation entitled 'Prevalence and correlates of hypertension among the middle aged population in Urban Thiruvananthapuram, Kerala ' is the result of original research and has not been submitted for any degree in any other University or Institution.

Thiruvananthapuram
May19, 2000

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CERTIFICATE

Certified that this dissertation entitled 'Prevalence and correlates of hypertension among the middle aged population in Urban Thiruvananthapuram, Kerala' is a record of bonafide original research work undertaken by Mr. Manu G Zachariah. in partial fulfilment of the requirements for the Degree of Master of Public Health, under our guidance and supervision.

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19 – 05 – 2000

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CONTENTS

ABBREVIATIONS

BMI – Body Mass Index.

BP- Blood Pressure.

CI – Confidence Interval.

CAD – Coronary Artery Disease.

CVA – Cerebrovascular Accident.

DBP – Diastolic Blood Pressure.

F – Females.

HTN – Hypertension.

JNC (VI) – Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (Sixth Report).

LVH – Left Ventricular Hypertrophy.

MI – Myocardial Infarction.

M – Males.

NHANES – National Health and Nutrition Examination Survey.

OC – Oral Contraceptive.

SBP – Systolic Blood Pressure.

SD - Standard Deviation.

SES – Socio-economic Status.

WHO – World Health Organization.

UNICEF- United Nations International Children's Emergency Fund.

ABSTRACT

Objective: To study the prevalence and correlates of hypertension (HTN) in community dwelling subjects in urban Kerala, India. HTN is an important cause of cardiovascular morbidity and mortality in the middle-aged.

Design: Cross-sectional survey of subjects aged 40 to 60, using a cluster sampling technique.

Setting: Urban community in Thiruvananthapuram district, Kerala.

Participants: 314 individuals (163 M, 108 F), mean age 48.66 ± 5.61 years.

Intervention: Measurement of blood pressure by nurse and interview.

Main Outcome measures: Prevalence of HTN (JNC VI / WHO criteria); awareness of, treatment for, and adequacy of control of HTN.

RESULTS: The overall prevalence of HTN was 54.5 % (95 % CI 49-60). Prevalence was higher in men (56.4 %; 95 % CI 48.8-64) compared to women (52.3%; 95 % CI 44.33-60.3) and increased with age. Multiple logistic regression analyses identified higher BMI (OR = 1.87, 95 % CI 1.1-3.2) and age group of 55 – 60 years (OR = 2.90, 95 % CI 1.4-6.1) as important correlates of HTN. Gender, level of education, smoking, marital status, diet, salt intake, alcohol consumption and physical activity were not related to prevalence of HTN. Among hypertensives, 30.4 % were aware of and treated for HTN, but only 8.8 % were adequately controlled. 52.9 % of HTN subjects were unaware of their condition despite having at least one physician office visit in the previous year.

CONCLUSIONS: In our community based urban sample, over half of all middle-aged subjects were hypertensive. Awareness of hypertension was low despite physician office visits, and control of elevated blood pressure was poor. These findings emphasize the need for community-based measures to increase awareness of HTN in the general population, and to promote the measurement of BP, knowledge of current HTN guidelines among physicians in urban Kerala.

CHAPTER – 1

INTRODUCTION

Cardiovascular diseases account for over half of all the deaths in the industrialised societies. Hypertension is the most common abnormality in these populations and is found to increase with aging. Not only is hypertension a common and major determinant of cardiovascular morbidity and mortality but is also a major treatable risk factor for disability and death for coronary artery, congestive heart failure, dissecting aneurysmal diseases, cerebrovascular accidents, renal diseases and various other neuropathies. Thus one of the major factors in reducing the overall cardiovascular morbidity and mortality worldwide is the detection evaluation and treatment of patients with hypertension[1].

In a study on the progression from hypertension to Congestive Heart Failure, it was found that hypertension antedated development of CHF in 91 % of cases. Hypertension was associated with a 2- to 3- fold risk for the development of CHF after adjusting for age and several other risk factors. Hypertensive men and women had a substantially greater risk for the development of CHF than their normotensive counterparts[2].

Hypertension is one of the most prevalent and powerful contributors to cardiovascular diseases, the leading cause of death in the United States. There is on an average, a 20 mm of Hg systolic and 10 mm of Hg diastolic increment increase in blood pressure from age 30 to 65 years. Isolated systolic hypertension is the dominant variety. Hypertension contributes to all of the major atheroscelorotic cardiovascular disease outcomes increasing risk, on an average, 2- to 3- fold[3].

It is estimated that in the United States approximately 50 million or 1 in 4 adults have high blood pressure based on the Third National Health and Nutrition Examination Survey (NHANES). The prevalence of hypertension increases with age and is higher in blacks than whites. Women have lower blood pressure measurement than men in early adult life, but their blood pressure increases more steeply with age to reach or exceed those of men beyond middle age[3].

Because of the high prevalence of hypertension in the general population and its sizable risk ratio, approximately 35 % of atheroscelorotic cardiovascular events may be due to hypertension. Hypertension predisposes powerfully to all of the major atheroscelorotic cardiovascular disease outcomes, including cardiac failure, stroke, coronary disease, and peripheral artery disease. Risk ratios are larger for cardiac failure and stroke, but coronary disease is the most common and most lethal sequela of hypertension equaling in incidence all the other cardiovascular outcomes combined[3].

For reasons that are unclear, hypertension predisposes particularly to Myocardial Infarctions (MI) that tends to go unrecognized. In men with hypertension, 35 % of MIs go unrecognized; 45 % of MIs go unrecognized in hypertensive women. This excess of unrecognised or silent MIs persists even if possible confounders such as diabetes, LVH, and antihypertensive therapies are controlled. The Framingham Study examined the hypothesis of a J curve relation between blood pressure and coronary mortality and found it confined to high-risk subjects with MI. It appears that there is a continuous graded influence of blood pressure on CHD incidence and mortality in healthy persons[3].

A study conducted on the relationship of Blood Pressure to cardiovascular death: The effects of Pulse pressure in the elderly, found that, for younger men (21 – 59), after adjusting for effects of other risk factors, when systolic and diastolic blood pressure were considered separately, SBP was predictive of cardiovascular death (SBP: RR = 1.23; 95 % CI = (1.02, 1.45) per 10 mm Hg of increase), and DBP showed a nonsignificant positive trend in relation to cardiovascular death (DBP: RR = 1.27; 95 % CI = (0.95, 1.69) per 10 mm Hg of increase[4].

Due to westernisation of dietary habits, lifestyle modification and environmental stress, the prevalence of hypertension in major cities in India is on the rise. The relationship between risk factors to blood pressure can vary from region to region due to regional heterogeneity within the country. So a study conducted elsewhere may not be relevant to a population anywhere in India. It is essential to assess the awareness of the subjects about hypertension, whether or not the subject is on treatment for hypertension

or whether the patient/s is compliant to the treatment and to find out the difference between reported and observed morbidity of hypertension.

Background Information

In order to achieve low prevalence of hypertension, WHO recommends the following approaches: primary approach and secondary approach. The goal of the secondary prevention is to detect and control high blood pressure in affected individuals. Hypertension is an " iceberg disease". Only half of the hypertensive subjects in the general population of most developed countries were aware of the condition, only about half of those aware of the problem were being treated and only about half of those treated were considered adequately treated during the 1970's. If this was the situation in countries with highly developed medical services, the number treated would be far less in developing countries[5].

The higher the blood pressure the greater the risk and lower the expectation of life. Hypertension is not only one of the major risks factors for most forms of cardiovascular diseases but that it is a condition with its own risk factors. These risk factors include non-modifiable risk factors such as age and genetic factors and modifiable risk factors like obesity, salt intake, saturated fat, alcohol, physical activity, environmental stress and other factors like oral contraception[6].

Modern anti-hypertensive drug therapy can effectively reduce high blood pressure and consequently the excess risk of morbidity and mortality from coronary, cerebrovascular and kidney diseases. The control measures comprise of early case detection, treatment and patient compliance. The only effective method of diagnosis of hypertension is to screen the population. In developed countries, it is considered that mass screening is not essential for adequate control of blood pressure in the population, because large majority of people has at least one contact in every two years with the health services[5]. If blood pressure is measured at each such contact, the bulk of the problem of detecting of those in need of intervention is solved. But in developing countries, there are no such frequent contacts with health services nor does the health care team get enough time to check the blood pressure due to the large queue of patients.

The aim of the treatment should be to obtain blood pressure below 140/90-mm Hg and ideally 120/80-mm Hg. Control of hypertension has been shown to reduce the incidence of stroke and other complications. This is the major reason for the need for identifying and treating asymptomatic hypertension[5]. So developing countries like India should launch nationwide control programs in the field of hypertension.

Elevated blood pressure in middle aged is widely accepted as a major risk factor for subsequent cardiovascular complications such as coronary heart disease and stroke. Consequently, identification of young adults who are likely to maintain elevated blood pressure in later life is of prime importance. Successive measurement of the same biological parameter in an individual over time may be predictable to some extent[6].

The term "tracking" is used to describe the extent of predictability or relative constancy that a measurable characteristic may have in a group of individuals over repeated observation. Investigation of the degree of tracking of a biological parameter over varying ages and time interval requires a large source of longitudinal data[6].

In a study conducted on tracking of blood pressure over a 40-year period in the University of Manitoba follow-up study, 1948 - 1988, the strongest evidence for tracking was in middle aged, 45-55 years. The strength of tracking decreased with increasing time between measurements. The relation of blood pressure to subsequent cardiovascular complications is probably best described as a continuum of risk whose effect may change with age. With this premise, it is important to recognize that there may not be one fixed cutpoint of blood pressure defining a level beyond which, there is an increased risk applicable to individuals of all ages. Because of this, the concept of tracking blood pressure is important[6].

If men in the upper end of the blood pressure distribution have the greatest likelihood to remain at high levels relative to others of the same age, then men at highest risk of cardiovascular disease in later life can be identified at a young age, before their blood pressure is sufficiently elevated to satisfy traditional definition of hypertension. This analysis presents evidence that tracking of blood pressure exists from young adulthood and suggest that young adult males in the top quintile of the blood pressure distribution are likely to remain in the top quintile. This is more apparent with systolic pressure than with diastolic pressure. This evidence raises a question concerning the risk

of cardiovascular events in later life associated with high levels of blood pressure. It is possible that men who "track" in the top blood pressure quintiles at younger adult ages are those who are at greatest risk for advanced hypertension and its consequences[6]. Hence, strategies for prevention of cardiovascular complications can be targeted in an early adulthood.

There is evidence that hypertension and coronary artery disease prevalence and mortality are becoming more common in the developing world. Alarmingly high burden of cardiovascular disease related deaths indicate a need for very strong public health initiative to promote effective prevention. Hypertension, which will become an epidemic in developing world calls for urgent epidemiological studies, by which future trends in risk factor levels can be assessed and preventive strategies can be planned based on it. The first step towards this will be the examination of prevalence of high blood pressure among populations in the region of interest. No information is available on the prevalence of hypertension among the middle aged urban population of Kerala.

Primary Objectives

1) To estimate the prevalence of hypertension in the urban middle-aged population (40 - 60 years) in the district of Thiruvananthapuram.

Secondary Objectives

1) To study the correlates of hypertension in this population.
2) To study the health seeking pattern for hypertension.

Scope of the study

The study will be useful for health policy and planning for the provision of health care for middle aged. The study will throw light on the need for strengthening Public Health Action towards screening, prevention, control and treatment strategies on hypertension.

Field of application of research

The present burden of cardiovascular -disease related deaths indicate that a need for vigorous public health action to promote effective prevention. The first step for this is to examine the current levels of blood pressure among the middle-aged population. Epidemiological studies like this is needed to determine the baseline, against which future trends in risk factor levels can be assessed and preventive strategies can be planned based on it.

