



Prevalence and Predictors of Hypertension among the Elderly Population in Rural Areas of Allahabad District: A Cross Sectional study

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Abstract:

Background: Hypertensive heart disease is one of the major reasons for the cardiovascular mortality. By age 60 approximately 60% of the population develops hypertension. With background of increasing proportion of elderly in India the study of epidemiology of hypertension among elderly is an important area for research.

Objective: To study the prevalence of hypertension and factors associated with it among elderly in rural areas of Allahabad.

Methodology: Cross sectional community based study done in rural areas of Allahabad during 2007-08. Multistage random sampling method was used. A total of 411 elderly persons aged 60 years and above were studied from the 8 villages each from 2 community development blocks Jasra and Bahadurpur area. The subjects were interviewed and examined using a predesigned and pretested proforma. Univariate and multivariate analysis was done.

Results: Prevalence of hypertension was found to be 45%. In the univariate analysis occupation, socio economic status, food habits, BMI, diabetes mellitus and anaemia were found to be significantly associated with hypertension at 5 percent level. Age group, education, family type and current tobacco use were significant at 10 percent level. On logistic regression analysis upper socio economic class, mixed food

habits (consuming both vegetarian and non vegetarian diet), normal BMI (18.09-22.25) and overweight and obese BMI (>22.25) and diabetes mellitus were found to be significant predictors of hypertension among the elderly people.

Conclusion: *The prevalence of hypertension was high. The significant predictors are upper socio economic class, mixed food habits overweight and obese BMI (>22.25) and diabetes mellitus.*

Key words: *Hypertension, prevalence, predictors, elderly, rural Allahabad*

Introduction

Cardiovascular diseases are one of the dominant contributors for the NCD mortality and morbidity. Hypertensive heart disease is one of the major reasons for the cardiovascular mortality. [1] According to the Framingham Heart Study, by age 60 approximately 60% of the population develops hypertension, and by 70 years about 65% of men and about 75% of women have the disease. [2] The Seventh Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-7) Reports hypertension occurs in more than two thirds of individuals after age of 65.[3] In terms of attributable deaths, raised blood pressure is one of the leading behavioural and physiological risk factor to which 13% of global deaths are attributed.[4]

Hypertension is a significant and often asymptomatic chronic disease, which requires optimal control and persistent adherence to prescribed medication to reduce the risks of cardiovascular, cerebrovascular and renal disease.[5]

With background of increasing proportion of elderly in India the study of epidemiology of hypertension among elderly is an important area for research.[6] Hence the above study has been done with the following objectives: 1. To study the prevalence of hypertension among the persons aged 60 years and above in the rural areas of Allahabad district of U.P, 2. To identify the important factors associated with the hypertension among the elderly population.

Methodology

The present study was conducted in the rural areas of Allahabad district during the March 2007 to January 2008.

Study Design: Community based Cross sectional study.

Sample Size: Based on a pilot study, the prevalence of hypertension among elderly persons was found to be 50 percent. Also on review of relevant literature the prevalence of hypertension was found to be approximately 50 percent.[7] Sample size was calculated using the formula: $n = \frac{4PQ}{L^2}$ where : n = sample size, P = prevalence of morbidity (50%), Q = 100-P, L = Allowable error (taken as 10 percent for the present study). Sample size was calculated to be 400. Finally, 411 subjects were included in the study.

Sampling Method: Multistage random sampling method was used in the present study. In the first stage, two Community Development Blocks of Allahabad district were selected randomly. The Community Development Blocks were Jasra in the trans Yamuna area and Bahadurpur in the trans Ganga area. In the second stage, 8 villages in each of these blocks were randomly selected. In the third stage, 25 study subjects from each of these villages were randomly selected. [Fig 1]

Study subjects: Persons aged 60 years and above were selected for the study. WHO (TRS-779) report refers to the heterogenous population of those aged 60 years and over as elderly people and the same criteria was used in this study.[8] Any document issued by the revenue or education

department (10th marks sheet, voter's ID card, ration card) which contained the age of the person was used while ascertaining the age of the subjects.

