The Prevalence of Hypertension and its Correlates in Elderly Population in Pune Maharashtra, India.

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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 "The Prevalence Of Hypertension And Its Correlates In The Elderly Population In Pune, Maharashtra, India" is the result of original research and has not been submitted for any degree in any other University or Institution.

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CERTIFICATE

Certified that this dissertation entitled "The prevalence of hypertension and its correlates in elderly population in Pune, Maharashtra, India" is a record of bonafide original research work undertaken by Mrunal Shetye in partial fulfillment of the requirements for the Degree of Master of Public Health, under our guidance and supervision.

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ABBREVATIONS

1. BP: Blood Pressure
2. SBP: Systolic Blood Pressure
3. DBP: Diastolic Blood Pressure
4. HTN: Hypertension
5. PMC: Pune Municipal Corporation
6. SES: Socio-economic status
7. BMI: Body Mass Index
8. WHR: Waist hip ratio
9. NHANES: National Health and Nutrition Examination Survey
10. CI: Confidence Interval
11. M: Males
12. F: Females

ABSTRACT

Objective: To study the prevalence and correlates of HTN in the elderly population of urban Pune. HTN and its subsequent complications are an important cause of mortality and morbidity in the elderly. The prevalence of HTN in the elderly in Pune is not known.

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

Setting: Pune Municipal Corporation, Maharashtra, India.

Participants: 243 individuals (136 F, 107 M), mean age 68±7.

Intervention: Measurement of BP by physician 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 71.6% (95% CI 65.9-77.3). Prevalence in males was 72.9% (95% CI 67.3-78.5) and in females was 70.6% (95% CI 64.9-76.3). Bivariate analysis identified Socio-economic status, level of physical activity undertaken in current occupation, education and BMI as significant correlates. Prevalence of HTN among smokers was lower compared to non-smokers, as was the prevalence among non-vegetarians as compared to vegetarians. Multiple logistic regression identified a higher BMI of more than 25(OR = 2.4, CI 1.1-5.9) and higher education (10^{th} >) (OR=3.57 95% CI 1.03-12.44) as a significant correlates. Severe physical activity in current occupation (OR=0.22, CI 0.06-0.81) was protective. Age, uses of extra salt and alcohol were not related. The relationship between smoking, vegetarian diet and HTN became insignificant. Among the hypertensives (n =174), only 44.8% were aware of their condition, 43.1% were taking treatment and only

11.5% achieved control. Of all the hypertensive subjects who visited a physician at least once in the previous year, 46.9% were unaware of their condition.

Conclusion: In our community based urban sample, 72% of the elderly subjects were found to be hypertensive. Increasing awareness of HTN especially in the educated and adapting healthy lifestyle habits to prevent excessive weight gain appear to be the primary, cost-effective and simple preventive measures one could implement for control of the epidemic of HTN. Given the increasing population of elderly, low levels of awareness, treatment and control of HTN, our findings emphasize the need for increasing the awareness of HTN in the general population, to promote the measurement of BP especially in the elderly and to disseminate knowledge regarding current HTN guidelines amongst physicians in Pune.

I: Introduction and Background:

An elevated arterial pressure is probably the most important public health problem in many countries today. It is common, asymptomatic, readily detectable, usually easily treatable and often leads to lethal complications if left untreated. [1]

Blood pressure (BP) was discovered by a clergyman, the Rev Stephen Hales in 1708, the experimental essentials for this purpose being a mare with a fistula in her withers, some brass piping and a glass tube. Measurement of BP in humans proved more troublesome. An accurate and practical instrument was introduced by von Basch only in 1880.The auscultatory method of measuring BP was discovered by Korotkoff in 1905. [2]

What is Blood Pressure?

Blood pressure is the pressure exerted by the blood against the inner walls of the blood vessels. [3] BP like height and weight is a biological characteristic of the individual. Like these 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. [4]

What is Hypertension?

Patients with raised BP and no definable cause are said to have Primary Hypertension, Essential Hypertension or Idiopathic Hypertension. [1] In more than 95% of cases a specific underlying cause of hypertension (HTN) is not found. [5] In the remaining 5%, HTN can be shown to be a consequence of a specific disease [5] or abnormality such as renal diseases, endocrine disease drugs or pregnancy.

Thus essential hypertension may be defined as sustained high BP not attributable to a single cause but reflecting the interaction of multiple genetic and environmental influences. In Pickerings words, "It is a quantitative deviation from the mean". The diagnosis of essential HTN is thus one of exclusion. [4]

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 W.H.O. scientific group[6] has reviewed risk factors for essential HTN. 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. [7] Population studies have shown that systolic pressure rises steadily until the 7th decade in men and the 6th in women. [4]
- **Genetic factors:** Based on twin and family studies BP levels appear to be genetically determined with polygenic inheritance. [6] The Montreal adoption survey showed a correlation between parents and their natural children that was approximately twice as great as correlation between parents and their adoptive children. The children of two normotensive parents have a 3% possibility of developing HTN whereas this possibility was 45% in children of two hypertensive parents. [8]

The **modifiable** risk factors are:

- **Obesity:** There is no question that a positive correlation exists between obesity and BP. [9] A gain in weight is associated with an increased frequency of HTN in subjects with normal BP and weight loss in obese subjects with HTN lowers their BP. [1]
- **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. [10]
- **Environmental factors:** HTN is a disorder initiated by tension or stress where psychological factors operate through mental processes. [7]
- **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. [11]
- **Other factors:** Consumption of saturated fat, sedentary life style, tobacco consumption, are other risk factors for HTN. [1]

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 Elderly:

The definition of elderly persons as individuals beyond 58, 60, or 65 years of age given by certain national and international agencies is only a working definition. It is a very arbitrary way of labeling a person as old. Aging cannot be viewed as a simple chronological event. Aging is a highly complex and heterogeneous process with physiological, psychological, social, economic, cultural, spiritual, and educational

dimensions. These factors determine the expression, attitude and behavior of a person and thus influence the quality of aging. [12]

The world is graying rapidly with the rate of growth of aging population exceeding the general population. [12] In India there are 70 million people above the age of 60 years (6% of the population) which is likely to increase to 12% by 2025 taking the number of elderly to 150 million. More importantly, by 2025 while the elderly population from the developed world will actually decline from 19% to 12%, it will rise in the developing countries to reach 1120 million, about three fourths of the global elderly. [13] In India a unique feature of the elderly is that over 75% are from the rural area. Further, whether urban or rural over 80% of them come from the unorganized sector. [14]

Health status of elderly in India:

With aging come a host of chronic health disorders. Data from a nation wide survey on the socioeconomic profile of Indian elderly carried out by the National Sample Survey Organization (NSSO) is summarized below. [15]

Variable	Rural (%)	Urban (%)
Chronic diseases	45	45
Economically independent	34	29
Employed	40	27
Living alone	8	6
Immobile	5.4	5.4
Estimated population in millions	39.5	8.7

The NSSO survey[15] reported 45% elderly in the rural area and a similar number in the urban area as suffering from chronic diseases. The major chronic diseases in rural area were joint pains and cough while in the urban area HTN, heart disease and diabetes

were more common. About 5% of the elderly sample was found to be physically immobile in both rural and urban areas.

According to the Government of India statistics[16] the leading causes of elderly mortality are; Cardiovascular disorders (33%), Respiratory disorders (10%), Infections like Primary tuberculosis, Pneumonia (10%), Neoplasm's (6%), and Accidents, poisoning, and violence (< 4%). The rest of the elderly mortality is due to nutritional, metabolic, gastrointestinal and genitourinary disorders. Murray and Lopez[17] estimated that for the year 1990, 13% of the elderly deaths in India were due to infectious diseases and about 85% were due to non-communicable diseases. Marginal under-nutrition due to dietary intake changes and personal beliefs is not uncommon in elderly. [18] The old age pension scheme although operative in most states barely covers 10% of the elderly population. [19] In 1997 there were 300 "Old Age Homes" in India, 207 of which were in the south, 71 in the west, and 31 in the north. [20] Most support for the elderly comes from informal sources such as family with friends and neighbors stepping in when needed. [21] In a study in New Delhi [22] it was found that elderly women looked after themselves while in the case of elderly men, spouses played a more active role in caring. The elderly in rural areas have easy access to support systems because of the slower pace of life. In contrast few people have time for others in urban areas. [23]

Need for the study:

There has been a steady rise in the population of elderly. The proportion of elderly in Maharashtra has increased from 5.27 (2,081,086) in 1961 to 7.91 (7,293,146) in 2001 with a projected rise to 11.72 (14,018,563) by 2021. The all India rise has been similar. From 5.63 (24,699,125) in 1961 to 7.08 (71,697,634) in 2001, the proportion of elderly is expected to be at 9.87 (36,458,825) in 2021.[46]

Various studies have shown that HTN is a major health problem and is more in urban subjects than in rural subjects.[25] With more than $250 billion in direct and indirect costs (in Americans alone) HTN imposes an enormous economical burden.[47]

Pune is an urban city in a state with a rapidly aging population. No study has been reported from Pune on Prevalence and correlates of HTN in the elderly. Studies are needed to assess the baseline morbidity due to HTN as well as the correlates of HTN, so as to plan for effective intervention measures (primary prevention) in interrupting the costly cycle of managing HTN and its complications. Thus the need for the study.