Review of literature

Definition of hypertension

Diagnosis of hypertension was done based on the Sixth Report of the Joint National Committee (JNC VI) on the prevention, detection, evaluation and treatment of high blood pressure. According to (JNC VI) hypertension is defined as SBP of 140 mm of mercury or greater, DBP of 90 mm of mercury or greater, or taking antihypertensive medication. This definition excludes hypertensives who have reduced their blood pressure to a normotensive range by non-pharmacological means[7].

Classification

Classification of Blood Pressure for Adults Aged 18 years and Older (JNC)			
	Blood Pressure, mm of Hg		
Category	Systolic		Diastolic
Optimal	<120	and	<80
Normal	<130	and	<85
High-normal	130-139	or	85-89
Hypertension			
Stage 1	140-159	or	90 - 99
Stage 2	160-179	or	100-109
Stage 3	≥ 180	or	N ≥ 110

JNC VI has classified Hypertension into three stages; Stage 1 (SBP 140-159 or DBP 90-99), Stage 2 (160-179 or DBP 100-109), Stage 3 (SBP ≥ 180or DBP ≥ 110)[7].

PREVALENCE OF HYPERTENSION

In a multicentric study on the prevalence and risk factors of hypertension and age-specific blood pressure in five urban cities among Indian women aged 25-64 years, the prevalence of hypertension (SBP ≥ 140 mm of Hg and DBP ≥ 90 mm of Hg) was found to be highest in Thiruvananthapuram. The prevalence found were 30.7% in Thiruvananthapuram in South India, 28 % in Mumbai in Western India, 22.6% in Moradabad in Northern India, 24.2 % in Nagpur in Central India and 19.1 % in Calcutta in Eastern India. The mean systolic and diastolic blood pressures were significantly higher in Thiruvananthapuram and Mumbai compared to other three cities[8].

The overall prevalence of hypertension was 25.6 % (n=823) and isolated diastolic hypertension was the most common form of hypertension (50.5 %, n=1506) in the five cities. Multivariate logistic regression analysis on pooled data from the five cities, after adjustment for age, showed that age, body mass index and obesity were strongly associated with hypertension. A sedentary life style and salt intake were weakly associated and alcohol intake was not a factor with these women[8].

A study conducted on the prevalence, awareness, treatment and control of hypertension in an elderly community - based sample in Thiruvananthapuram, Kerala, India, found that the overall prevalence of hypertension among elderly (age above 60 years) as 51.8 %(95% CI: 46.8% - 56.8%)[9].

A study conducted on the prevalence and determinants of hypertension in the urban population of Jaipur in Western India among adults over the age of 20 years, found that the prevalence of hypertension according to JNC-V (SBP ≥140 mm of Hg and DBP ≥ 90 mm of Hg) criteria as 30 % in men and 33 % in women and increased with age in all subjects. Significant determinants of hypertension were age, smoking and body mass index[10].

A study on blood pressure pattern in the urban and rural areas in Isfahan, Iran, found that there was a significant difference between mean systolic and diastolic blood pressure and the prevalence of hypertension among urban and rural populations ($p < 0.001$)[11].

In a study conducted on prevalence and determinants of hypertension in an un-industrialised rural population of North India, the prevalence of risk factors among hypertensive as compared to normotensive were alcohol consumption (43.2 % Vs 23.1) only among males, ($p < 0.001$), higher economic status ($p < 0.001$) and smoking (43 % Vs 41.5 %), ($p < 0.05$) [12].

Prevalence of hypertension was found to increase markedly with age, increasing body mass index and with heavy alcohol consumption, in a study conducted among 7735 middle aged men from general practices in 24 towns in England, Wales and Scotland. It was not related to smoking and only to a small extent to social class[13].

Risk factors for hypertension:

The risk factors can be classified into non-modifiable and modifiable risk factors.

Body Mass Index

Obesity is a growing epidemic worldwide. Currently, nearly one quarter of the US population is considered to be overweight (defined as body mass index (BMI) = 25 – 29.9 kg/m^2), and an additional one quarter is clinically obese (defined as BMI ≥ 30). Body weight is also increasing in developing countries that are undergoing economic transition. A study conducted on body mass index and cardiovascular risk in a rural Chinese population, observed strong positive associations between body mass index and blood pressure and hypertension in that rural population. They also observed an inverse association of BMI with HDL cholesterol levels and direct associations with Total Cholesterol / HDL cholesterol ratio, fasting glucose, and triglyceride levels. In the

Nurses' Health study, women with a BMI of 32 kg/m^2 or greater had approximately six times higher risk of developing hypertension compared with women whose BMIs were less than 23 kg/m^2. The mechanism for the relation between obesity and blood pressure has not been fully elucidated. Insulin resistance and peripheral hyperinsulinemia resulting from overweight and obesity may play a critical role in the development of hypertension[14].

Physical Activity

After 22 years of follow-up, the Honolulu Heart Program has accrued sufficient data to permit an assessment of the association between physical activity and the risk of thromboembolic and hemorrhagic stroke. Evidence suggests that physically active lifestyles are associated with a reduced risk of stroke, particularly in the late middle years of life where morbidity and mortality from stroke become increasingly serious[15].

Diet

In a study conducted on "High risk for coronary Heart Disease in Thiruvananthapuram City: A study of serum lipids and other risk factors" found that those who had high blood pressure had a mean Total Cholesterol level of 242.0 ± 61.6 mg/ dL, while those whose blood pressure was in the normal range had Total Cholesterol of 213 ± 39.8 mg/dL ($p<0.05$)[16]. Epidemiological studies have shown that urban subjects, who have a three-fold greater CHD prevalence as compared to rural subjects, have significantly higher cholesterol levels[17].

Dietary Sodium

In a meta-analysis of randomized controlled trials on the effect of reduced dietary sodium on blood pressure, has concluded that dietary sodium restriction for hypertensive individuals might be considered, but the evidence in the normotensive population does not support current recommendations for universal dietary sodium restriction. There is now a need to look beyond blood pressure control with this dietary intervention in the light of new evidence linking low urinary sodium excretion with higher mortality risk and recent reports describing the adverse metabolic effects of a low-sodium diet[18].

Education Status

An inverse association between socioeconomic status, as measured by years of education, and blood pressure has been reported in a number of studies. In a study to examine the validity of education for predicting blood pressure among 11554 examined persons aged 25-75 years from the Second National Health and Nutrition Examination Survey (1982-1984) found that education was inversely related to hypertensive status in whites and in black females. These finding suggested that information on education may be of little value for identifying populations at risk of high blood pressure, particularly if age and body mass are known[19].

In a study conducted in Harlem on prevalence and social correlates of cardiovascular risk factors, it was found that disadvantaged urban communities are at high risk for cardiovascular disease. Income and education were inversely related to

hypertension, smoking and physical inactivity. These results highlight the importance socioenvironmental factors in shaping cardiovascular risk[20].

Sex

Hypertension is less common among women than in men before menopause. This may be due to reduced blood volume as result of menstruation. Women suffer less cardiovascular morbidity and mortality than men for any degree of hypertension.

Alcohol

A study conducted on "Alcohol consumption, metabolic cardiovascular risk factors and hypertension in women" observed that women consuming 1-14 units of alcohol/week had a reduction in CHD risk, but there was an increased prevalence of hypertension among those consuming ≥ 15 units/week[21]. Heavy alcohol intake (≥ 300 ml/ week)(≥ 34 g/ day) was strongly, significantly, and independently related to systolic and diastolic pressure in individual subjects[22].

Relevance of the problem

The spectrum of disease in developing countries is changing from communicable disease to chronic diseases especially cardiovascular disease (CVD) like hypertension. There were no studies on prevalence of hypertension among middle-aged population in Kerala.

CHAPTER – 2

METHODOLOGY

Introduction

Primary data was collected by conducting house to house cross sectional survey in Thiruvananthapuram Corporation area. The survey instrument used was a pre-tested questionnaire, sphygmomanometer and stethoscope for measuring blood pressure, bathroom scale for measuring weight and graduated plum line for measuring height. Multi-stage cluster sampling was done to obtain the study sample, which comprised of 30 clusters selected from among the 50 wards of Thiruvananthapuram Corporation, which has a population of about 525000. The survey collected data on demographic characteristics, socioeconomic status, health conditions and health-related behaviors.

Description of the sampling frame

Study Location

The sampling frame consists of 50 clusters (wards) in the Thiruvananthapuram Corporation area, covering a population of about 525000. Thirty clusters (wards) were randomly selected for this study.

Study Design

Immunization coverage is often measured by UNICEF by using 30 clusters of seven each with the assumption that the coverage will not be less than 50% and to estimate a 95% CI with a precision of 10%. This method was adopted in this study. Estimating the prevalence of hypertension was the main objective and it was assumed that the prevalence of hypertension in middle aged would not be less than 50% as seen from some other studies and reports in developed and developing countries. Sampling was done on the basis of 30 clusters of 10 subjects each, instead of 7subjects. Only 10 subjects from each selected cluster was taken because it may not be possible to examine all the subjects in each cluster due to time and budgetary constraints. According to 1991 census there is 50 wards with a total population of 524006. Household members were eligible for the survey if they were in the age group of 40 to 60 years.

Sample Size Calculation

Minimum sample size required from simple random sampling was estimated using the following formula:

$$(Z^2PQ/\Delta^2)$$

Where,

Z= Confidence Limit Factor, which is 1.96 for 95 % Confidence Interval.

P= Prevalence of hypertension which have been taken as 50 %.

Q= (1-P), i.e.:(Chance of non-occurrence) = 0.5.

Δ= Precision Factor, i.e.: (Difference between expected prevalence and worst expected prevalence) = (0.56-0.44) = 0.12.

For an assumed prevalence of 50 % through simple random sampling, sample size required is about 265 to get a C.I of (44,56). Since it was planned to do a cluster sampling of 30 clusters of ten each, the sample size was increased to 300. Since there was more than one middle-aged subject in the last household of some of the clusters, the study ended up with a sample size of 314.

Sampling methods

Data from Urban Primary Census Abstract of Thiruvananthapuram (1991) prepared by NIC, Kerala State was utilised for this study. There were 50 wards in the urban area and the population of each ward was added together (cumulative population) and was then divided by 30 to get the sampling interval. The Sampling interval thus calculated was 17467. Then a random number was selected using currency note, which was 5359.

The first cluster was selected based on this random number. The rest of 30 clusters were selected by adding the random number and sampling interval and finding the ward where this figure fell in the cumulative population. It was decided to include 10 subjects from each cluster making a total of 300 subjects. A total of 314 subjects who lived in the chosen 224 households, were interviewed and examined for blood pressure, height and body weight, from 23rd December 1999 to 23rd February 2000.

Details of the sampling frame and the selected 30 clusters are given in appendix 1.

Survey instrument

Study Variables

Dependent variable

The dependant variable was hypertension. This was defined as per JNC-VI criteria as SBP of 140 mm Hg or greater and or DBP of 90 mm Hg or greater and or taking antihypertensive medication.[15]

Independent variables

1) Age
2) Sex
3) Socio-economic characteristic
4) Religion
5) Marital status
6) Occupation
7) Educational level
8) Dietary habit
9) Smoking
10) Chewing
11) Alcohol
12) Body mass index (BMI)
13) Extra salt
14) Physical activity

The researcher who is a nurse graduate administered a pre-tested questionnaire, to collect data on socio-economic, demographic and health characteristics. Variables such as age, sex, household size, religion, marital status, occupation and education, past medical history, past and present hypertension status and treatment for it, dietary habit, salt intake, tobacco use, alcohol use, physical activity, body weight, height and blood pressure measurement were recorded from each participant. Participants were asked to report up to the highest educational level they have obtained. Information on their current and past occupation and the duration of their longest held occupation was also collected. Socio-economic status (SES) was assessed taking into consideration, participant's monthly percapita expenditure, household assets and type of house.

Information on current and past tobacco consumption, current and past smokeless tobacco consumption, current and past alcohol consumption were assessed with standardized questionnaires and recorded according to type, frequency or amount, duration, reason for quitting the habit and duration of quitting, if at all he or she has quitted any of these habits. Physical activity was determined by categorising the activities into three: vigorous, moderate and light activities. Details of the checklist used for categorising physical activity is given in appendix 2.