Method of Collection of Data: Ethical clearance was obtained from the Institutional Ethics committee. Data was collected by house to house visits. Informed consent was taken after explaining the purpose and objective of the study to the study subjects. The study subjects were interviewed and examined. The information collected was recorded on a pretested and pre-designed proforma.

Tools Used:

Socio-economic Status: Modified BG Prasad classification corrected to the January 2007 AICPI (All India Consumer Price Index) was used. The class I and II (Upper and Upper middle) was considered as upper class, III and IV (Lower middle and upper lower) was considered as middle and V (Lower) as lower class.

Marital status was categorized as currently married and not currently married which included widow, widowers, separated/divorced and unmarried. Literacy status was classified into 3 categories as Illiterates, those with 1 to 10 years of education and more than 10 years of education. Occupational status was categorized into involved and not involved in economically gainful work. Food habits were grouped into pure vegetarian and mixed (included both vegetarian and non vegetarian food). Current tobacco users were the subjects who were using smoked (beedi, cigarettes, chillum etc.) or smokeless (Khaini, gutka, etc.) form of tobacco for the past one year or more. Current alcohol users were the subjects who were using any form of alcohol for the past one year or more.

Weight: Weight was measured using electronic weighing machine with subject standing erect with barefoot and light clothing to the nearest 0.1 Kg.

Height :The height was measured using

stadiometer with the elderly standing upright with heels close to each other, arms hanging by the side, eyes looking straight forward and Frankfurt's plane (line joining the floor of the external auditory meatus and floor of the orbit) in the horizontal plane. The height was measured to the nearest 0.5 centimeters.

Body Mass Index (BMI) : BMI was calculated using the formula : $\frac{\text{Weight in Kg.}}{\text{Height in m}^2}$. It was

classified as BMI < 18.09 as undernourished, BMI 18.09-22.25 as normal range, and BMI > 22.25 as overweight.[9]

Blood Pressure: Blood pressure was measured in the right upper arm, using the auscultatory method with mercury sphygmomanometer (Diamond) in the sitting position. Two separate measurements were made and the average of the two measurements was recorded. In some cases, where high blood pressure was recorded for the first time, the blood pressure was checked more than twice and took the average of the two close readings. Systolic Blood Pressure was noted at the point at which the first of 2 or more sounds is heard (phase I) and Diastolic Blood Pressure at the point before the disappearance of sounds (phase V).

Staging of Hypertension: Joint National Committee (JNC)-VII staging was used. For the purpose of applying tests of significance and for logistic regression analysis subjects with systolic BP of less than 140 and diastolic BP of less than 90 mm of Hg were considered as non hypertensives and those with more than that were considered to be hypertensives.[3]

Diabetes mellitus was identified based on history, review of previous records. Anemia was assessed by physical examination (pallor in palpebral conjunctiva, tongue, nail bed and palmar creases). For assessing depression Geriatric Depression Scale (Short form) was used. A score of more than 5 was considered as depression.[10] Diagnosis was based on history, physical examination and

review of previous records.

Statistical Analysis: All the data collected was analysed using Statistical Software, SPSS Ver. 12, Epi-Info and NCSS. Tests of significance chi square test for the categorical variables. Binary logistic regression analysis was done by enter method including the variables which showed a significance at 10 percent level on univariate analysis. Hosmer and Lemeshow goodness of fit test and Nagelkerke R square were also calculated.

Results

Among the 411 elderly subjects nearly 59 percent belonged to the 60 to 69 years age group followed by 70 to 79 years group which constituted around 31 percent. Only 10 percent were in the age group of 80 years and above. There were 214 (52.1%) men and 197 (47.1%) women in the study population. Nearly 254(61.8%) were currently married, 288(70%) were illiterate. Among the literates 103(25%) had 1-10 years of education and 20 (5%) had more than 10 years of education. Nearly 64% were current users of tobacco and only 10 subjects were current consumers of alcohol.

Of the 411 elderly subjects 16 were known cases of diabetes mellitus giving a prevalence of 3.9 percent. There were 88(21.4%) elderly who were anaemic and 81(19.7%) were depressed.