Objectives:

1. To study the prevalence of HTN in the elderly in Pune city.
2. To study the prevalence of the correlates of HTN in the elderly in Pune city.

II: Review of Literature:

Hypertension in the elderly:

With the proportion of elderly increasing in the general population, HTN in the elderly is an increasingly important public health concern. 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. [36] The third National Health and Nutrition Examination Survey (NHANES III) in the USA showed that HTN was present in 54% of all persons aged 65-74 with an even higher prevalence of 72% in Black Americans of the same age group. [24]

HTN has different pathological, physiological, clinical and therapeutic implications in this age group. Due to loss of arterial wall elasticity with age major vessels including the aorta become stiff and less distensible. As age advances these stiff vessels also lose beta-adrenergic responsiveness with unchanged alpha-adrenergic responsiveness. These together raise the peripheral vascular resistance and aortic impedance, which needs a powerful systolic ejection of the left ventricle to maintain cardiac output. This results in a rise in the systolic BP (SBP) and an increase in the left ventricular mass with compromised cardiac output and renal blood flow. Participation of the Renin-Angiotensin and kidney in HTN pathogenesis in elderly is minimum. [35] HTN in the elderly has three subtypes: [25]

- isolated systolic HTN
- raised diastolic BP
- combined increases of systolic and diastolic pressure.

It has been reported that SBP is a better predictor of events (stroke, heart failure, end stage renal disease and all cause mortality) than diastolic BP (DBP). [26,28] Recently it has become clear that an elevate pulse pressure (SBP minus DBP), which indicates reduced vascular compliance in large arteries may be an even better marker of increased cardiovascular risk than SBP or DBP alone. [27]

Although primary HTN is the most common form of HTN certain identifiable cause of HTN (e.g. atherosclerotic renovascular HTN, primary aldosteronism) may occur more frequently in older persons especially in those whose HTN first presented after age 60 or is resistant to treatment. [29] BP must be measured with special care in elderly because some have pseudo-hypertension (falsely high sphygmomanometer readings) due excessive vascular stiffness. [31]More older persons with HTN, especially women may have white coat HTN and excessive variability in SBP. [30] Treatment of HTN in elderly has demonstrated major benefits. Antihypertensive therapy has been shown to reduce strokes, coronary heart disease, heart failure and mortality. [32] HTN therapy in older persons as in younger persons should begin with lifestyle modification. [26] If the goal BP is not achieved, pharmacological treatment is indicated. The starting dose in older patients should be about half that used in younger patients. Diuretics with or without beta-blockers are preferred. [33,34] The goal of treatment in older patients should be the same as in younger patients (to <140/90). Any reduction in BP appears to confer benefit, the closer to normal, the greater the benefit. [26]

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. [1, 41] 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's on the 2nd and 3rd occasion can halve the apparent prevalence of HTN.[4] 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.[42] In youth and middle age, men have a higher prevalence of HTN than women 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.[43] Prevalence of various forms of HTN in the general population and in specialized clinics is given below. These estimates are based on a number of reports available in the literature.[1]

Diagnosis	General population(%)	Specialty clinic(%)
Essential HTN	92-94	65-85
Renal parenchymal HTN	2-3	4-5
Renovascular HTN	1-2	4-16
Primary Aldosteronism	0.3	0.5-12
Cushings Syndrome	<0.1	0.2
Phaeochromocytoma	<0.1	0.2
O.C. pill induced	0.5-1	1-2
Miscellaneous	0.2	1

In the Rotterdam study whose 7983 participants were over the age of 55 years, the prevalence of HTN (based on the BP levels 160/90 mm Hg) in males was 31% while that in females was 39%.[60] In India high BP as a clinical problem was known to the

ancient sages. [44]One of the earliest studies done in the general population was by Chopra in 1942. [45] Since then a number of studies have been published. A summary of few of the studies, which have been conducted in urban areas, is given below.[45,48-55,62.]

Author	Year	Age grp.	Criteria	Sample			HTN %		
				T	M	F	T	M	F
Chopra[45]	1942	18-70	130/?	1000	*	*	21.4	*	*
Dotto[49]	1949	18-50	?	2500	2500	nil	1.24	1.24	-
Padma.[56]	1959	20-75	140/90	679	659	20	6.19	*	*
Mathur[48]	1963	20-80	160/95	1634	1408	226	4.35	3.98	6.64
Malhotra[45]	1971	20-58	160/95	4232	4232	Nil	9.24	9.24	*
Gupta[52]	1978	20-69	160/95	2023	1151	872	6.43	5.99	6.99
Wasir[53]	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[54]	1985	20-75	160/95	1008	803	205	14	15.4	8.78
Gupta[55]	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
Kalava.[62]	2000	>60	140/90	133	58	75	59	*	*

Trend analysis in comparable studies among urban areas shows a significant increase in the prevalence of HTN. It has also been observed that there is a significant increase in the mean SBP.

Year	Author	Systolic BP	Diastolic BP
1942	Chopra RN[45]	120.4	73.2
1949	Dotto BB[49]	121.6	82
1954	Dubey VD[50]	123.5	82.5
1959	Padmavati S[56]	123.4±11	86.9±12
1963	Mathur KS[48]	125.2±19	81.9±16
1971	Malhotra SL[45]	126±13	79.4±7

1978	Gupta SP[52]	125±15	82±11
1985	Sharma BK[54]	128.7±18	84.2±15
1995	Gupta R[55]	128.8±17	83.2±10
2000	Kalavathy[62]	137±19	88±8
Correlation coefficent r		.95(p<.001)	.43(p<.212)

The prevalence of HTN defined by the JNC V criteria also shows a steep increase from 6.2% in 1959[56] to 30.9% in 1995. [54] The International Clinical Epidemiology Network (INCLEN) [57] which used old WHO criteria showed that the prevalence of HTN was more than 20% among 6 of the 12 communities studies in different parts of Asia and Latin America. The cause of the increase in prevalence of HTN is speculative. Dash et al [58] reported a prevalence of 0.44% in tribal Orissa population but subjects who moved to cities showed an increased prevalence of 2.56%.[59] Similar observations were reported in the Kenyan Luo migration study. [60]

Physical Activity and Blood Pressure:

Technological progress in industrialized countries has generally lead to decreasing physical activity in most jobs. [74] 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. [75] 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. [63] 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. [64] In a community based study in Taiwan [60]

physical activity especially low sports activity was risk factor independent of 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. [65,66] Since HTN is a risk factor for stoke and cardiovascular disease, benefits of physical activity are automatically extended to these conditions. Findings from the Honolulu Heart Program, [68] Eastern Finland[69]and British Regional Heart Study[70] indicate a protective effect of work related physical activity that was statistically significant. Moderate levels of physical activity were associated with a reduced risk of fatal and nonfatal stroke. [70] The effects of physical activity persisted in the absence of HTN, diabetes mellitus and left ventricular hypertrophy. [68]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. [71] 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. [72]

Obesity, Body Mass Index and Blood Pressure:

Obesity refers to excessive storage of energy in the form of fat. The two most common methods to assess the degree of obesity are Body Mass Index (BMI) also know as the Quetelets index and Relative Weight. BMI is calculated by dividing the body weight (in kilograms) by height (in meters) square. Relative weight is expressed as a percentage of an age, sex and height determined standard. Less accurate measures of body fat are ponderal index and skinfold thickness. [76] BMI has been classified by