Measurement of blood pressure

The components of the examination included resting blood pressure, anthropometry, and pre-tested standardized questionnaires to assess lifestyle and health habits. The researcher who is a nurse using a standardized mercury sphygmomanometer (Diamond Company), and stethoscope measured blood pressure. Measurements were done on the left arm of the subject in the sitting position with their back supported and

the arm resting at the chest level[7]. Right arm was used only in two subjects in whom it was difficult to get radial artery pulsation. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured to the nearest 2mm of mercury at two times. If the difference between the first and second measurement were more than 10 mm of mercury in either of systolic or diastolic pressure, a third measurement was taken. The first measurement was taken after finishing the household part of the questionnaire and the second one was taken after finishing the rest of the questionnaire. Each measurement was taken with a time interval of at least 5 minutes of rest. The first appearance of Korotkoff sound (phase1) is used to define SBP and disappearance of Korotkoff sound (phase 5) is used to define DBP.

Participants were asked if they ever had hypertension or high blood pressure. Among those who reported being hypertensive, information on self reported current use of anti-hypertensive medication was also recorded. Before measurements the subjects were asked whether they had taken hot drinks or hot beverages like tea or coffee (ingestion of caffeine) or smoked tobacco or chewed tobacco or had vigorous physical activity within the preceding thirty minutes. If they had done any of these then measurements were postponed by thirty minutes. The average of these measurements was used for analysis. Since the age group of the study was middle aged (40 – 60 years) they are mostly in the working class, and so the survey was done mainly during afternoon and evening.

Definition of hypertension, awareness, treatment and control

Diagnosis of hypertension was done based on the Sixth Report of the Joint National Committee (JNC VI) on the prevention, detection, evaluation and treatment of high blood pressure. According to (JNC VI) hypertension is defined as SBP of 140 mm of mercury or greater, DBP of 90 mm of mercury or greater, or taking antihypertensive medication. This definition excludes hypertensives who have reduced their blood pressure to a normotensive range by non-pharmacological means. Awareness of hypertension was defined as the subject reporting a prior diagnosis of hypertension (or elevated blood pressure) made by a health professional. Treatment for hypertension was defined as current use of a prescription medication for lowering elevated blood pressure among hypertensive subjects in the sample; the only treatment considered was pharmacological. Control of hypertension was defined as pharmacological treatment associated with SBP less than 140mm of mercury and DBP less than 90 mm of mercury[7]. Control rates were calculated separately for all hypertensive subjects, and for the subgroup of hypertensives being treated with antihypertensive medications, since awareness and treatment are prerequisites for the control of hypertension. The positive relationship between SBP and DBP and cardiovascular risk has long been recognised. This relationship is strong, continuous, graded, consistent, independent, predictive, and etiologically significant for those with and without CHD.

Anthropometry

Anthropometric measurements were made with the participants without wearing shoes or chappals. Weight was recorded on bathroom weighing scale (Hanson Industries) imported from Ireland, which was standardized and recorded to the nearest half kilogram. Weight was measured each time after ensuring that the pointer was at zero mark. Height was measured to the nearest one-half centimeter using a graduated standardized plum line. Body Mass Index was calculated by using the formula,

$$BMI = \text{Weight in Kilogram}/(\text{Height in meter})^2.$$

Socioeconomic characteristics of survey population

Socioeconomic status was assessed in terms of level of education, occupation, household size, and household expenditure, type of house, assets, religion and marital status. Number of years of schooling was used as initial parameter and later classified into illiterate (those who cannot read and write), primary (up to 4^{th} standard), 4^{th} to 10^{th} standard, 10^{th} standard and above. Information on current and past occupation was collected, which was then categorised into three based on the level of physical activity. Socioeconomic status was determined during the survey by the enumerator taking into account type of household, household size, household expenditure and the assets, which is subjective in nature. Percapita household expenditure was calculated based on the number of persons currently staying in the household at the time of survey.

Statistical methods

Blood pressure values of the study sample are presented as mean (± standard deviation). Comparisons of prevalence, awareness, treatment and control of hypertension of different subgroups of interest were done using the Chi-square and Chi-square trend test. Examination of distribution of blood pressure in the study sample was done according to WHO defined grades (or JNC-VI stages) of hypertension[7]. The prevalence of isolated systolic hypertension (ISH) was defined as an SBP greater than or equal to 140 mm of Hg and with a DBP less than 90 mm of Hg. Statistical analysis was performed using the SPSS for windows Release 6.1 software and Epi Info. A p values less than 0.05 was used to define statistical significance.

CHAPTER – 3

RESULTS

Characteristics of study sample

There were more men in the study sample (male: female sex ratio = 1.08). About 59 % of the participants were between the age of 40 and 50 years, while the rest were between the age of 50 and 60 years. The majority of the participants were literate and belonged to the middle SES and Hindu religion. About 98% of the study sample was married. About 96 % never used extra salt in their diet (additional salt taken other than what is added in the food during preparation) while 86 % were non-vegetarian (those taking either of egg, fish or meat). Current non-smokers are about 81 % while past non-smokers were also about 81 %. Current users of smokeless tobacco by chewing and past users of smokeless tobacco by chewing were 5 % and 3 % respectively. Current non-alcoholics and past non-alcoholics were 86 % and 91 % respectively. Regarding reported morbidity 23.2 % had hypertension, 12.4 % had diabetes, 3.2 % had asthma and 8 % had arthritis or joint pain. Women in the study sample never used to smoke or drink alcohol while a very few women were current smokeless tobacco users. For analysis purpose, those smoking tobacco at least once per week was considered to be a smoker, those

chewing tobacco at least once per week was considered as a chewer and those drinking alcohol at least once per week was considered to be an alcohol user.

Table –3.1. Age and sex composition of study population

Age	Male (n =163)		Female (n=151)		Total sample (n=314)	
	n	%	n	%	n	%
40-44 years	35	21.5	48	31.8	83	26.4
45-49 years	51	31.3	52	34.4	103	32.8
50-54 years	30	18.4	31	20.5	61	19.4
55-60 years	47	28.8	20	13.2	67	21.3
Total	163	100	151	100	314	100

(Age of 40 years is included in 40-44 years and age of 60 is included in 55-60 years)

Table 3.1 shows the age and sex composition of the study population. Majority of the respondents are in the age group 45-49 years (32.8 %). Women in this age group comprised of 34.4 percent (52 cases), while men this age group comprised of 31.3 percent (51 cases).

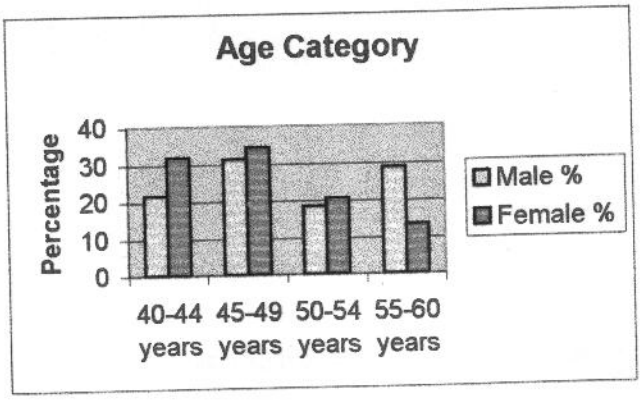


Figure – 3.1 Age and sex composition of study population

Table –3.2. Monthly Percapita Expenditure (in Rupees)

Monthly Per Capita Expenditure	No. of Household	Percentage (%)
Less than Rs. 750	71	31.7
Rs.750 – Rs.1250	68	30.4
Above Rs.1250	85	37.9
Total	224	100

Majority of the respondents, 37.9 percent (85 households) was having monthly percapita expenditure above Rs.1250. Those households having monthly percapita expenditure less than Rs. 750 were 31.7 percent (71 households) and those having monthly percapita expenditure between Rs.750 and Rs.1250 comprised of 30.4 percent (68 households).

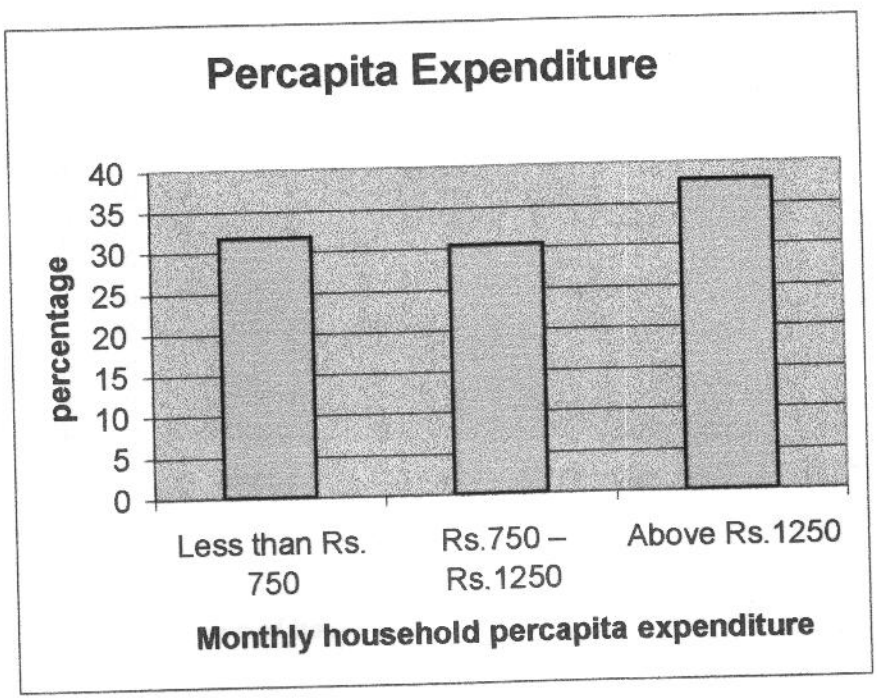


Figure – 3.2. Monthly Percapita Expenditure (in Rupees)

Table –3.3. Type of household

House Type	No. of household	Percentage (%)
Kucha	27	12.1
Semi-Pucca	136	60.7
Pucca	61	27.2
Total	224	100

Type of house is an indicator of the economic condition. Those living in Kucha house is considered to be the poorest, followed by those living in Semi-pucca and Pucca houses. Among the sample household, those living in semi-pucca house were the highest with 136 (60.7%), while those living in kucha and pucca type were 27 (12.1%) and 61 (27.2%) respectively.

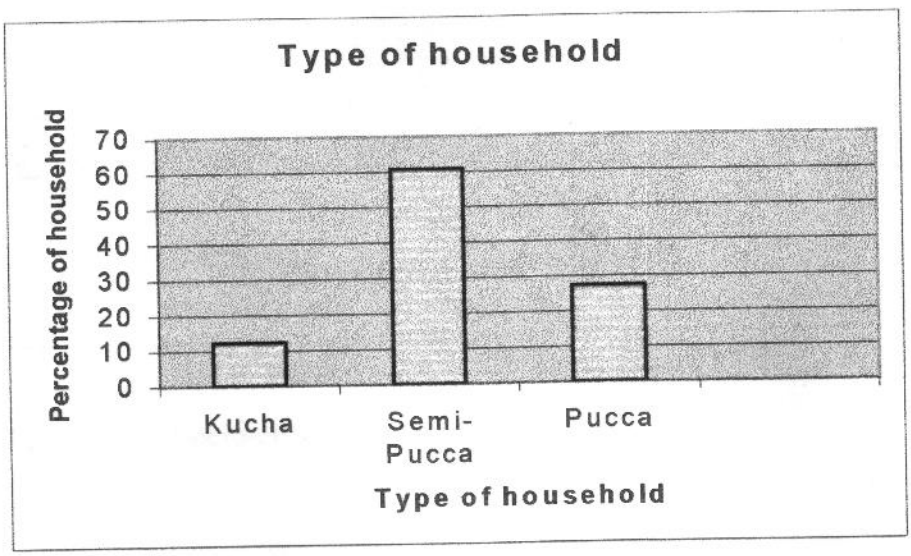


Figure – 3.3. Type of household

Table –3.4. Socio-economic Status (SES)

SES	No of households	Percentage (%)
Upper	32	14.3
Middle	130	58
Lower	62	27.7
Total	224	100

Using the investigators assessment of SES categorization, 130 (58 %) of the sample belonged to the middle SES group, while those in the upper and lower SES group comprised of 32 (14.3 %) and 62 (27.7 %) respectively.