The prevalence of hypertension (Systolic BP \geq 140 and / or Diastolic BP \geq 90) among the elderly subjects based on JNC VII classification was found to be around 45 percent. Nearly one fourth of the subjects were in the pre hypertension category. (Table 1)

In the univariate analysis occupation, socio economic status, food habits, BMI, diabetes mellitus and anaemia were found to be significantly associated with hypertension at 5 percent level. Age group, education, family type and current tobacco use were significant at 10 percent level. A lower proportion of current tobacco users were found to be having hypertension compared to non users (Table 2).

All the factors which were found to be significant at 10 percent level were entered into binary logistic regression analysis by enter method. On logistic regression analysis upper socio economic class, mixed food habits (consuming both vegetarian and non vegetarian diet), normal BMI (18.09-22.25) and overweight and obese BMI ($>$ 22.25) and diabetes mellitus were found to be significant predictors of hypertension among the elderly people (Table 3). Hosmer and Lemeshow goodness of fit was not significant ($p=0.793$) which indicated good fit of the logistic regression model. Nagelkerke R square showed that 20 percent of the hypertension among the elderly can be predicted by the variables in the model.

Figure 1. Sampling frame

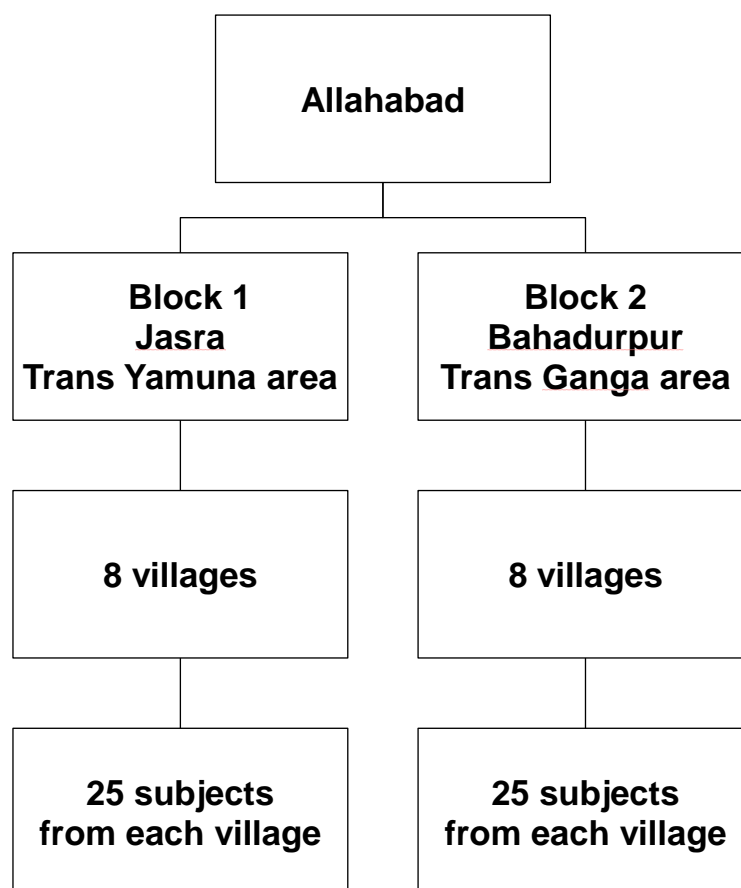


Table 1: Classification of hypertension among elderly according to JNC VII

Blood Pressure (mm Hg)	Male		Female		Total	
	No.	%	No.	%	No.	%
Normal *SBP <120 & DBP <80	69	16.8	59	14.4	128	31.2
Pre Hypertension SBP 120-139 & **DBP 80-89	51	12.4	48	11.7	99	24.1
Stage I Hypertension SBP 140-159 &/or DBP 90-99	59	14.4	43	10.5	102	24.9
Stage II Hypertension SBP ≥160 &/or DBP ≥100	35	8.5	47	11.3	82	19.8
Total	214	52.1	197	47.9	411	100.0

($\chi^2 = 4.44$, $df=3$, $p > 0.05$ Not significant).