WHO[77] into the following groups; >25kg/m^2 is considered overweight while >30kg/m^2 is considered as obese. The NHANES data[78] 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. [9] Data from NHANES III which comprised more than 30,000 people, showed that systolic and diastolic BP increased with increased BMI. [79] The Framingham study, [80] a longitudinal study involved more than 5000 men and women aged 30 to 59 at entry. 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[81] who followed 7,685 males for over 30 years recorded an increase in incidence of HTN with increasing ponderosity. In San Antonio Heart Study[82] the 8-year incidence of HTN was greater with higher BMI. Further some studies[83] 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[80] 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. [84] In early 1900's Ambard and Beaujard[85] 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[86] in the 1940's reconfirmed the BP lowering effect of salt restriction. Dahl[87] 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[88] confirmed a direct linear relationship between salt and BP. The INTERSALT study, [89] the most rigorous observational study of the relationship between dietary salt and 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[90] of the data yielded an even stronger relationship but has been criticized on grounds of assumptions unsupported by data and questionable statistical methods. [91] The Scottish Heart Health study [92] also found no correlation between sodium and BP after correcting for confounding variables including BMI and alcohol consumption. A meta- analysis of 32 trials[93] 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). Three recent meta-analysis have shown small but consistent reductions in BP in hypertensive participants in clinical trials of salt restriction. [94] 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. [88,95.] 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.[96] 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. [95] The BP lowering effects of decreasing sodium intake are greater for older persons. [93] Thus 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. [97,98,99,100,101] Alcohol has an acute pressor effect. [97] Abrupt alcohol withdrawal in heavy drinkers may also result in a significant rise in the BP which recedes in a few days. [32,99,102] In the INTERSALT study[102] 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. [103] 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.[102] 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 whisky. Women[104] (who absorb more ethanol than men) and lighter weight people[105] 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.[32] Alcohol is not only a risk factor for high BP but can also cause resistance to antihypertensive therapy[106] and is a risk factor for stroke.[107] 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.[108,109] 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.[110,111] Health 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.[112] Hashimoto[113] studied the acute changes in BP during cigarette smoking and concluded that SBP and DBP increased significantly more in elderly subjects. In another study[114], day time 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[115] 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[116] the 24 hour ambulatory BP was 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[117] compared the office and 24 hour ambulatory BP and concluded that in white hypertensives 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. [118] The cardiovascular benefits of discontinuing tobacco use can be seen within a year in all age groups. [119]

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.[33] Inadequate potassium intake may increase BP. [120] Thus adequate potassium intake (about 90 mmol per day) preferably from food sources such as fresh fruits and vegetables should be maintained. [121]

Low dietary calcium intake is associated with an increased prevalence of HTN. [122]

Low magnesium intake appears to be associated with a higher BP. [120] 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. [120] No consistent relationship between dietary proteins, carbohydrates, garlic, onion and HTN have been established. [123] 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. [124] Dsylipedemia 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. [32] In a systematic review of dietary intervention trials to lower blood total cholesterol in free living subjects[125] 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, [126] 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. [127] Data from the Harlem Household survey[128] revealed that income and education were inversely related to HTN. Sorel et al[129] 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. [130] 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. [131] 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 to1.1-1.2 at age 65. [1] In one study[127], 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. [132,133] In a five city Indian study of women[134] the overall prevalence of HTN was 25.6% and isolated diastolic HTN was the most common form of HTN. Wegner[135] reports that SBP peaks in the middle age for men but continues to increase in women till 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[136] reports 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. [137] Recent trials of older persons support a similar approach to HTN management in men and women. [26]

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.[36] In a rural African study[138], 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[139] 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[140] 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 hypertensives. 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. [141,142] The relation between low BP and mortality may be because people with low BP may have co-morbidity, fragility and poor health. [141,143] Overall the findings support recommendations to treat high BP in the elderly. The Seven Countries Research Group[144] 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:

Data from some studies on awareness treatment and control of HTN is given in the table below;

Author	HTN Criteria	Awareness(%)	Treatment(%)	Control(%)
Chadha SL[145]	160/90	50	30	9
Ibrahim MM[146]	140/90	37.5	23.9	8
Caroline T[61]	160/90	80	65	45.9
Kalavathy[62]	140/90	44.9	42.7	11.4
NHANES II[32]	140/90	51	31	10
NHANES III Phase I[32]	140/90	73	55	29
NHANES III Phase II[32]	140/90	68	53	27

One study investigated and quantified the extent to which variations in guidelines influence the assessment of control of HTN. [147] 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.

III: Methodology:

The study was designed to estimate the prevalence of hypertension and its correlates in the elderly population of urban Pune. This section involves a brief description of the study area, the study population, the study design, the study instruments and the study variables.

Description of the study area and its population:

The study was conducted in Pune, a city 160 kilometers south of Mumbai (formerly Bombay) and 555 meters above the sea level encompassing an area of 138 sq. kilometers. It is an agglomeration of various civic and cantonment areas. Pune has five medical colleges with their hospitals, four large government hospitals, six private multi-specialty hospitals with state of the art technology, and a multitude of small clinics and hospitals. Given its pleasant climate all year round it was initially a city favored by retired government servants. However with the increasing cost off living and scarcity of land in Mumbai, many companies have Pune based operations. Thus Pune is in transition shedding its retirement paradise image for an industrial, educational and modern one.

The Pune Municipal Corporation (P.M.C.) covers a major portion of the city. The Pune Cantonment, Dehu Cantonment, Khadki Cantonment, Pimpri Chinchwad Municipal Corporation are the other major regions of this area. Recently a number of fringe villages have also been added to the existing P.M.C. area. The P.M.C. for administrative convenience is divided into 12 divisions and 124 wards.

According to the 1991 Census the population of P.M.C area was 1,566,651 residing in 85 wards. Through the powers vested with the State election Commissioner by the Constitution, the 85 wards were divided and redefined into 124 wards for the 1997 elections. This was done to facilitate the increase in population estimated at an

approximate 1.8 million. The newly reconstituted 124 wards have 594,916 males and 566,168 females registered as voters, the total being 1,161,084 voters above the age of 18 years. The population of males above the age of 60 years is 113,606 while that of females in the same age group is 107,747.

The P.M.C. has released some data on the demographic, socio-economic and vital statistics of its citizens, which are summarized below:

- Sex Ratio (F/M per 1000) = 945
- Average size of household = 5.66
- Percentage population of 60 + = 2.6 percent
- Literacy rates males (age above 7 years) = 83.4 percent
- Literacy rates females (age above 7 years) = 64 percent
- Crude Birth Rate = 32.5
- Crude death rate = 8.8
- Infant Mortality Rate = 72.5
- Total Fertility Rate = 3.07

The sampling method and the sample size:

A cluster sample with probability proportional to size was used. In the first step the wards and their populations were listed and the cumulative population was calculated. This population was then divided by 30 (the number of clusters we were going to study), which gave us the sampling interval. Then a random number was chosen using a currency note, which was less than the sampling interval. The ward whose cumulative population was equal to or exceeded this random number was chosen as the first cluster. The sampling interval was added on to this number, to get the second cluster and to this was added the sampling interval again to get the third cluster, and so on. In this way 30 wards were identified to give a cluster of 30. The details of

cluster selection are given in the appendix. Maps of all the 30 wards were obtained from the P.M.C. which clearly defined the boundaries of each ward. The major intersections in a ward were listed and a lottery taken. Lottery was taken by a person chosen randomly with no interest in the study. This decided randomly the exact street to be surveyed. It was then decided that the first bungalow or building on the left side of the road after the grocery shop would be approached first. A household member was approached and asked if a person of either sex above the age of 60 years was available. If yes, then the elderly would be explained the purpose of the visit and his cooperation and verbal consent requested. If the elderly subject refused (inspite of repeated requests) or there were no elderly in the house then the next house was approached. This was continued till eight elderly subjects were covered in one cluster. Using prevalence data from previous studies, a sample size of 240 was arrived at in the following way:

Sample size was calculated by using the formula $\frac{(Z)^2PQ}{\Delta^2} * d$.

Where,

Z= Confidence limit factor which is 1.96 for 95% confidence interval

P= Prevalence of hypertension, which was taken as 52% as reported in an elderly community based prevalence study done in Kerala, India.[62]

Q=1-P

Δ= Precision factor. (Difference between assumed prevalence and lowest expected prevalence). Here lowest expected prevalence was assumed as 45%, so Δ=0.52-0.45=0.07.

d= design effect =1.2.

The formula we used ($\frac{(Z)^2PQ}{\Delta^2} * d$) is for random sampling method.