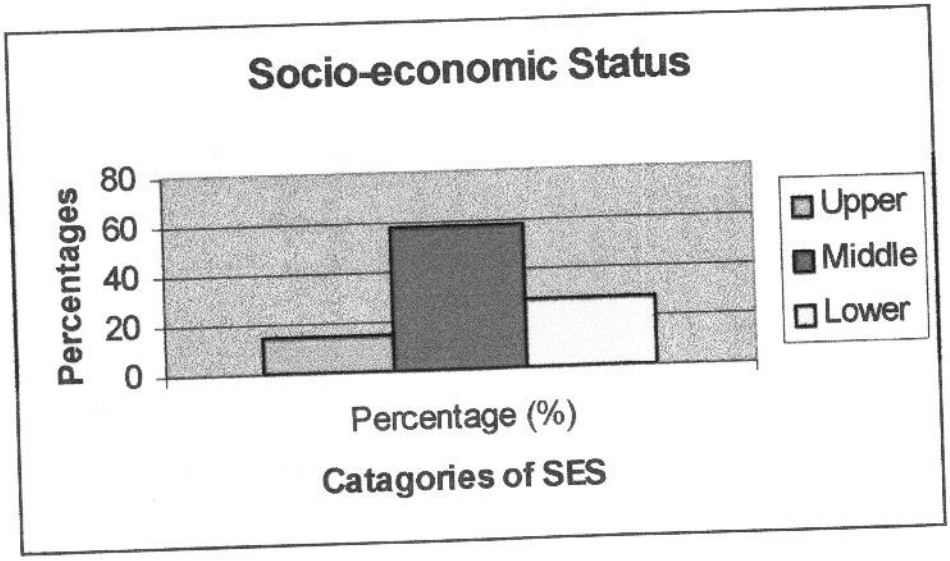


Figure – 3.4. Socio-economic Status (SES)

Table 3.5. Religion

Religion	Number	Percent %
Hindu	227	72.3
Christian	60	19.1
Muslim	27	8.6
Total	314	100

Hindus constituted 72.3 % of the Religion. Christians were 19.1 % percent and Muslims were 8.6 % percent.

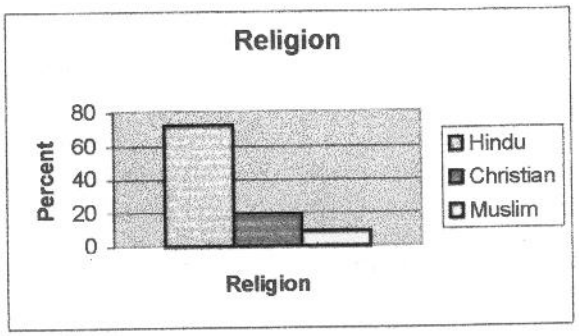


Figure – 3.5. Religion

Table 3.6. Marital status

Marital status	Male	Female	Total	Percentage
Married	161	148	309	98.4
Divorced	0	1	1	0.3
Never Married	2	2	4	1.3
Total	163	151	314	100

Table 3.7. Current Occupation profile of study population

Occupation	Number	Percentage
House Wife	111	35.4
Retired	27	8.6
Officer	22	7.0
Business	21	6.7
Clerk	19	6.1
Teacher	11	3.5
Fishing	9	2.9
Technician	9	2.9
Unemployed	9	2.9
Tailor	8	2.5
Others	68	21.65
Total	314	100

Considering the current occupation profile of the study sample, housewives comprised of a majority of 35.4 percent.

Table 3.8. Past occupation profile of study population

Occupation	Number	Percentage
Same as current	234	74.5
House Wife	8	2.5
Teacher	7	2.2
Others	65	20.7

Past occupation is defined as the previous occupation of the respondent, which was of the highest duration. Among the study sample 74.5 percent had the same past occupation as current occupation.

Table 3.9. Level of education of study population

Level of Education	Men (n=163)	Men %	Women (n=151)	Women %	Total (n=314)	Total %
Illiterate	6	3.68	11	7.28	17	5.4
1-4 years	7	4.29	3	1.99	10	3.18
5-10 years	79	48.47	97	64.24	176	56.05
>=11 years	71	43.56	40	26.49	111	35.4
Total	163	100	151	100	314	100

Illiteracy among men and women were 3.68 percent and 7.28 percent respectively, even though a few among them had gone to school but were unable to read and write. Among men about half (48.47) of them had at least 5-10 of school education, where as it is around 65 percent among women. Education more than 10 years was higher among men compared to women.

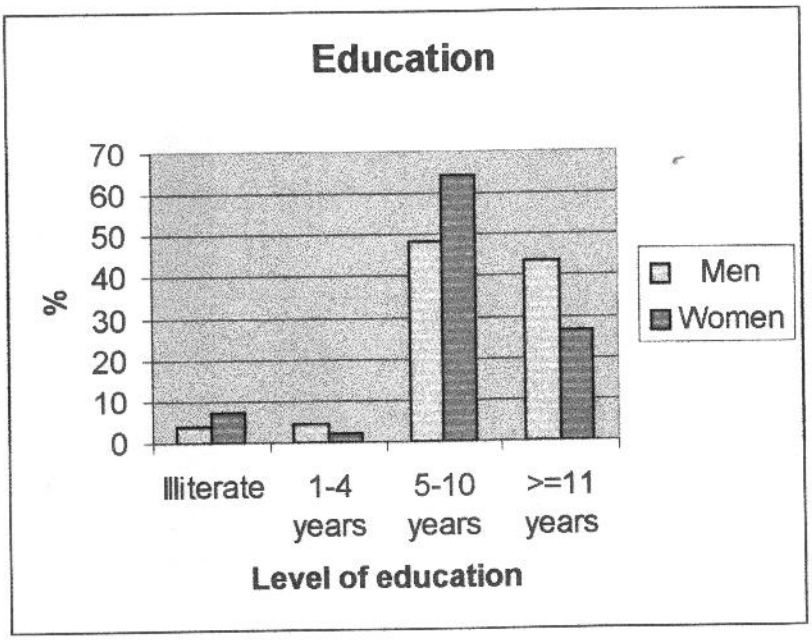


Figure – 3.6. Level of education of study population

Table 3.10. Reported Morbidity (%)

Reported Morbidity	Men (n=163)	Women (n=151)	Total (n=314)
Hypertension	21.5	25.2	23.2
Diabetes	13.5	11.3	12.4
Asthma	3.1	3.3	3.2
Arthritis/Joint pain	6.7	9.3	8.0

Reported morbidity of hypertension in the study sample was 23.2 percent. They were 12.4 percent, 3.2 percent and 8 percent respectively for Diabetes, Asthma and Arthritis. Reported morbidity of Hypertension was found to higher among women compared to men.

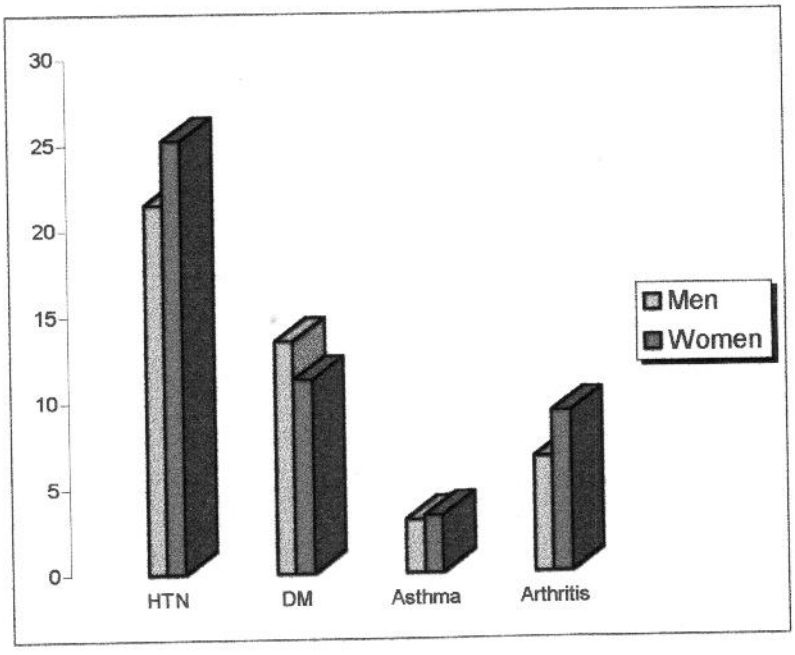


Figure – 3.7. Reported Morbidity (%)

Table 3.11. Body Mass Index (BMI) %

Body Mass Index (BMI)	Men (n=163)	Women (n=151)	Total (n=314)
< 25 Kg/m^2	69.9	47.0	58.9
25-30 Kg/m^2	23.3	38.4	30.6
30 Kg/m^2 and above	6.7	14.6	10.5

Among the study sample 58.9 percent had normal Body Mass Index (Less than 25 Kg/m^2) while 30.6 percent were overweight (BMI between 25 Kg/m^2 and 30 Kg/m^2) and 10.5 percent were having obesity (BMI more than 30 Kg/m^2). Obesity and overweight is more prevalent among women compared to men. Mean BMI of the study sample was 24.5 Kg/m^2.

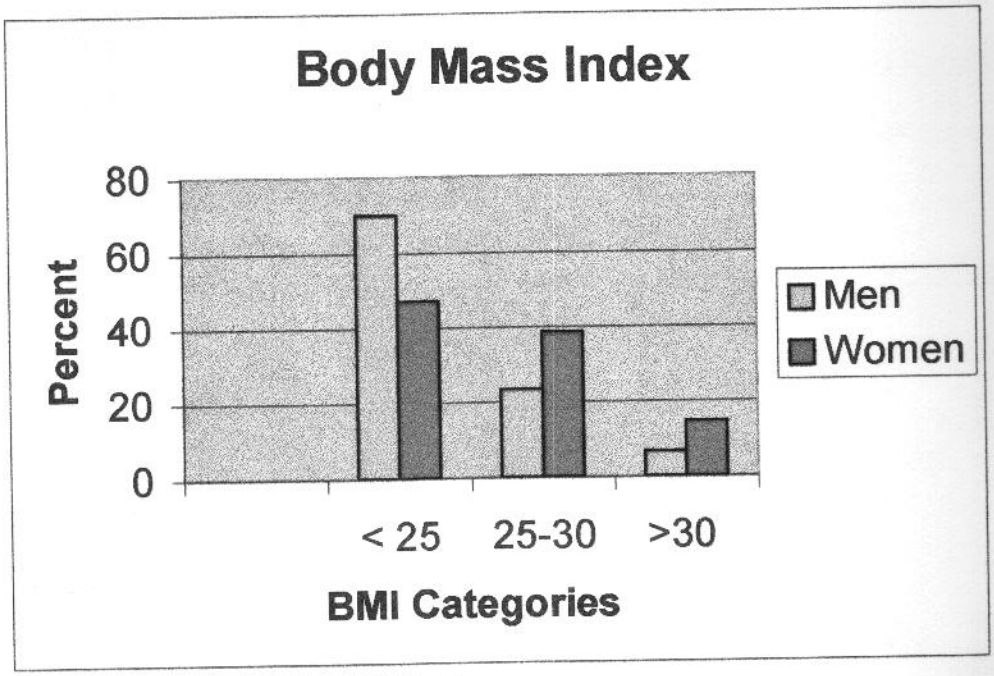


Figure – 3.8. Body Mass Index (BMI) %

Table 3.12. Diet

Diet	Male (n=163)	Female (n=151)	Total (n=314)
No extra salt	95.7	96.7	96.2
Non-vegetarian	84.7	87.4	86.0
Egg	66.9	60.3	63.7
Fish	82.2	84.8	83.4
Meat	71.2	61.6	66.6

About 96% used no extra salt in their diet. Extra salt means salt added to food while eating other than that which is added during cooking. Non-vegetarians in the study sample were 86 %. Non-vegetarians are defined as those who ate either of fish or meat, at least once in a week. Those eating egg, fish and meat respectively were 63.7 %, 83.4 % and 66.6 % respectively.