* SBP= Systolic Blood Pressure, ** DBP= Diastolic Blood Pressure.

Table 2: Univariate analysis of factors associated with hypertension

Factors	Hypertension		P value
	No.(%)	No hypertension No.(%)	
Age group in years			
60-69	100(40.8)	145(59.2)	0.073
70-79	67(53.2)	59(46.8)	
≥80	17 (42.5)	23(57.5)	
Mean±SD	69.8±7.2	68.7±8.3	
Gender			
Male	94(43.9)	120(56.1)	0.720
Female	90(45.7)	107(54.3)	
Marital status			
Currently Married	110(43.3)	144(56.7)	0.350
Non married	74(48.1)	80(51.9)	
Education			
Illiterate	125(43.4)	163(56.6)	0.067
1-10 years	45(43.7)	58(56.3)	
>10years	14 (70.0)	06(30.0)	
Occupation			
No Gainful work	139(48.3)	149(51.7)	0.029
Gainful work	45(36.6)	78(63.4)	
Family type			
Joint	64(46.4)	74 (53.6)	0.060
Three generation	70(51.1)	67(48.9)	
Nuclear	36 (34.0)	70(66.0)	
Living alone	14 (46.7)	16(53.3)	
Socio Economic status			
Lower	55(44.4)	69(55.6)	0.001
Middle	111(41.9)	154(58.1)	
Upper	18 (81.8)	04(18.2)	
Food habits			
Pure vegetarian	74 (37.2)	125(62.8)	0.003
Mixed	110 (51.9)	102(48.1)	
Current Tobacco use*			
No	75(50.7)	73(49.3)	0.071
Yes	109(41.4)	154(58.6)	
BMI			
<18.09	49(31.8)	105(68.2)	0.000
18.09-22.25	89(50.3)	88(49.7)	
>22.25	46 (59.0)	32(41.0)	
Mean±SD	18.95±3.21	20.29±3.43	
Co morbid conditions			
Diabetes Mellitus	No	171(43.3)	0.003
	Yes	13 (81.2)	
Anemia	No	157(48.6)	0.003
	Yes	27 (30.7)	
Depression	No	143(43.3)	0.237
	Yes	41 (50.6)	

*Current Tobacco use- both smoked and smokeless tobacco

Table 3: Binary logistic regression analysis of factors associated with hypertension

Factors	OR	95% CI		P value
		Lower	Upper	
Age group in years				
60-69	1.0			
70-79	1.61	0.99	2.61	0.056
≥80	1.48	0.66	3.33	0.339
Education				
Illiterate	1.0			
1-10 years	1.04	0.61	1.77	0.884
>10years	1.61	0.49	5.28	0.432
Occupation				
No Gainful work	1.0			
Gainful work	0.61	0.37	1.02	0.058
Family type				
Joint	1.0			
Three generation	1.24	0.74	2.09	0.420
Nuclear	0.59	0.33	1.05	0.071
Living alone	1.05	0.43	2.58	0.908
Socio Economic status				
Lower	1.0			
Middle	0.98	0.61	1.58	0.939
Upper	5.27	1.45	19.11	0.011
Food habits				
Pure vegetarian	1.0			
Mixed	2.24	1.43	3.51	0.000
Current Tobacco use				
No	1.0			
Yes	0.62	0.49	1.18	0.082
BMI				
<18.09	1.0			
18.09-22.25	1.78	1.02	3.13	0.044
>22.25	2.19	1.10	4.37	0.026
Co morbid conditions				
Diabetes Mellitus	No	1.0		
	Yes	4.20	1.06	16.60
Anemia	No	1.0		
	Yes	0.57	0.30	1.10

Discussion

The developing countries are undergoing demographic transition with increase in life expectancy. As a result there is increase in the proportion of elderly segment of population. Hypertension is an important risk factor for

cardiovascular morbidity and mortality, particularly in the elderly.