For our study we used cluster sampling so in order to reduce the design effect, 20% of the calculated sample was added to the sample size.

Thus, sample size = $\frac{1.96^2 * (.52 * .48)}{(.07)^2} * 1.2 = 235$

We used cluster sampling because of convenience, limitations of time, and money constrains. Thus a minimum of 8 elderly were examined in each cluster to achieve the sample size of 240.

The study design:

The study was a cross sectional survey, which was conducted in 30 of the randomly selected wards of P.M.C., in elderly who were defined as individuals of the age 60 years or above. The physician explained the purpose of the visit to the individual and his/her cooperation and verbal consent were requested. The first part of the questionnaire was then administered which contained questions regarding identification, place of residence and determinants of socioeconomic status. This took about 10 to 15 minutes to administer. The blood pressure (BP) was measured and recorded on the questionnaire. The remainder of the questionnaire was administered which took another 20 to 30 minutes at the end of which weight, height and BP were recorded. The entire interview and examination took about 40 to 45 minutes.

Measurement of blood pressure:

The physician took two BP readings during the course of the interview. If the difference of the two BP recordings was more than 10 mm Hg a third reading was taken and the average of the readings was taken as the BP. The measurement of blood pressure was done using a mercury column sphygmomanometer using a standardized technique.[39] BP was measured in a sitting posture with legs uncrossed and resting on the ground. The left arm was used for the measurement of BP. The right arm was used only in case of poor pulsation in the left arm or left sided paresis. It was ensured that

patients had not smoked or ingested caffeine during the 30 minutes preceding the measurement. If they had, then the recording of BP was deferred as long as possible. The first appearance of the Korotkoff sounds (phase 1) was used to define SBP. The disappearance of Korotkoff sounds (phase 5) was used to define DBP. An appropriate sized cuff was used. With the instrument at the level of the heart the cuff was inflated 30 mm Hg above the level at which the radial pulse disappeared. It was then deflated slowly at the rate of 2mm/second and the readings recorded to the nearest 2mm. The mean of the two (three if indicated) SBP and the mean of the two DBP readings was calculated and used as mean SBP and DBP.

Definition of hypertension, awareness, treatment and control:

Diagnosis of hypertension was done based on the criteria formulated by the World Health Organization[40] and the US Sixth National Committee on Detection, Evaluation and Treatment of Hypertension.[32] The criteria used were SBP of 140 mm Hg or greater, DBP of 90 mm Hg or greater and/or taking antihypertensive medication.[40, 32] This excludes those subjects who have reduced their blood pressure to normotensive range by non pharmacological methods. Awareness of HTN was defined as the subject reporting a prior diagnosis of HTN made by a health professional. Treatment of HTN was defined as current use of a prescription medication for lowering elevated BP among hypertensive subjects. The only treatment considered was pharmacological.[37] A diagnosis of treated HTN was made only if the subject had a prior diagnosis of HTN and was on antihypertensive drugs. This was done to avoid misclassification of normotensive subjects on cardiovascular drugs for indications other than HTN. Control of HTN was defined as pharmacological treatment associated with SBP and DBP less than 140 and 90 mm of Hg respectively.[37]

The study instruments:

A standardized weighing scale, mercury sphygmomanometer, graduated plumb line for measurement of weight, blood pressure and height respectively were used. A stethoscope was used for auscultation of Korotkoff sounds while measuring the BP. A questionnaire was administrated to capture information on the demographic and socio-economic status, dietary habits, past medical history, risk behavior and physical activity level of the individual. Since the study was multi-centric to be conducted simultaneously in urban and rural areas of Trivandrum and Bangladesh along with Pune, the questionnaire was developed which would be relevant in all the settings as far as possible. It was pre tested and suitable modifications were made before it as administered by the physician. Age was recorded in the form of number of completed years. In the event exact age was not known, incidents of local importance or national events were used to correlate, so as to get an estimate of the age. Since the education pattern has changed dramatically over the past few decades we considered it prudent to inquire about the number of years of schooling rather than the exact education attained. We knew that in the past what is known as "vernacular 7^{th}" was the highest level of education available at a school level in contrast to " SSC 10^{th} standard" which is available now. Housing pattern was classified into three categories:

Pucca: where the rooms had a cement roof, wall and floor.

Semi-Pucca: where the rooms had cement wall and floor but the roof was either tiled, of asbestos or corrugated metal sheets.

Kuttcha: where cement use was absent, the floor and wall usually made of mud or thatch and the roof was of any material other than cement.

The investigator also assessed subjectively the SES of the subject considering the living conditions, the appearance of the room, and other physical features of the

subjects immediate environment. An objective assessment was also done using a large number of criteria listed in the questionnaire. The subjects were then classified in three categories, SES I to III, from the poorest to the richest.

Physical activity level was estimated using a modification of the CARDIA questionnaire. The subject was asked to recount his/her physical activities of the previous day and asked if it was a "usual" day. Physical activity was classified into three categories, from I to III, least to most. Details of current and past occupation were also collected with a view to ultimately convert them into some measure of physical activity undertaken at place of work. Thus rather than stopping at the job title a detail inquiry was made into the exact nature of the job.

Details regarding the type of diet taken, the frequency of eating eggs, meat or fish, the type of cooking oil used as well as use of extra salt was recorded. Use of extra salt was defined as addition of salt to the food at the time of eating, to over and above that already added while cooking. However it is known that some households prepare "Dal" without salt traditionally. Here the investigator was lead by his own experience and judgment. Data regarding the frequency and quantity of tobacco and alcohol used was also collected. Information was collected from the subjects themselves. However assistance was sought from household members if the subject had difficulty in hearing. Data on dietary habits was corroborated with information specifically sought from those managing the kitchen in most cases a female member of the household.

Anthropometric measurements in the form of height and weight were recorded for all subjects. (See Appendix) Bathroom type weighing scales of the same brand were newly purchased and were standardized. The mercury sphygmomanometers were also standardized. To decrease inter observer variability, measurement techniques were

standardized. Height was measured using a graduated plumb line, which was developed, tested and standardized by the investigators.

Duration of the study:

The study was conducted over a seven week period during the months of December 1999, January and February 2000.

Data collection strategy:

After selecting 30 wards and acquiring their maps a plan was devised to cover them in as short time and as convenient way as possible. It was estimated on the basis of pre testing of the questionnaire that each interview would take not less than 45 minutes. Since Pune is spread over a very large area with very congested streets especially in the older parts of the city (where nine of the selected wards were located) it was estimated that it would take at least an hour to reach the study area. Thus with an estimated 2 hours of traveling and 6 hours of interviewing (not considering the time interval between the interviews when we would have to search for elderly subjects) we decided to cover 1 cluster per day. Interviews were conducted on all days including Sundays. Evenings were avoided, as most elderly would then be with their grandchildren in the park or out meeting friends.

White coat HTN and Pseudo HTN:

White coat HTN is defined as persistently raised clinic pressure together with a normal daytime ambulatory pressure. This type of HTN can occur at any age and in both sexes but appears to be slightly more common in subjects over 60 years.[30] These subjects do not exhibit any outward signs of stress or anxiety, nor do they have tachycardia. Since we would be visiting the subjects in their house, we speculate that the potential of white coat HTN would be reduced.

Pseudo HTN is due to falsely high sphygmomanometer readings secondary to vascular stiffness. We did not use the Osler maneuver in the present study to exclude pseudo HTN because of concerns regarding the validity of the maneuver.[31]

Data storage and analysis:

Data was first entered in Excel software and then analyzed using SPSS software.

IV: Results:

The survey covered 243 individuals. All the subjects were urban dwellers. The number of households covered to get 243 subjects was 164. This does not include the households without the elderly.

Characteristics of sample population:

No of **Males**	107	44%
No of **Females**	136	56%
Total	243	100%

Distribution of male and female subjects by age group:

Age group	Males	Percent	Females	Percent
60-64	20	18.7	57	41.9
65-69	29	27.1	36	26.5
70-74	25	23.4	26	19.1
75-79	18	16.8	12	8.8
80 & above	15	13.9	5	3.7
Total	107		136	

The mean age of males in the population was 70.46±7.3 years while for females it was 68.4±6.9 years.

The religious break up of the population:

Religion	Frequency	Percent	Males/Females
Hindu	226	93	101/125
Muslim	7	2.9	2/5
Christian	5	2.1	1/4
Others	5	2.1	3/2
Total	243	100	107/136

Distribution by marital status:

The subjects were either married or widowed. There were no divorcees or never married individuals.