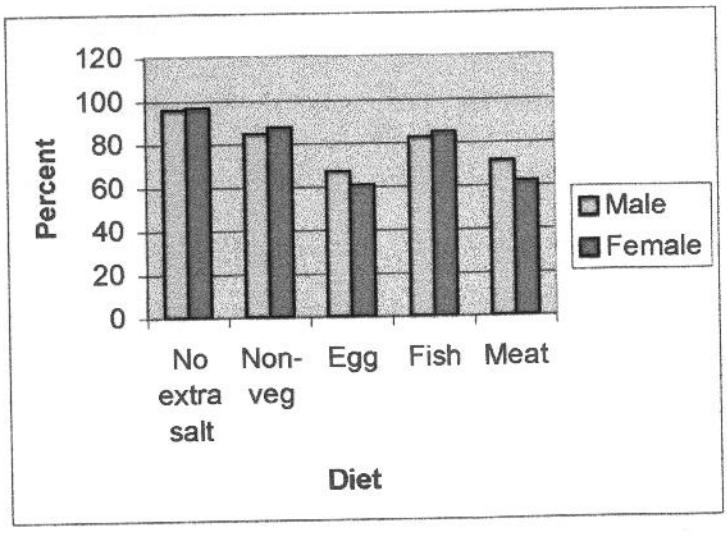


Figure – 3.9. Diet

Table 3.13. Habits

Habits	Males
Current smokers	36.2
Past smokers	43.6
Current chewers	8
Past Chewers	5.3
Current alcoholic	27
Past alcoholic	20

Among the study sample there where about 36 % of current smokers, 43 % of past smokers, 8 % of current chewers, 5.3 % of past chewers, 27 % of current alcoholic and 20 % of past alcoholic among males. None of the women in the study sample had these habits, but a few were past chewers.

Prevalence of Hypertension and mean blood pressure levels

The overall prevalence of hypertension in the study sample was 54.5 % [(95 % CI =49.0,60.0) 171 subjects (92 men and 79 women)] using the standard criteria formulated by World Health Organization (WHO) and the US Sixth Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VI). By using the older criteria for hypertension, i.e. SBP>160 mm of Hg and DBP >95 mm of Hg, and or use of antihypertensive medications, the prevalence of hypertension was 36 % [(113 subjects-59 men and 54 women)]. The prevalence of isolated systolic hypertension was 4.1 %, using the definition SBP≥ 140 mm of Hg and DBP< 90 mm of Hg.

Table 3.14. Prevalence of hypertension according to sex

	Male		Female		Total	
	n	%	n	%	n	%
HTN	92	56.4	79	52.3	171	54.5

Prevalence of hypertension was higher among males (56.4 %) compared to females (52.3 %).

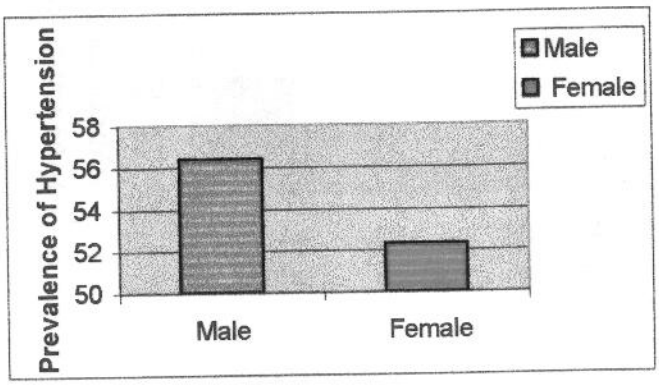


Figure – 3.10. Prevalence of hypertension according to sex

Table 3.15. Mean Blood Pressure measurement according to sex

	Men		Women	
	Mean	SD	Mean	SD
SBP	134.28	17.26	137.51	20.79
DBP	89.17	10.09	88.81	10.71

Mean SBP was higher among women, where as mean DBP was higher among men.

Table 3.16. Prevalence of hypertension according to age group

Age group	Hypertensive		Non-Hypertensive		Total		P* value
	n	%	n	%	n	%	
40- 44 years	35	42.2	48	57.8	83	26.4	
45-49 years	57	55.3	46	44.7	103	32.8	*0.004$^{\chi}$
50 – 54 years	34	55.7	27	44.3	61	19.4	
55 – 60 years	45	67.2	22	32.8	67	21.3	
Total	171	54.5	143	45.5	314	100	

P* value calculated by Chi-square trend test ($^{\chi}$)

As age increases prevalence of hypertension is increasing. This was found to be significant in Chi-square trend test.

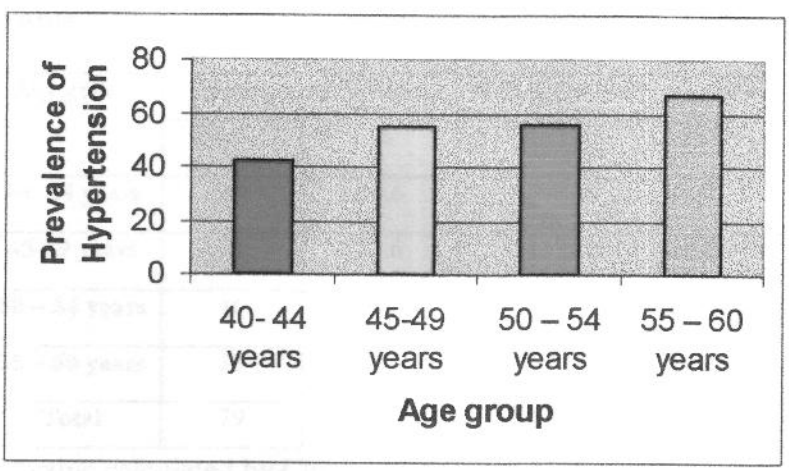


Figure – 3.11. Prevalence of hypertension according to age group

Table 3.17. Prevalence of hypertension according to age group among males

Age group	Hypertensive Men		Non-hypertensive men		OR	p value
	n	%	n	%		
40- 44 years	16	45.7	19	54.3	1.00	
45-49 years	26	51.0	25	49.0	1.24	
50 – 54 years	18	60.0	12	40.0	1.78	0.03
55 – 60 years	32	68.1	15	31.9	2.53	
Total	92	56.4	71	43.6		

p*value calculated by Chi-square test(χ)

Among males those in the age group 55-60 years had 2.53 times odds of having hypertension compared to those in the age group 40-44 years. Those in the age group 50 – 54 years and 45 – 49 years had 1.78 and 1.24 times odds, respectively of having hypertension compared to those in the age group 40 – 44 years. This shows there is a linear trend.

Table 3.18. Prevalence of hypertension according to age group among women

Age group	Hypertensive Women		Non-hypertensive women		OR	p value
	n	%	n	%		
40- 44 years	19	39.6	29	60.4	1.00	
45-49 years	31	59.6	21	40.4	2.25	0.079
50 – 54 years	16	51.6	15	48.4	1.63	
55 – 60 years	13	65.0	7	35.0	2.83	
Total	79	52.3	72	47.7		

p*value calculated by Chi-square test(χ)

Among females those in the age group 55-60 years had 2.83 times odds of having hypertension compared to those in the age group 40-44 years. Those in the age group 50 – 54 years and 45 – 49 years had 1.63 and 2.25 times odds respectively, of having hypertension compared to those in the age group 40 – 44 years.

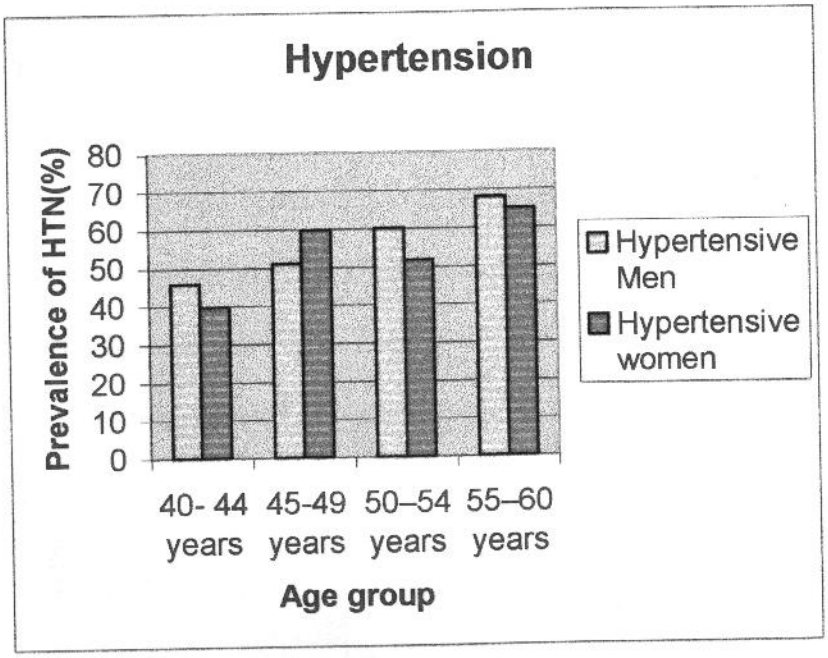


Figure – 3.12. Prevalence of hypertension according to age group and sex

Table 3.19. Prevalence of hypertension according to education

Level of education	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
Illiterate	8	47.1	9	52.9	1.00	
1-4 years	5	50.0	5	50.0	1.13	0.4
4-10 years	95	54.0	81	46.0	1.32	
11 years & above	63	56.8	48	43.2	1.48	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square trend test (χ)

In this study there is no significant relationship between level of education and hypertension.

Table 3.20. Prevalence of hypertension according to Socio-economic status

SES	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
Upper	16	34.8	30	65.2	1.00	
Middle	98	56.3	76	43.7	2.42	0.01
Lower	57	60.6	37	39.4	2.89	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square trend test (χ)

Prevalence of hypertension was significantly higher among lower SES compared to middle and higher SES. Those belonging to lower SES had 2.89 times odds of having hypertension compared to upper SES, whereas those in middle SES had 2.42 times odds of having hypertension compared to upper SES.

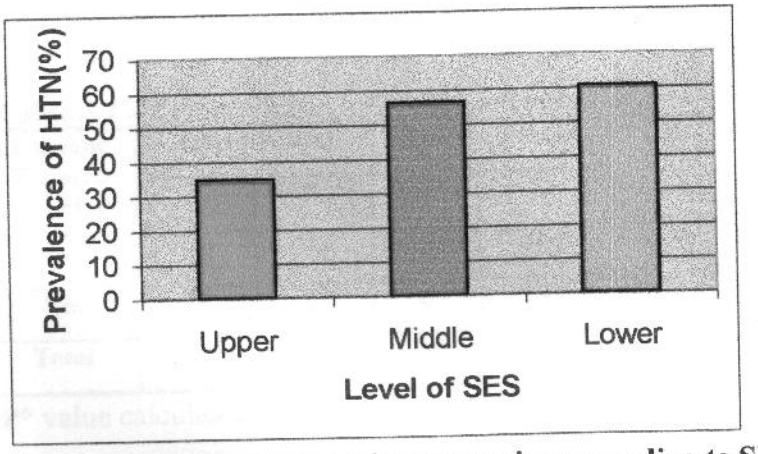


Figure – 3.13. Prevalence of hypertension according to SES

Table 3.21. Prevalence of hypertension according to Tobacco Smoking

Current Smoking	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
No	145	56.9	110	43.1	1.00	0.10
Yes	26	44.1	33	55.9	0.60	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square test (χ)

In this study, it was found that there was no significant relationship between smoking and hypertension.