The present study was carried out in the rural areas of Allahabad district. The prevalence of hypertension was found to be around 45 percent among the people aged 60 years and above.

The prevalence was found to be over 30 percent among rural population aged more than 30 years in different studies in India.[7,11,12] Higher prevalence of around 55 % was found among the rural elderly population by Hypertension study group and Rashid AK in rural areas of Kerala and Malaysia respectively.[9,13] Prevalence of over 60 percent was reported by the Framingham Heart study.[2] This difference might be because of different geographic area. The studied area belongs to a backward area in the eastern Uttar Pradesh. Epidemiological transition is slowly taking place. Nearly quarter of the study subjects were in the pre hypertension category which is a cause for concern as they are likely to develop hypertension over time. Moreover pre hypertension is also associated with increased risk of cardiovascular diseases.[14]

The prevalence was nearly similar among the male and female elderly population. Comparable results were found by the Hypertension study group and others. [7, 9,14] Hypertension prevalence is less in women than in men until 45 years of age, is similar in both sexes from 45 to 64 years of age, and is much higher in women than men >65 years of age as per NCHS data.[15] In the Framingham heart study elderly over age 70 years, 65% of men and 75% of women have the disease. [2] The prevalence of hypertension increases as the age advances as quoted by different studies across India and world over. [2, 7, 12, 14] In the current study there was increase from 60-69 years group to 70-79 years group. After that there was a decline. Comparable results were found by the hypertension study group with increase in the 2nd tertile of age group and decline in the 3rd tertile.[9] This might be because of the smaller sample in the 80+ age group. Prevalence of hypertension in the present study was not related to marital status which is in conformity with other studies. [7, 9, 16,17]

The association of higher educational levels and upper socio economic class with increased odds of hypertension is in contrast to findings from developed countries, where risk factors for

cardiovascular diseases, including hypertension, are more pronounced among the less educated and lower socio economic groups.[17- 22] However, it is important to note that our study was cross-sectional and the communities surveyed are at an early stage of epidemiological transition.

Prevalence of hypertension was found to be higher among the subjects not involved in economically gainful activity. Sedentary type of work or physical inactivity or unemployment has been found to be an important risk factor for hypertension in various studies. [7, 12, 17, 22-28] Elderly population who were involved in economically gainful activity were found to be at lower risk of hypertension.

In a study in Surat city by Momin MH et. al the prevalence of hypertension was significantly higher among nuclear type of family (35.5%) as compared to the Joint type of family (25.8).[29] But in the present study such an association was not seen.

In the present study the subjects consuming pure vegetarian food had significantly lower prevalence of Hypertension compared to those consuming mixed diet. Vegetarian diets have been associated with low BP.[30,31] Even in industrialized countries, where elevated BP is commonplace, individuals who consume a vegetarian diet have markedly lower BPs than do non vegetarians. [32-34]

Current tobacco use has not been found to be associated with hypertension in this study. But tobacco smoking was found to be associated with lower odds of hypertension by the hypertensive study group and others. [9,14] Even though it has been proved that consumption of tobacco is an important risk factor for hypertension such contrasting finding may indicate other complex and significant factors influencing vascular tone among elderly hypertensive subjects.[7, 35,36]

Several studies have indicated higher BMI as a significant predictor for hypertension.[7,9,12, 27,37] Comparable results were found in the current study.

The prevalence of hypertension was found to be significantly higher among the elderly with diabetes in the present study. [12, 38] Hypertension was found to affect approximately 70% of patients with diabetes and was approximately twice as common in persons with diabetes as in those without.[39,40] The association of diabetes mellitus with increased odds of hypertension has been reported on many occasions.[9,12,17,27,37]

The current study shows that depression was not associated with the hypertension. A handful of studies have suggested that depression may be more common among individuals with hypertension.[41-43] While a much larger body of evidence shows no association between hypertension and depression.[44-49] Additional research found no crude or adjusted association between hypertension and depression.[44-47, 49, 50]

Limitation

Diabetes mellitus was identified based on history, review of previous records. No objective measurement of blood glucose was made. Anemia was assessed by physical examination alone. No laboratory/objective assessment was done. Hence it might be an underestimate.