Marital status	Frequency	Percent	M/F	M/F Percent
Married	166	68.3	91 / 75	54.8 / 45.2
Widowed	77	31.7	16 / 61	20.8 / 79.2

Distribution by socioeconomic status as assessed by the investigator:

SES class	Freq.	%	Males n	Females n	M/F Percent in each class
Poor	93	38.3	39	54	41.9/58.1
Middle	126	51.9	58	68	46/54
Rich	24	9.9	10	14	41.7/58.3
Total	243	100	107	136	

Distribution by current and past occupations translated into physical activity levels:

Physical activity level	**Current** Freq.	%	M/F % in each level	**Past** Freq.	% n154	M/F% in each level
1	149	61.3	63.1 / 36.9	42	27.3	81 / 19
2	79	32.5	8.9 / 91.1	43	27.9	51.2 / 48.2
3	15	6.2	40 / 60	69	44.8	47.8 / 42.2
Total	243	100		154	100	

Distribution of the study population by educational level:

Education Level	Freq.	Percent	M/F in each group	M/F % in each group
Illiterate	94	38.7	33 / 61	35.1 / 64.9
Till 4^{th}	23	9.5	6 / 17	26.1 / 73.9
5^{th} to 10^{th}	82	33.7	44 / 38	53.7 / 46.3
Beyond 10^{th}	44	18.1	24 / 20	54.5 / 45.5
Total	243	100		

The chronic disease morbidity profile for the study population:

Disease	Diabetes	HTN	Asthma	Joint Pain	Others
Absent	214	162	232	195	149
Present	29 (11.9%)	81(33.3%)	11 (4.5%)	48(19.8%)	94(38.7%)

n=243

79.4%(193) of the study population had visited a doctor, for some health complaint, in the past one year. Of these, the majority were women (56%). An allopathic practitioner was consulted by 86% of those who had visited a doctor. Blood pressure was measured in 81.9% of these subjects (n=193) during these visits. Of the 166 individuals who consulted an allopathic practitioner 83.7% had their BP measured while only 40% of those who consulted an ayurvedic practitioner had their BP measured. Blood sugar level was measured in 31.3% of all subjects while blood cholesterol levels were measure in 15.2%. Only 2 subjects were on lipid lowering drugs. 9.5% reported that they had been diagnosed as having heart failure by a doctor while 33.3% reportedly suffered from HTN. Of these 81 hypertensive individuals 75 (92.6%) were taking pharmacological treatment.

Diet pattern of the study population:

Type of diet	Frequency	Percent
Vegetarian	117	48.1
Non-vegetarian	126	51.9
Egg eaters	99	78.6%(n=126)
Meat eaters	116	92%(n=126)
Fish eaters	58	46%(n=126)

Type of cooking oil used currently and in the past:

Type of oil	Current Users	Percent	Past Users	Percent
Groundnut	166	68.3	217	89.3
Sunflower	57	23.5	8	3.3
Kardi	13	5.3	11	4.5
Palm oil	6	2.5	6	2.5
Mustard	1	0.4	1	0.4
Total	243	100	243	100

From the data available for use of **extra salt** (n=230), 16.5% used extra salt of whom 55.3% were females.

Profile of tobacco and alcohol use in study population:

Type	**Current** Use				**Past** Use			
	n	%	M%	F%	n	%	M%	F%
Smoking	18	7.4	88.9	11.1	25	11.1	100	0
Smokeless tobacco use	94	38.7	38.3	61.7	13	8.7	61.5	38.5
Alcohol	12	4.9	100	0	21	9.1	100	0

n=243

Distribution by physical activity level:

Level	Freq.	Percent	Males	M% in each group	Female	F% in each group
Mild	151	62.1	60	39.7	91	60.3
Moderate	87	35.8	43	49.4	44	50.6
Severe	5	2.1	4	80	1	20
Total	243	100	107		136	

Distribution by Physical Measurements:

Variable	Males		Females	
	Mean	S.D.	Mean	S.D.
Height	1.62	.06	1.51	.33
Weight	59.11	12.8	52.7	13.52
Mean Systolic BP	143.6	17.2	145.9	21.18
Mean Diastolic BP	86.3	11.6	86.3	11.6
Body mass index	22.23	4.2	22.84	5.2

Distribution of body mass index (B.M.I):

BMI group	Freq.	Percent	Males	M% in each group	Females	F% in each group
≤ 24.99	175	72	82	46.9	93	53.1
25 -29.99	53	21.8	20	37.7	33	62.3
≥ 30	15	6.2	5	33.3	10	66.7
Total	243	100	107		136	

This describes the findings of the population studied.

V: Analysis:

On analysis the prevalence of hypertension using criteria mean SBP≥ 140 mm Hg and mean DBP ≥90 or on antihypertensive therapy, was found to be 71.6% (95% CI 65.9-77.3).

Sex wise profile of hypertension in the study population:

HTN	Freq.	Percent	Males	M%	Females	F%
Absent	69	28.4	29	42	40	58
Present	174	71.6	78	44.8	96	55.2
Total	243	100	107		136	

(Fisher's Exact Test Two Tailed .774)

Prevalence in males was 72.9%(95% CI 67.3-78.5) while in females it was 70.6% (95% CI 64.9-76.3).

The prevalence of **isolated systolic HTN** (defined as mean SBP≥ 140 mm Hg, mean DBP<90 mm Hg) was 16.9%.

Isolated SBP	Freq.	Percent	Males	M%	Females	F%
Absent	202	83.1	86	42.6	116	57.4
Present	41	16.9	21	51.2	20	48.8
Total	243	100	107		136	

(Fisher's Exact Test Two Tailed .388)

Prevalence of isolated systolic HTN in males was 19.6%(95% CI 14.61-24.59), while in females it was 14.7%(95% CI 10.25-19.115).

Distribution of HTN by age group:

Age group(yrs)	HTN Present	Percent	HTN Absent	Percent
60-64	51	66.2	26	33.8
65-69	47	72.3	18	27.7
70-74	39	76.5	12	23.5
75-79	23	76.7	7	23.3
80 and above	14	70	6	30

(Pearsons p value .716)

Prevalence of HTN by investigative assessment of socio-economic status:

HTN	SES 1		SES 2		SES 3	
	n	(%)	n	(%)	n	(%)
Absent	39	41.9	26	20.6	4	16.7
Present	54	58.1	100	79.4	20	83.3
Odds Ratio	Reference		2.78 (1.47,5.27)		3.61(1.05,13.63)	

Pearsons p value < .001. 95% CI indicated in the brackets.
Chisquare for linear trend p value 0.0005

Subjects belonging to the high SES had an Odds of 3.61 of developing HTN while those in the middle SES bracket had a Odds of 2.78. Thus it is observed that there is significant trend in the relation between HTN and SES; as SES increases the prevalence of HTN increases.

Prevalence of HTN by religion:

HTN	Hindu		Muslim		Christian		Others	
	n	%	n	%	n	%	n	%
Absent	65	28.8	1	14.3	2	40	1	20
Present	161	71.2	6	85.7	3	60	4	80
Total	226	100	7	100	5	100	5	100

Pearsons p value .75

Prevalence of HTN by marital status:

HTN	Married n=166		Widowed n= 77	
	Freq.	Percent	Freq.	Percent
Absent	46	27.7	23	29.9
Present	120	72.3	54	70.1

(Fisher's exact test two tailed .760)

85.9% of the male hypertensives were married while 14.1% were widowed. (p value 0.762) In the female hypertensives 55.2% were married while 44.8% were widowed. (p value 1.0)

Prevalence of HTN by current occupation expressed in terms of physical activity level where 1 is least active and 3 is most active.

HTN	COPAL=1		COPAL=2		COPAL=3	
	N	%	n	%	N	%
Absent	41	27.5	18	22.8	10	66.7
Present	108	72.5	61	77.2	5	33.3
Odds Ratio	5.27(1.53,19.02)		6.78(1.81,26.67)		Reference	

COPAL = Current Occupation Physical Activity Level.
(Pearsons p value .002) 95% CI given in brackets.

Subjects involved in current occupation involving least physical activity had an Odds of 5.27 and those involved in moderate activity had an Odds of 6.78, of developing HTN, when compared to those involved in occupation requiring severe physical activity.

Prevalence of HTN by past occupation expressed in terms of physical activity level where 1 is least active and 3 is most active.