Table 3.22. Prevalence of hypertension according to Past & Current Tobacco Smoking

Past & Current Smoking	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
Never smoker	116	54.5	97	45.5	1.00	0.31
Past smoker	33	68.8	15	31.3	1.84	
Current	22	41.5	31	58.5	0.59	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square trend test (χ)

In this study there is no significant relationship between past and current smoking and hypertension.

Table 3.23. Prevalence of hypertension according to Current Tobacco Chewing

Current Tobacco Chewing	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
No	161	53.8	138	46.2	1.00	0.48
Yes	10	66.7	5	33.3	1.71	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square test (χ)

In this study there is no significant relationship between current tobacco chewing and hypertension.

Table 3.24. Prevalence of hypertension according to Past & Current Tobacco Chewing

Past Tobacco chewing	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
Never chewer	157	53.8	135	46.2	1.00	
Past chewer	5	62.5	3	37.5	1.43	0.38
Current	9	64.3	5	35.7	1.55	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square trend test (χ)

In this study there is no significant relationship between past and current tobacco chewing and hypertension.

Table 3.25. Prevalence of hypertension according to Current Alcohol consumption

Current Alcohol consumption	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
No	148	54.8	122	45.2	1.00	
Yes	23	52.3	21	47.7	0.99	0.88
Total	171	54.5	143	45.5		

P* value calculated by Chi-square test (χ)

In this study there is no significant relationship between current alcohol consumption and hypertension.

Table 3.26. Prevalence of hypertension according to Past & Current Alcohol consumption

Past & Current Alcohol consumption	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
Never Alcoholic	137	54.6	114	45.4	1.00	
Past Alcoholic	14	56.0	11	44.0	1.06	0.87
Current Alcoholic	20	52.6	18	47.4	0.92	
Total	170	54.5	143	45.5		

P* value calculated by Chi-square trend test (χ)

In this study there is no significant relationship between past and current alcohol consumption and hypertension.

Table 3.27. Prevalence of hypertension according to Body Mass Index

BMI	Hypertensive		Non-Hypertensive		OR	P* value
	n	%	n	%		
< 22.7 Kg/m^2	44	43.6	57	56.4	1.00	0.01
> 22.7 Kg/m^2	127	59.6	86	40.4	1.91	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square test (χ)

Median BMI of the study sample was 22.7 Kg/m^2. There was a strong positive association between Body Mass Index and Hypertension. Body Mass Index of more than 22.7 Kg/m^2 was found to be significantly associated with hypertension. Those having BMI more than 22.7 Kg/m^2 had 1.91 times odds of having hypertension compared to those with BMI less than 22.7 Kg/m^2.

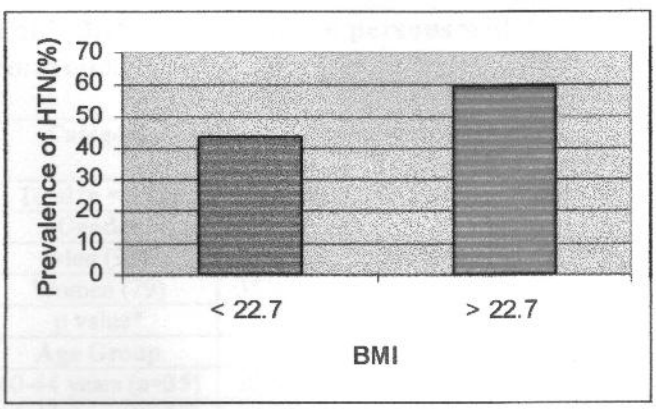


Figure – 3.14. Prevalence of hypertension according to BMI

Table 3.28. Prevalence of hypertension according to Level of Physical Activity

Physical Activity	Hypertensive		Non-Hypertensive		OR	P*
	n	%	n	%		
Light	45	60.8	29	39.2	1.00	0.12
Moderate	99	54.1	84	45.9	0.76	
Vigorous	27	47.4	30	52.6	0.58	
Total	171	54.5	143	45.5		

P* value calculated by Chi-square trend test (χ)

In this study there is no significant relationship between level of physical activity and hypertension.

From the above bivariate comparisons of the association of hypertension with selected variables, the statistically significant variables are Body Mass Index, Age and Socio-economic status.

Table 3.29. Percentage of persons with hypertension who were aware, treated and controlled

Category	Hypertensives (n =171)		
	Aware	Treated	Controlled
Total (n = 171)	66(38.6)	52(30.4)	15(8.8)
Gender			
Men (92)	31(33.7)	23(25)	8(8.7)
Women (79)	35(44.3)	29(36.7)	7(8.9)
p value*	0.15	0.14	0.82
Age Group			
40-44 years (n=35)	13(37.1)	10(28.6)	4(11.4)
44-49 years (n=57)	22(38.6)	20(35.1)	6(10.5)
50-54 years (n=34)	12(35.3)	8(23.5)	1(2.9)
55-60 years (n=45)	19(42.2)	14(31.1)	4(8.9)
p value**	0.70	0.87	0.49

* Chi-square test **Chi-square Trend test
(All values in brackets are percentages)

Only about two-fifth of the hypertensive subjects were aware of their condition. About half of those aware of their condition were on treatment. But, only less than one-tenth of the hypertensive subjects satisfied the definition of JNC VI recommendation (Pharmacological treatment associated with SBP and DBP less than 140 and 90 mm of Hg, respectively). Awareness and treatment among women differed by about 10 % more among women compared to men, whereas in case of control of hypertension it did not differ between men and women. Awareness of hypertension showed an increasing trend as age increases. Awareness, treatment and control of hypertension were lowest in the age group of 50 – 54 years. 52.9 % of HTN subjects were unaware of their condition despite having at least one physician office visit in the previous year.

Multivariate analysis using multiple Logistic regression was attempted to study the adjustment for several variables simultaneously.

Table 3.30. Results of Multivariate Analysis

Variable	Odd's Ratio	95 % C.I	p value
Age			
Age group (40 – 44 years)	1.00		
Age group (45 – 49 years)	1.65	0.89, 3.05	0.11
Age group (50 – 54 years)	1.72	0.85, 3.50	0.12
Age group (55 – 60 Years)	2.90	1.39, 6.06	0.00
BMI			
BMI <22.7 Kg/m^2	1.00		
BMI >22.7 Kg/m^2	1.87	1.10, 3.17	0.02
SES			
Lower	1.00		
Middle	1.85	0.89, 3.83	0.09
Upper	1.83	0.82, 4.07	0.13
Tobacco smoking			
No tobacco smoking	1.00		
Tobacco smoking	0.57	0.28, 1.16	0.11
Sex			
Male	1.00		
Female	0.72	0.42, 1.25	0.24

All the variables in the univariate analysis that had a P value < 0.05 and those variables that were clinically significant were used for multivariate analysis using multiple logistic regression. The variables that were taken were Age, BMI, SES, Tobacco smoking and Sex. An attempt to find out the interaction between tobacco smoking and sex was also done and was found to be insignificant. After adjusting for age and socio-economic status, BMI of more than 22.7 Kg/m^2 was significantly associated with elevated blood pressure ($p<0.05$). BMI of more than 22.7 Kg/m^2 had 1.87 (C.I = 1.10, 3.17) times odds of having hypertension compared to those with BMI less than 22.7 Kg/m^2 . After adjustment for BMI, socio-economic status, tobacco smoking and sex, age group (55 – 60 years) was significantly associated with elevated blood pressure. Age group (55 – 60 years) had 2.90 times (C.I = 1.39, 6.06) odds of having hypertension compared to those in the age group (40 – 44 years)($p<0.01$). Those living in upper socio-economic status had 1.83 (C.I = 0.82, 4.07) times odds of having hypertension compared to those in lower socio-economic status.

CHAPTER – 4

DISCUSSION

Among all Indian states, Kerala has the largest proportion of elderly population (8.8 % of the population according to the 1991 Census). The epidemiological transition accompanying this demographic change in Kerala will lead to increasing prevalence of chronic morbidity, particularly among the elderly in Kerala. The main culprit behind the screen will be hypertension. If the cohort of middle aged are having hypertension at an early age, the consequences to this same cohort after two or three decades will be alarming. If these hypertensives can be detected at an early age, morbidity associated with hypertension a few decades after could be prevented. A study of prevalence of hypertension among middle-aged in Kerala is likely to throw light into the Pandora's box.

Prevalence

The overall prevalence of hypertension in the study sample was 54.5 % [(95 % CI = 60.0, 49.0) 171 subjects (92 men and 79 women)] using the standard criteria formulated by World Health Organization (WHO) and the US Sixth Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VI). Prevalence of hypertension was higher among males 56.4 % (95 % C.I = 48.8, 64.0), compared to females 52.3 % (95 % C.I = 44.33, 60.27). Males had a higher prevalence than females in the age category 25 – 54, in a study conducted on the prevalence of coronary heart disease in the rural population of Thiruvananthapuram district, Kerala, India[23].

The prevalence of hypertension among women in the age group 45 – 54 years was 56.6 %(C.I: 49.04, 64.19). Similar finding were reported among women of 45-54 age group in Thiruvananthapuram as 48 % in a five city multi-centric study[8]. The prevalence of hypertension among men in the age group was 54.3 % (C.I: 46.68, 61.92). Age related increase in the prevalence of hypertension across the fourth and fifth decade of life as expected was also observed in both sex. Similar findings are reported in a study on Blood pressure, hypertension and correlates in urbanised workers in Nigeria[24]. Prevalence of hypertension among males was significantly lower among smokers compared to non-smokers.

Correlates of hypertension

Many studies have shown that as the BMI increases the risk for hypertension also increases. In our study we took median (22.7 Kg / m^2) as the cut off for dividing into those with lower and higher BMI. In multivariate logistic regression analysis, Body Mass Index emerged as an important correlate of hypertension when overweight was classified as having BMI more than 22.7 kg /m^2. Since Indians have a smaller body frame size and abdominal fat distribution, a modest increase in body weight and body mass index more than 23 Kg / m^2 is possibly associated with central obesity and insulin resistance, resulting in a rapid increase in blood pressure. It is possible that BMI more than 23 Kg / m^2 should be considered as an important risk factor of hypertension. Significant risk of hypertension was observed among those with BMI greater than 23 Kg / m^2 (SBP: OR = 1.84 with 95 % C.I; 1.09 – 3.09: DBP: OR = 2.30 with 95 % C.I; 1.35 – 3.94) in a study conducted on Blood pressure and Glycemic status in relation to Body Mass Index in a rural population of Bangladesh[25]. After adjustment for BMI and socio-economic status,

age group (55 – 60 years) was significantly associated with elevated blood pressure. Age group (55 – 60 years) had 2.90 times odds of having hypertension compared to those in the age group (40 – 44 years). Those living in upper SES had 1.83 times odds of having hypertension compared to lower SES.

There is general consensus on 5 modifiable causes of elevated blood pressure: excessive intake of calories (leading to obesity), salt, and alcohol: inadequate physical activity: and low potassium intake[26].

Sex, religion, occupation, level of education, diet - egg, fish, meat, salt intake, past smoking, current and past tobacco chewing, current and past alcohol intake, marital status and physical activity were found to be not associated with hypertension. In an analysis of observational data among populations, the association of blood pressure with sodium intake was substantially larger than was generally appreciated[27]. There is a chance that job-related stress and genetic influence has a higher hand on the increasing prevalence of hypertension.

Awareness

There was a striking lack of awareness of elevated blood pressure among participants in our study; only 23.2 % of hypertensives were aware of their condition. Gender related differences in hypertension were not evident, perhaps due to high level of education in the state of Kerala among both sex. Use of alternate system of medicine for the treatment of hypertension was negligible. Interpretation of data regarding awareness, treatment and control of hypertension was complex in developing countries because it

reflects an intricate interplay between availability, accessibility and affordability of physician services and pharmacological medication. Education and SES of patients, awareness of guidelines among practitioners and individual physician thresholds for treatment of high blood pressure also have an effect on the treatment and control of hypertension. Low awareness of hypertension indicate that physicians in the region surveyed currently pay inadequate attention to measuring blood pressure and treating hypertension in elderly subjects. Compared to men women had more awareness of hypertension and they tried treatment more compared to men.

Strengths of the study

1. The study sample was reasonably representative of middle-aged subjects in Thiruvananthapuram with regard to the demographic characteristics.
2. The use of a community-based sample of modest size was one of the strengths of this study.

Limitations of the study

The method of recording blood pressure twice or thrice in one sitting is not usually recommended. Due to limitation in time and budget blood pressure was not estimated on different sittings. There is possibility that the prevalence of hypertension may be overestimated in the middle aged because of the phenomenon of pseudohypertension.

Ethical Consideration

The objectives of the study were clearly explained to all the participants by the researcher at the time of interviews. So, the participants were fully aware of the study and

its objectives before giving consent to participate in the study. The participants who were in need of some kind of medical intervention, were given advises accordingly. Those who were in need of preventive advice or health education were also given those services.

CONCLUSIONS

1) The prevalence of hypertension is high among this urban middle-aged study population. We observed that about 54.5 % (95 % CI = 49.0,60.0) of the subjects between the age group of 40 and 60 years had elevated blood pressure.
2) The correlates of hypertension were BMI and age.
3) We noticed striking difference in the awareness of the disease among the subjects, despite the fact that state is having the highest literacy rate in India and has easy accessibility to health care facility. Among hypertensives, 30.4 % were aware of and treated for HTN, but only 8.8 % were adequately controlled. 52.9 % of HTN subjects were unaware of their condition despite having at least one physician office visit in the previous year.

POLICY IMPLICATIONS

Improved detection and massive treatment of hypertension in the general population have reduced the prevalence of elevated blood pressure and lowered the mean level of blood pressure. However, the new onset of essential hypertension in the general population continues unabated indicating the need for primary prevention. Prevention of this highly prevalent powerful contributor to cardiovascular disease would appear preferable to early detection and a lifetime of antihypertensive treatment. Obesity,

particularly abdominal adiposity, has been consistently shown to promote hypertension. The majority of hypertension in women and much of the early-onset hypertension in men can be attributed to excess body fat. Hence, weight control program should have a major impact on the occurrence of hypertension in young and middle-aged adults. Other measures that can be recommended are more exercise, avoidance of excess alcohol intake, and salt restriction[3]. These measures will reduce the Body Mass Index. Maintenance of normal calcium, and magnesium intakes may also be helpful. Targeted interventions towards persons who are obese, have high normal blood pressure, or have a family history of high blood pressure have been shown in clinical trials using weight reduction, exercise and salt restriction to reduce the incidence of hypertension. It is claimed that such measures could reduce prevalence of hypertension in the population by 20 % to 50 %[3]. The greatest opportunity for reducing the incidence of CHF and the excess mortality it carries is through preventive strategies directed toward earlier detection and more aggressive management of hypertension and other CHF risk factors[2].

There is a need for better implementation of anti-hypertensive clinic in the urban area with emphasis for the need of strengthening health education programs among the hypertensives especially life style modification. The only effective method of diagnosis of hypertension is to screen the population. In developed countries, it is considered that mass screening is not essential for adequate control of blood pressure in the population, because large majority of people has at least one contact in every two years with the health services. If blood pressure is measured at each such contact, the bulk of the problem of detecting of those in need of intervention is solved. But in developing

countries, there is no such frequent contact with health services nor does the health care team get enough time to check the blood pressure due to the large queue of patients. Efforts must be taken to screen for hypertension, which is an "iceberg disease", among middle aged as well elderly and develop a database of the population so that this silent killer can be better tackled. But this requires willingness to allot more budgets for health services so that primary or essential health care can be provided in terms of screening, prevention, control and treatment for hypertension.

A retrospective study on acute myocardial infarction in North Kerala – a 20-year hospital based study has revealed that there is an increase in the number of cases of first acute myocardial infarction admitted to the hospital. The occurrence in younger age group and peak occurrence in the 5th decade was noted[28]. If hypertension could be detected in an early age, the occurrence of major chunk of diseases like CAD, CVA, CHF, aneurysm and renal disease could be prevented, which means that we are saving a lot money to be utilised for the treatment of these morbidity. This age group (middle-aged) must be specially targeted, as they are the most productive age group to the nation as well as the family. Disability of the breadwinner will affect the well being of the family. The higher prevalence of undetected hypertension among the middle aged points towards the need for health education not only in hypertensives but also among non-hypertensives. These health education programs should be provided through better utilisation of mass media.

REFERENCES

1. Frohlich D Edward. Blood pressure measurement, Canadian Journal of Cardiology, Vol 11 Suppl H November 1995; 35H-37H.
2. Levy Daniel, Larson G Martin, Vasan S Ramachandran, Kannel B William, Ho L K Kalon. The progression from hypertension to Congestive Heart Failure, JAMA, 1996, Vol. 275, No. 20; 1557 – 1562.
3. Kannel William B. Blood Pressure as a cardiovascular Risk Factor, Prevention and Treatment. JAMA. May 22/29, 1996, Vol.275; No.20; 1571 – 1576.
4. Lee Mei-ling T, Rosner B A, Weiss T Scott. Relationship of blood pressure to cardiovascular death: The effects of pulse pressure in the elderly, Ann Epidemiol. 1999, Vol. 9, No. 2; 101 – 107.
5. Park J E, Park K. Epidemiology of Chronic Non-Communicable Diseases and conditions, Text book of Preventive and Social Medicine, 12th edition, 1989; 237 – 240.
6. Tate Robert B, Manfreda J, K. D. Andrew, Cuddy T. E. Tracking of Blood pressure over a 40 – year period in the University of Manitoba Follow-up Study, 1948-1988, American Journal of Epidemiology, 1995, Vol. 142, No.9; 946 – 954.
7. Joint National Committee on Prevention, Detection, Evaluation, and Treatment of hypertension. The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of hypertension, Archives of Internal Medicine, Nov 24,1997, Vol. 157; 2413 - 2446.
8. Singh R.B, Beegom R, Mehta S. A, et al. Prevalence and risk factors of hypertension and age-specific blood pressures in five cities: A study of Indian women, International Journal of Cardiology, 1998, Vol. 63; 165 -173.
9. Kalavathy M.C, Thankappan K. R, Sankara Sarma P, Vasan R.S. Prevalence, awareness, treatment and control; of hypertension in an elderly community – based sample in Kerala, India, The National Medical Journal of India, 2000, Vol. 13, No. 1; 9 – 15.
10. Gupta R, Gupta S, Gupta V P, Prakash S. Prevalence and determinants of hypertension in the urban population of Jaipur in western India, J Hypertens, 1995, Vol. 13, No. 10; 1193 – 2000.
11. Sarraf Zadegan N, Amini Nik S. Blood pressure pattern in urban and rural areas in Isfahan, Iran, J Hum Hypertens, 1997, Vol. 11, No. 7; 425 – 428.
12. Malhotra P, Kumari S, Kumar R, Jain S, Sharma BK. Prevalence and determinants of hypertension in an un-industrialised rural population of North India, J Hum Hypertens,1999, Vol. 13, No. 7; 467 – 472.
13. Shaper A G, Ashby D, Pocock S J. Blood pressure and hypertension in middle-aged British men, J hypertens, Vol. 5, No. 5; 367 – 374.
14. Hu B Frank, Wang Binyan, Chen Changzhong, Jin Yongtang, Yang Jianhua, Stampfer J Meir, and Xu Xiping. Body Mass Index and cardiovascular risk factors in a rural Chinese population, American Journal of Epidemiology, 2000, Vol. 151, No. 1; 88 – 97.
15. Abbott D R, Rodriguez L Beattriz, Burchfiel M Cecil and Curb David J. Physical activity in older middle-aged men and reduced risk of stroke: The Honolulu Heart Program, American Journal of Epidemiology, 1994, Vol. 139, No. 9; 881 – 893.

16. Joseph Aleyamma, Raman Kutty V R, Soman C R. High risk for coronary heart disease in Thiruvananthapuram city: A study of serum lipids and other risk factors, IHJ, 2000, Jan-Feb; 29 – 35.
17. Gupta Rajeev, Singh A K, Basira Rajaram, et al. Influence of Total Cholesterol levels on long-term mortality in coronary heart disease: A reappraisal, IHJ, 2000, Jan-Feb; 23 – 28.
18. Midgley Paul Julian, Matthew Glenday Andrew, Greenwood T Margaret Celia, Logan Gorden Alexander. Effect of reduced dietary sodium on blood pressure - A meta-analysis of randomized controlled trials, JAMA, 1996, Vol. 275, No. 20; 1590 – 1597.
19. Sorel E. Janet, Ragland R David, Syme Leonard S and Davis B Wayne, Educational Status and Blood Pressure: The second National Health and Nutritional Examination Survey, 1976 – 1980, and the Hispanic Health and Nutrition Examination Survey, 1982-1984, American Journal of Epidemiology, 1992, Vol. 135,No.12; 1339 – 1348.
20. Diez-Roux A V, Northridge M E, et al. Prevalence and social correlates of cardiovascular disease risk factors in Harlem, American Journal of Public Health, 1999, Vol. 89,No. 3; 302 – 307.
21. Nanchahal Kiran, Ashton David W, Wood A David. Alcohol consumption, metabolic cardiovascular risk factors and hypertension in women, International Journal of Epidemiology, 2000, Vol. 29; 57 – 64.
22. 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,Vol. 297; 319 - 328.
23. Raman Kutty V, Balakrishnan K. G, Jayasree A. K, Thomas J. Prevalence of coronary heart disease in the rural population of Thiruvananthapuram district, Kerala, India, International Journal of Cardiology, 1993, Vol. 39; 59 - 70.
24. Kadiri S, Walker O, Salako B Land Akinkugbe O. Blood pressure, hypertension and correlates in urbanized workers in Ibadan, Nigeria: a revisit, Journal of Human Hypertension, 1999, Vol. 13, Issue. 1;23 – 27.
25. Sayeed M A, Khan A R, Banu Akhtar, et al. Blood pressure and glycemic status in relation to Body Mass Index in a rural population of Bangladesh, Bangladesh Med. Res. Counc. Bull, 1994, 20(2); 27 – 35.
26. High Blood pressure , Some answers, new questions, continuing challenges, 1996, JAMA, Vol. 275, No. 20; 1604 – 1606.
27. Law M R, Frost C D, Wald N J. By how much does dietary salt reduction lower blood pressure? I – Analysis of observational data among populations, II-Analysis of observational data within populations, 6 April 1991, British Medical Journal, Vol.302; 811 – 818.
28. Mammi I V M, Pavithran K, Rahiman Abdu P, Pisharody Ramadas and Sugathan K. Acute Myocardial Infarction in North Kerala – A 20 year hospital based study, Indian Heart Journal, 1991, Vol. 43, No. 2; 93 – 96.