HTN	POPAL=1		POPAL=2		POPAL=3	
	n	%	n	%	N	%
Absent	9	21.4	9	20.9	26	37.7
Present	33	78.6	34	79.1	43	62.3
Total	42	100	43	100	69	100

(Pearsons p value .078)

Past occupation was not significantly related to HTN.

Prevalence of HTN by Education level:

HTN	Illiterate		Upto 4th std.		4th to 10th std.		>10th std.	
	n	%	n	%	N	%	n	%
Absent	36	38.2	7	30.4	22	26.8	4	9.1
Present	58	61.7	16	69.6	60	73.2	40	90.9
Odds Ratio	Reference		1.42		1.69		6.21	

The trend test shows that as the level of education increase the prevalence of HTN increases. (p value .0007)

Prevalence of HTN by reported Diabetes and Heart failure:

HTN	**Diabetes**				**Heart Failure**			
	Absent = 214		Present = 29		Absent = 220		Present =23	
	n	%	n	%	N	%	n	%
Absent	63	29.4	6	20.7	67	30.5	2	8.7
Present	151	70.6	23	79.3	153	69.5	21	91.3
p value	0.386				0.028			

The Odds of having heart failure in hypertensives was 4.6. (1, 29.23)

Prevalence of HTN by visit to a doctor in the past one year and blood pressure measurement in such a visit:

HTN	Visited Dr. in past 1 year				Was BP measured			
	Yes =193		No =50		Yes =162		No =81	
	n	%	n	%	N	%	n	%
Absent	48	24.9	21	42	37	22.8	32	39.5
Present	145	75.1	29	58	125	77.2	49	60.5
p value	0.021 (Fishers exact 2 tailed)				0.009 (Fishers exact 2 tailed)			

75% of all the patients who visited a physician in the previous year were suffering from HTN. 77% of the hypertensives who had visited a physician had their BP measured.

Prevalence of HTN by blood sugar and blood cholesterol measurement:

HTN	Blood sugar measured				Blood cholesterol measured			
	Yes = 76		No = 145		Yes = 37		No = 182	
	n	%	n	%	n	%	N	%
Absent	10	13.2	51	35.2	3	8.1	57	31.3
Present	66	86.8	94	64.8	34	91.9	125	68.7
p value	0.080 (Pearsons)				0.009 (Pearsons)			

With regards to blood sugar measurement 22 subjects had their blood drawn but the investigation done was not known. With regards to blood cholesterol 24 individuals had their blood drawn but were not aware of the investigation done. 81 subjects (33.3%) were aware that they had HTN (as previously diagnose by a doctor). Of these 75 were taking treatment (96.2%) while 6 did not take any pharmacological therapy. We observed that all the 75 previously diagnosed hypertensives and taking treatment were hypertensives by our assessment while of the remaining 6 not on treatment, only 3 were currently hypertensives.

It was observed that the odds of having HTN with a vegetarian diet was 1.81 (.99, 3.34). No significant correlation was found between prevalence of HTN and the type of cooking oil used currently or in the past and excess salt intake.

Prevalence of HTN by smoking.

HTN	**Current Smokers** n = 107				**Past Smokers** n = 91			
	Yes =16		No = 91		Yes = 25		No = 66	
	n	%	n	%	N	%	N	%
Absent	8	50	21	23	5	20	16	24.2
Present	8	50	70	77	20	80	50	72.5
p value	0.034(Fisher's exact 2 tailed)				0.784(Fisher's exact 2 tailed)			

Current smokers showed a lower prevalence of HTN when compared to non-smokers. OR=0.36 (95% CI 0.13-1.06). Since there were only 2 women smokers, analysis was done excluding women.

Prevalence of HTN by smokeless tobacco use:

HTN	**Current User**				**Past User** n = 150			
	Yes =94		No = 149		Yes = 13		No = 137	
	n	%	n	%	n	%	N	%
Absent	30	31.9	39	26.2	3	23.1	36	26.3
Present	64	68.1	110	73.8	10	76.9	101	73.7
p value	0.333 (Pearsons)				0.801 (Pearsons)			

The relation between HTN and smokeless tobacco use was insignificant.

Prevalence of HTN by alcohol use:

HTN	Current User n = 107				Past User n = 95			
	Yes = 12		No = 95		Yes = 21		No = 74	
	n	%	n	%	n	%	n	%
Absent	2	16.6	27	28.4	5	23.8	22	29.7
Present	10	83.3	68	71.5	16	76.2	52	70.2
p value	0.5 (Fisher's exact 2 tailed)				0.785(Fisher's exact 2 tailed)			

Analysis was limited to males only as there were no women alcohol users.

Prevalence of HTN by physical activity levels, 1 denoting least activity, 3 denoting severe activity.

HTN	PAL=1		PAL=2		PAL=3	
	n	%	n	%	n	%
Absent	39	25.8	28	32.2	2	40
Present	112	74.2	59	67.8	3	60

Pearsons P value 0.487 PAL= Physical activity level.

Prevalence of HTN by Body Mass Index:

HTN	≤ 24.99		25-29.99		≥ 30	
	n	%	N	%	n	%
Absent	60	34.3	8	15.	1	6.7
Present	115	65.7	45	84.9	14	93.3
Odds Ratio	1		2.93		7.30	

Pearsons p value .00392.

Thus as the BMI increases, prevalence of HTN increases.

Results of Multiple Logistic Regression:

The results of multiple logistic regression are summarized below.

Variables	Odds R	95% CI	p value
Education			
Illiterate	Ref		
upto 4th	1.4239	0.48-4.23	0.52
4th-10th	1.2188	0.56-2.64	0.61
>10th	3.5765	1.03-12.44	0.04
Vegetarian	1.0989	.054-2.23	0.79
Smoking	0.3507	0.11-1.05	0.06
BMI			
<25	Ref		
25-30	2.4156	1-5.9	0.04
>30	6.9237	0.75-63	0.08
Age Group			
60-64	Ref		
65-69	1.3662	0.6-3.1	0.45
70-74	2.0524	0.82-5.11	0.11
75-79	1.6154	0.54-4.86	0.38
80>	1.4116	0.41-4.81	0.57
Sex	0.7157	0.33-1.54	0.3855
Current Occupation			
Phy act 1	Ref		
Phy act 2	1.3715	0.62-3	0.4207
Phy act 3	0.2256	0.06-0.81	0.0198

SES was omitted from the analysis due to interaction with Education. Higher education was significantly correlated as a risk factor for HTN. Occupations requiring severe physical activity were protective, while a high BMI was a significant risk factor. The relation of smoking and vegetarian diet with HTN lost its significance. Age, was not a significant correlate of HTN.

VI: Discussion:

Accelerated population aging experienced in the last few decades is an unprecedented phenomenon. Currently this is more so in the developing countries. Soon three fourths of the elderly will be in the developing world. [12] A natural concomitant of aging of the population in India is likely to be an increase in the burden of HTN and related cardiovascular diseases. [148]

In Pune, we estimated the prevalence of HTN in the elderly at 71.6%. Such a high prevalence was also found in urban Bangladesh (74.6%) by a co-investigator who performed the study using the same study protocol. The Harlem Household Survey[128] reports a prevalence of 60% and 57.6% in males and females respectively, in the 45-64 age group. A prevalence of 59% was also reported from urban Trivandrum.[62] A prevalence of 72% in black Americans in the 65-74 age group has also been reported. [24] The Egyptian National HTN Project reported a prevalence of 56.6% in those of age 75 years and older.[146] Of importance is the fact that the prevalence of HTN depends on the defining criteria. Most older studies use 160/90 as a cut off point. The prevalence of HTN thus would be lower in these studies in comparison to those studies that use 140/90 as a cut off point.[41]

In bivariate analysis, SES, Education level, current occupation, vegetarian diet, smoking and BMI emerged as important correlates of HTN. In our study the SES and HTN were directly related. This was similar to a study from North India. [127] People from lower SES may indulge in more manual labor for their subsistence and eat less of fatty food in comparison to higher SES subjects which may keep them healthier. In our study, education level was directly correlated to HTN. This could be related to the trend seen in SES. More educated people tend to be better off, with less physical taxing work and more resources to consume high calorie and fat content foods. These

findings are in contrast to the findings of Harlem Health Survey, [128] and another study conducted in rural Rajashtan.[126] They report that income (SES) and education level are inversely related to HTN. Sorel et al[129] argue that due to the general increase in the level of education, educational achievement may no longer have the same social meaning or relation to other dimensions of social class such as income or occupation. In their study after adjustment for age and body mass the inverse association between education and blood pressure was either weakened or eliminated among the study participants.