APPENDIX - 1

Cluster Identification Form

Sampling interval: 17467

Random number: 5359

Name of Ward	Population	Cumulative population	Cluster number	
1 Medical College	9318	9318	1	5359
2 Pattom	15844	25162	2	22826
3 Kesavadasapuram	12390	37552		
4 Kuravankonam	12087	49639	3	40293
5 Kowdiar	10085	59724	4	57760
6 Vattiyoorkavu	15008	74732		
7 Pangode	10777	85509	5	75227
8 Thirumala	10396	95905	6	92694
9 Sasthamangalam	11978	107883		
10 Kanjirampara	12795	120678	7	110161
11 Nanthencode	9170	129848	8	127628
12 Kunnukuzhi	8751	138599		
13 Kannanmoola	10329	148928	9	145095
14 Palayam	7663	156591		
15 Vazhuthacaud	8093	164684	10	162562
16 Jagathy	9123	173807		
17 Poojappura	13763	187570	11	180029
18 Thrikannapuram	13269	200839	12	197496
19 Mudavanmughal	14072	214911		
20 Karamana	14595	229506	13	214963
21 Nedumcaud	11898	241404	14	232430
22 Attukal	7825	249229		
23 Valiachala	7407	256636	15	249897
24 Thycaud	8369	265005		
25 Thampanoor	10552	275557	16	267364
26 Secretariat	8068	283625		
27 Rishimangalam	9284	292909	17	284831
28 Sreekanteswaram	10508	303417	18	302298
29 Palkulangara	8792	312209		

30 Pettah	8870	321079	19	319765
31 Chacka	11008	332087		
32 Titanium	9083	341170	20	337232
33 Veli	6371	347541		
34 Sankumughom	13796	361337	21	354699
35 Vallakkadavu	8522	369859		
36 Perumthanni	10136	379995	22	372166
37 Fort	7266	387261		
38 Chenthitta	5489	392750	23	389633
39 Chala	9010	401760		
40 Puthen Street	7394	409154	24	407100
41 Manacaud	14085	423239		
42 Sreevaraham	10607	433846	25	424567
43 Kamaleswaram		446962	26	442034
44 Valiathura	6929	453891		
45 Bheemapally	15353	469244	27	459501
46 Manickavilakom		483175	28	476968
47 Poonthura	12898	496073	29	494435
48 Ambalathara	9953	506026		
49 Kalippankulam	7344	513370	30	511902
50 Kalady	10636	524006		
TOTAL	**524006**			
Total/30	17466.87			
Sampling interval	17467			

APPENDIX - 2

QUESTIONNAIRE

Achutha Menon Centre for Health Science Studies,
Sree Chitra Tirunal Institute For Medical Sciences &Technology, Thiruvananthapuram. Study on **"Prevalence and Correlates Of Hypertension"**, conducted by ***Manu G. Zachariah***, MPH Scholar.

Code No: Date: Cluster No:
Ward No: Ward Name:
Name: Age: Sex:
Address:

1. Total household size:

2. Information on SES
   a) What is your (household) expenditure in the last month? Rs:
   b) Type of the house: Kucha / Semi-pucca / Pucca
   c) Assets: Bike/Car/TV/A.C/ Fridge/VCR/Phone/Computer/Wash machine/Gas/Stove

3. Religion: Hindu / Christian / Muslim / Others (specify)

4. Marital status: Married / Divorced / Widowed / Never Married

5. Occupation:
   a) Current: Duration:
   b) Past: Duration:

6. Education:

7. Past Medical History:
   a) Did you had any major illness: Yes / No
   b) Which major illness: DM/ HTN / ASTH / REND / Others (specify)
   c) Did you visit a doctor in the last one-year? Yes / No
   d) If yes, the doctor you visited belong to which system of medicine: Allopathic / Ayurveda / Homeopathy / Naturopathy / Siddha / Others (specify)
   d) If you had visited, did the doctor measure your blood pressure? Yes / No
   e) Are you on any pills for lowering blood cholesterol? Yes / No
   f) Did you undergo a blood test for identifying DM? Yes / No
   g) Did you undergo a blood test for identifying or Cholesterol status? Yes / No
   h) Have you been told to have heart failure by a doctor? Yes / No

8. Hypertension:
   a) Do you have hypertension? Yes / No
   b) Are you currently on treatment for hypertension? Yes / No
   c) System of medicine used for treatment for hypertension:
      Allopathic / Ayurveda / Homeopathy / Naturopathy / Others (specify)
   d) Currently used anti-hypertensive allopathic drugs:
      Duration:
   e) Are you currently taking contraceptives (if female)? Yes / No
   f) If yes type of contraceptive used: OCP / Implantable / Injectables
   g) If yes, Brand: Duration:
   h) Have you taken contraceptives in the past (if female)? Yes / No
   i) If yes type of contraceptive used: OCP / Implantable / Injectables
   j) If yes, Brand: Duration:

9. Dietary habit:
   a) Vegetarian / Egg / fish / meat
   b) Frequency: Egg: /1 /7 /30
      Fish: /1 /7 /30
      Meat: /1 /7 /30
   c) Use of extra salt: Yes / No

10. Smoking:
   a) Do you smoke? Yes / No
   b) If yes, since how long?
   c) Type: Cigarette / Beedi / Others (specify)
   d) Frequency: Cigarette: /1 /7 /30
      Beedi /1 /7 /30
      Others /1 /7 /30
   e) If No: Did you ever smoke? Yes / No
   f) If yes: How long did you smoke?
   g) Type: Cigarette / Beedi / Others (specify)
   h) Frequency: /1, /7, /30
   i) Reason For Quitting:
   j) Duration of quitting?

11. Chewing:
   a) Do you chew tobacco? Yes / No
   b) If yes, since how long?
   c) Type: Khaini / Betel quid /Panmasala / Others
   d) Frequency: /1, /7, /30
   e) If No: Did you ever chew? Yes / No
   f) If yes: How long did you chew?
   g) Type: Khaini / Betel quid / Panmasala / Others
   h) Frequency: /1, /7, /30
   i) Reason for quitting?

j) Duration of quitting?

12. Alcohol
    a) Do you drink alcohol? Yes / No
    b) If yes, since how long?
    c) Brand: Whisky / Brandy / Rum / Gin / Vodka / Toddy / Arrack / Others
    d) Frequency: /1, /7, /30
    e) If No: Did you ever drink alcohol? Yes / No
    f) If yes: How long did you drink?
    g) Brand: Whisky / Brandy / Rum / Gin / Vodka / Toddy / Arrack / Others
    h) Frequency: /1, /7, /30
    i) Reason for quitting?
    j) Duration of quitting?

13. Physical activity: Vigorous / Moderate / Light

14. Any other relevant information:

Measurements

Body Weight (Kg):

Height (cm):

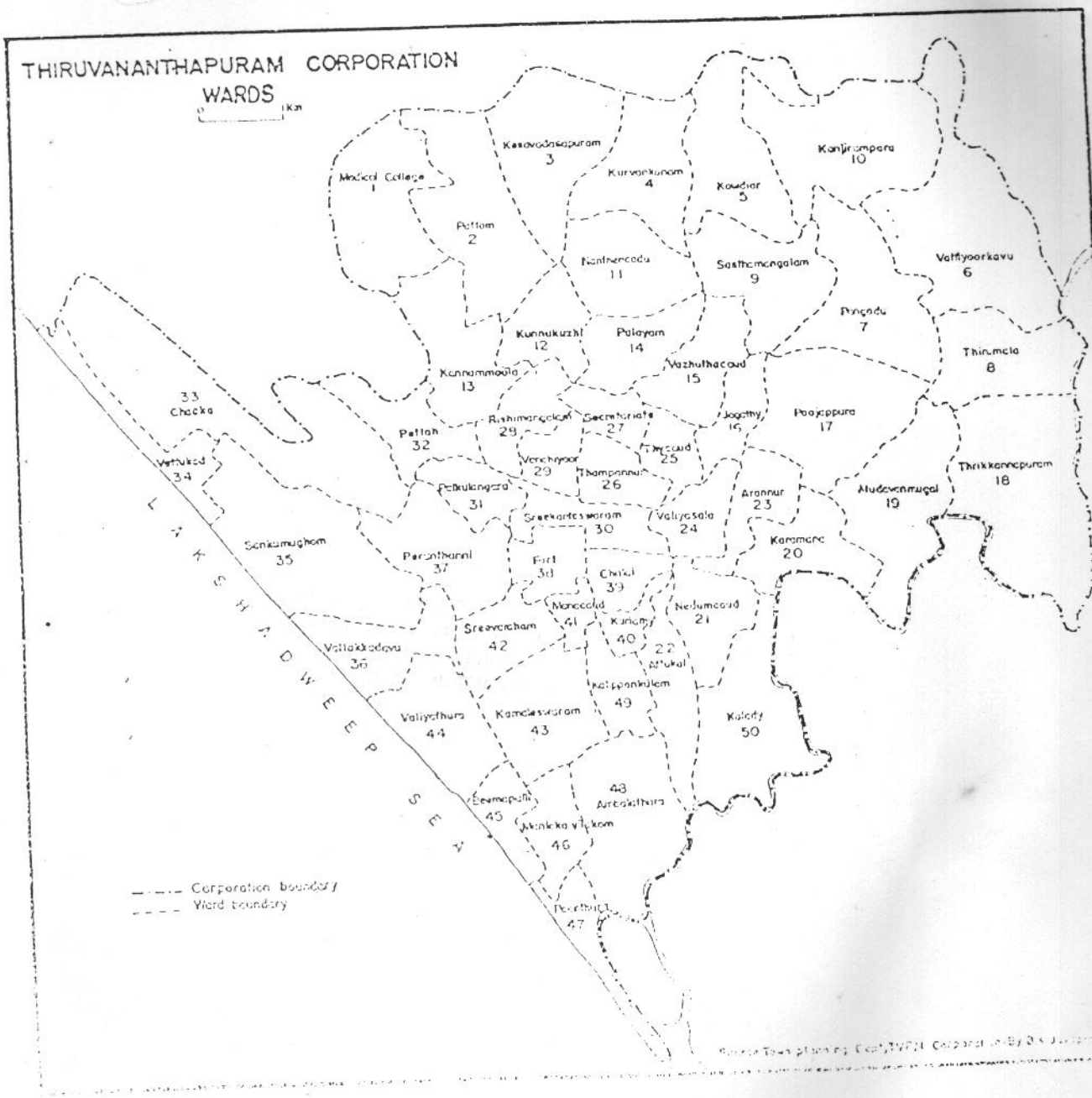
Blood Pressure (mm of Hg):

Blood Pressure	SBP (mm of Hg)	DBP (mm of Hg)	Arm used
1st Measurement			
2nd Measurement			
3rd Measurement			

Checklist

Physical Activity Categories		
1. Vigorous activities	2. **Moderate activities**	**3. Light activities**
Agricultural work	Home maintenance of garden	Walking
Pulling Riksha / Cart	Maintenance of cattle	Walking to office
Digging	Fetching water	Desk work at office
Breaking stone	Carrying Wood	Watching TV
Exercise: By bicycle, rowing, …	Cooking	Reading Books
Carpentry work/ Masonry work	Washing cloths	Ironing cloths
Others specify	Others specify	Others specify:

APPENDIX 3


THIRUVANANTHAPURAM CORPORATION
WARDS
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Medical College 1
Kesavadasapuram 3
Kurvankonam 4
Kowdiar 5
Kanjirampara 10
Pettom 2
Nanthencodu 11
Sasthamangalam 9
Vattiyoorkavu 6
Panchadu 7
Kunnukuzhi 12
Palayam 14
Vazhuthacaud 15
Thirumala 8
Kannammoola 13
33 Chacka
Pattom 32
Rishimangalam 29
Secretariate 27
Jagathy 16
Poojappura 17
Vellaikad 34
Vanchiyoor 29
Thycaud 25
Thampanoor 26
Thrikkannapuram 18
Pettukuzhy 31
Sreekanteswaram 30
Valiyasala 24
Arannur 23
Mudavanmugal 19
Sankumugham 35
Parunthanni 37
Fort 38
Chalai 39
Karamana 20
Manacaud 41
Kunnumpuram 40
Nedumcaud 21
Sreevaraham 42
Vallakadavu 36
Attukal 22
Kalippankulam 49
Valiyathura 44
Kamaleswaram 43
Kulathoor 50
48 Aranaikathura
Beemapalli 45
Anchuthengu 46
Poonthura 47
Arabian Sea
Corporation boundary
Ward boundary