Our study shows that as the BMI increases the prevalence of HTN increases. There are many studies in the literature which agree with our finding. [9,79,80,81,82]

Trend test using low BMI group as reference revealed that the middle and high BMI group had an OR of 2.93 and 7.3 (p value .001) of developing HTN. Current occupation was assessed in terms of level of physical activity involved (thus a proxy of physical activity level). Occupation involving severe physical activity had protective effect (OR=0.22 95% CI 0.06-0.81). This may be due to the fact that such occupations usually involve people of lower SES, of lower educational achievements and those who cannot afford frequently a high calorie, fat rich diet. Vegetarian diet was identified as a risk factor for HTN (OR= 1.8 95%CI 0.99-3.334). The reason for this could be speculated as follows. These vegetarian hypertensives were initially non-vegetarians and after learning of their HTN switched to a vegetarian diet.

Prvalence of HTN in smokers was lower than that in non-smokers. This has been reported in literature and its causes discussed in the review of literature.[115,116] Further among those who were aware of their HTN status(81) only 3.7% were smokers. Among those who were not aware, 9.3% were smokers. Thus hypertensives may have been more aware of the dangers of smoking and thus quit. Following

multivariate analysis, higher education, occupations involving severe physical activity and moderately high BMI retained their significant correlation with HTN, while smoking, vegetarian diet lost their significant association.

In our study of the 174 hypertensives, an astonishing 55.2% were not aware that they had HTN. This was despite the high frequency of physician office visits in the previous year (79.4%). This is similar to the findings of some studies. [62, 32,145,146] Other studies,[32] especially the Dutch study[61] show a much higher level of awareness (upto 80%). Of the 174 hypertensives only 43.1% were taking treatment. Of the 78 hypertensives who were aware, 75 were taking treatment (96%). These findings correspond to those of phase II and III findings of the NHANES[32] and a study in elderly from Trivandrum. [62] Of all the hypertensive subjects only 11.49% had their HTN under control. Even when the analysis was limited to those hypertensives on treatment the percentage of controlled was only 26.7%. These findings are similar to those of other studies. [32,62,145] It is note worthy to observe that regarding awareness, treatment and control, those studies which are in agreement with our study are from developing countries, while the studies which show higher rates for awareness, treatment and control are from the developed countries. Interpretation of data on awareness, treatment and control of HTN is complex issue in developing countries like India as it reflects an intricate interplay between availability, accessibility and affordability of physician services and pharmaceutical drugs. Education and SES of patients, awareness of guidelines among practitioners and individual physician thresholds for treatment of HTN also have an effect on the treatment and control of HTN.

Constraints and limitations of the study:

As this is a study restricted to the elderly, we are essentially examining survivors of HTN, 60 years of age and above. It is quite possible that younger individuals leading a high-risk lifestyle with respect to HTN may not survive up to the age of 60. Thus the prevalence we found could be an underestimate. Another limitation is that the reported household expenditure is grossly underreported for fear of incurring additional taxation. However an investigative assessment of the socio-economic status was done by the physician to help get a more realistic idea of the subjects true socio-economic status. The measurement of waist to hip ratio (WHR) an index of upper body obesity, correlates more closely with HTN compared to other measures of adiposity. However its measurement requires removal of clothing, privacy and female examiners for women. This was not possible in our study. Thus we used BMI which has shown to have a moderate correlation with WHR. [149] Osler maneuver was not done as explained previously. Another major shortcoming of our study is the use of BP measurements obtained on a single occasion. The effect of regression to the mean of BP when measurements are made on more than one occasion is well known. Single visit measurements, even when averaged may overestimate the prevalence of HTN by 17%.[150] Unfortunately due to constrains of time, money and other resources a second visit was not possible to take additional BP measurements.

Strengths of the study:

A single physician conducted the study in a field area with which he was familiar, both geographically and linguistically. The study design was such that there was no selection bias. Of the eligible respondents, two husbands did not permit an interview and examination with their spouses, one daughter in law refused an interview with her mother in law, while one male had left town and would return only after a week.

These were the only non-responders encountered. Since the study was conducted at home, in the settings in which the subject would be comfortable, and not the usual clinic setting, we expected that the phenomenon of white coat HTN would be reduced.

Public Health implications:

Data from the Eastern Asia[151] demonstrates a stronger association of HTN with the risk of stroke in this part of the world compared to the West. Combining our prevalence findings with population data on the elderly subjects,[46] we project that there may be 5.2 million elderly people in Maharashtra and 51.3 million elderly people in India with HTN by the year 2001. These figures underscore the importance and the dire need for active and rapid public health intervention measures to alleviate the burden of HTN in the elderly in the near future, as well deflect impending accompanying clinical and economic consequences.

Thus the public health challenges of HTN could be summarized as: [32]

1. Prevent the rise of BP with age.
2. Decrease the existing prevalence of HTN.
3. Increase HTN awareness and detection including that of isolated systolic HTN.
4. Improve control of HTN.
5. Improve the opportunities for treatment.

Because physical inactivity is a modifiable risk factor countries should set concrete policy objectives for physical activity, especially since promoting physical activity as a policy endeavor need not be expensive. Even a little physical activity is beneficial for otherwise inactive people. When starting out people should start slowly using large muscle groups and gradually increasing the frequency and duration of their participation over time. [73]

Conclusions:

In our community based urban sample, 72% of the elderly subjects were found to be hypertensive. Increasing awareness of HTN especially in the educated and adapting healthy lifestyle habits to prevent excessive weight gain appear to be the primary, cost-effective and simple preventive measures one could implement for control of the epidemic of HTN. Given the increasing population of elderly, low levels of awareness, treatment and control of HTN, our findings emphasize the need for increasing the awareness of HTN in the general population, to promote the measurement of BP especially in the elderly and to disseminate knowledge regarding current HTN guidelines amongst physicians in Pune.

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VIII: APPENDIX :

1. Cluster Identification Form:

Ward No	Total population	Cum. Pop	Cluster No		Sampling interval=38702
1	11124	11124		38702	Random Number =17362
2	9475	20599	1	RNo17362	56064
3	10423	31022			94766
4	10500	41522			133468
5	6558	48080			172170
6	5182	53262			210872
7	11964	65226	2		249574
8	7376	72602			288276
9	8810	81412			326978
10	7636	89048			365680
11	6329	95377	3		404382
12	12634	108011			443084
13	10749	118760			481786
14	9029	127789			520488
15	6075	133864	4		559190
16	8866	142730			597892
17	7869	150599			636594
18	10377	160976			675296
19	10240	171216			713998
20	10401	181617	5		752700
21	9960	191577			791402
22	8715	200292			830104
23	10962	211254	6		868806
24	9745	220999			907508
25	10468	231467			946210
26	13950	245417			984912
27	8673	254090	7		1023614
28	11955	266045			1062316
29	8898	274943			1101018
30	14658	289601	8		1139720
31	6935	296536			
32	11011	307547			
33	5002	312549			
34	10353	322902			
35	7928	330830	9		
36	9309	340139			
37	10447	350586			
38	8626	359212			
39	14073	373285	10		
40	9042	382327			
41	8308	390635			
42	9453	400088			
43	10341	410429	11		
44	8518	418947			
45	10012	428959			
46	8369	437328			
47	10262	447590	12		
48	11646	459236			

49	10329	469565	
50	8435	478000	
51	13897	491897	13
52	9021	500918	
53	9947	510865	
54	16050	526915	14
55	9215	536130	
56	10344	546474	
57	10009	556483	
58	5462	561945	15
59	9475	571420	
60	8189	579609	
61	9014	588623	
62	9556	598179	16
63	8454	606633	
64	7424	614057	
65	8389	622446	
66	8359	630805	
67	9912	640717	17
68	4864	645581	
69	9718	655299	
70	8747	664046	
71	7782	671828	
72	8108	679936	18
73	8724	688660	
74	10743	699403	
75	8906	708309	
76	9070	717379	19
77	8566	725945	
78	9703	735648	
79	8754	744402	
80	9072	753474	20
81	8251	761725	
82	7083	768808	
83	5078	773886	
84	12377	786263	
85	10517	796780	21
86	10135	806915	
87	9697	816612	
88	8157	824769	
89	8269	833038	22
90	8052	841090	
91	9668	850758	
92	10358	861116	
93	10206	871322	23
94	10499	881821	
95	10998	892819	
96	9146	901965	
97	7886	909851	24
98	6251	916102	
99	11374	927476	
100	8247	935723	
101	8942	944665	
102	8961	953626	25

103	9729	963355	
104	9550	972905	
105	9346	982251	
106	8945	991196	26
107	8972	1000168	
108	8349	1008517	
109	8827	1017344	
110	10427	1027771	27
111	10083	1037854	
112	9776	1047630	
113	9007	1056637	
114	9559	1066196	28
115	11015	1077211	
116	9153	1086364	
117	9607	1095971	
118	8537	1104508	29
119	9691	1114199	
120	10745	1124944	
121	8882	1133826	
122	8863	1142689	30
123	9597	1152286	
124	8771	1161057	

QUESTIONNAIRE

Code No:	Date:	Ward Name:	Ward No:
Name:		Age:	Sex:
Address:			
1.Household Size:	Subjective SES: 1 2 3		
2.What was your total household expenditure in the last month? Rs.			
3.Type of household: Kuccha Semi- Pucca Pucca			
4.Assets: 2-wheeler Car TV Fridge VCR Phone Gas Stove AC Washing Machine			
Computer Music system Own House Rented House			
5.Religion: Hindu Muslim Christian Jain Parsi Sikh Other			
6.Marital status: Married Divorced Widowed Never Married			
7.Current Occupation:		Duration:	
8.Past Occupation:		Duration:	
9.Education:			
10.**Past history** of major illness: DM HTN ASTH REND Others			
11.Did you visit a doctor in the last one year? Yes No		12.System ?	
13.Was your BP measured? Yes No	14.Was any blood test done? (For?) Yes No _____		
15.Are you taking medicines for lowering blood cholesterol? Yes No		16.Have you been told you have heart failure by a doctor? Yes No	
17.Do you have HTN? Yes No	18.Are you taking medicines for it? Yes No		
19.System?	20.Current Allopathic drug used:	21.Other therapy:	
22.**Dietary habits**: Vegetarian Egg Fish Meat		23.Type of cooking oil used:	
24.Frequency (weekly): Egg Fish Meat		25.Extra salt used? Yes No	
26.Do you **smoke**? Yes No	27.If yes since how long(yrs):	28.Type:	
29.Frequency(weekly):	30. If no did you ever smoke? Yes No	31. If yes how long did you smoke? (yrs):	
32.Duration of quitting (yrs):	33.Reason for quitting?	34.Frequency (weekly)	35.Type:
36.Do you chew **tobacco**? Yes No	37.If yes since how long(yrs):	38.Type:	
39.Frequency(weekly):	40. If no did you ever chew? Yes No	41. If yes how long did you chew? (yrs):	
42.Duration of quitting (yrs):	43.Reason for quitting?	44.Frequency (weekly)	45.Type:
46.Do you drink **alcohol**? Yes No	47.If yes since how long(yrs):	48.Type:	

59.Frequency(weekly):	60. If no did you ever drink? Yes No	61. If yes how long did you drink? (yrs):

62.Duration of quitting (yrs):	63.Reason for quitting?	64.Frequency (weekly)	65.Type:
66.Daily physical activities:			
67.Any other relevant information:			

Measurements:

Body weight(kg):	Height(cm):	BMI:
Blood Pressure	Systolic BP(mm of mercury)	Diastolic BP(mm of mercury)
First reading		
Second reading		
Third reading (if required)		

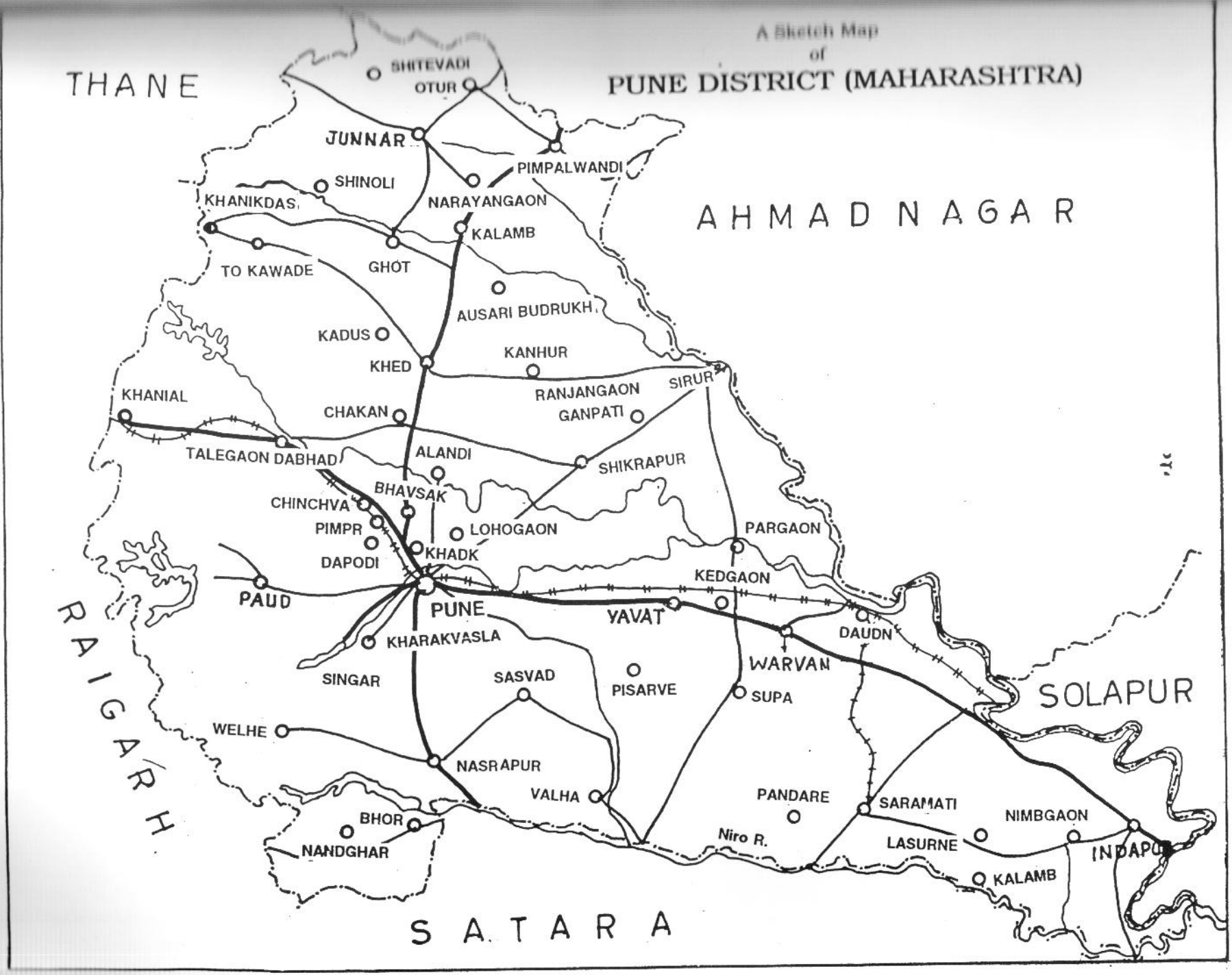
Checked for completeness.

Signature of the investigator

3.Physical activity check list.

Checklist

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


A Sketch Map
of
PUNE DISTRICT (MAHARASHTRA)
THANE
AHMAD NAGAR
SATARA
RAIGARH
SOLAPUR
SHITEVADI
OTUR
JUNNAR
PIMPALWANDI
SHINOLI
NARAYANGAON
KHANIKDAS
KALAMB
TO KAWADE
GHOT
AUSARI BUDRUKH
KADUS
KANHUR
KHED
SIRUR
RANJANGAON
KHANIAL
CHAKAN
GANPATI
TALEGAON DABHAD
ALANDI
SHIKRAPUR
BHAVSAK
CHINCHVA
PIMPR
LOHOGAON
PARGAON
DAPODI
KHADK
KEDGAON
PAUD
PUNE
YAVAT
DAUDN
KHARAKVASLA
WARVAN
SINGAR
SASVAD
PISARVE
SUPA
WELHE
NASRAPUR
VALHA
PANDARE
SARAMATI
NIMBGAON
BHOR
Niro R.
LASURNE
INDAPUR
NANDGHAR
KALAMB