Conclusion

Hypertension is highly prevalent among the elderly population of rural Allahabad. The significant predictors for hypertension among them are upper socio economic class, mixed food habits (consuming both vegetarian and non vegetarian diet), normal BMI (18.09-22.25) and overweight and obese BMI (>22.25) and diabetes mellitus.

Recommendations

Regular screening of all the people aged above 60 years for hypertension. Appropriate management of hypertension including life style modification and better control of diabetes mellitus may go a

long way in preventing the complication associated with hypertension. Yoga and meditation can also be included in the strategy.

References

1. Bloom DE, Cafiero ET, Jané-Llopis E et al. The Global Economic Burden of Non-communicable Diseases. Geneva: World Economic Forum. A report by the World Economic Forum and the Harvard School of Public Health.2011. http://www3.weforum.org/docs/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf (cited 2013 Aug 5)
2. Chaudhry KN, Chavez P, Gasowski J et al. Hypertension in the elderly: some practical considerations. *Cleve Clin J Med.* 2012;79(10):694-704.
3. Chobanian AV, Bakris GL, Black HR et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA* 2003; 289:2560-2572.
4. http://www.who.int/cancer/publications/national_capacity_prevention_ncds.pdf (cited 2013 Aug 5)
5. Lionakis N, Mendrinou D, Sanidas E et al. Hypertension in the elderly. *World J Cardiol.* 2012;4(5): 135-147.
6. World population prospects 2012 revision. Key findings and advance tables. United Nations, New York 2013. http://esa.un.org/wpp/Documentation/pdf/WPP2012_%20KEY%20FINDINGS.pdf (cited 2013 Aug 5)
7. Hazarika NC, Biswas D, Narain K et al. Hypertension in the native rural population of Assam. *Natl Med J India.* 2004;17(6):300-304.

8. WHO. Health of the elderly . TRS. 1989; 779: 8
9. Hypertension Study Group. Prevalence, awareness, treatment and control of hypertension among the elderly in Bangladesh and India: A multicentre study. *Bull World Health Organ.* 2001;79:490–500.
10. Welty C, Palmer RM. Aging and the Geriatric Patient. Chapter 26. Textbook of Clinical Preventive Medicine. 2nd Edition, American Medical Association. 301-312.
11. http://www.japi.org/february_2013_special_issue_hypertension_guidelines/06_epidemiology_of_hypertension.pdf (cited 2013 Aug 5)
12. Yadav S, Boddula R, Genitta G et al. Prevalence and risk factors of pre-hypertension and hypertension in an affluent north Indian population. *Indian J Med Res.* 2008;128:712-720.
13. Rashid AK. Azizah AM. Prevalence of hypertension among the elderly Malays living in rural Malaysia. *Austr Med Jr.* 2011; 4, 6, 283-290.
14. Thankappan KR, Sivasankaran S, Khader SA et al. Prevalence, correlates, awareness, treatment, and control of hypertension in Kumarakom, Kerala: Baseline results of a community-based intervention program. *Indian Heart J.* 2006; 58: 28-33.
15. National Center for Health Statistics. Health, United States, 2007 With Chartbook on Trends in the Health of Americans. Hyattsville, Md: National Center for Health Statistics; 2007.
16. Hazarika NC, Biswas D, Narain K et al. Hypertension and its risk factors in tea garden workers of Assam. *Natl Med J India.* 2002;15:63–8.
17. Abed Y., Abu-Haddaf S. Risk Factors of Hypertension at UNRWA Primary Health Care Centers in Gaza Governorates. *ISRN Epidemiology.* 2013; Article ID 720760, 9 pages. <http://www.hindawi.com/isrn/epidemiology/2013/720760/cta/> (cited 2013 Sept 17)
18. Leino M, Raitakari OT, Porkka KVK et al. Association of education with cardiovascular risk factors in young adults: the Cardiovascular Risk in Young Finns Study. *Int Jr of Epid.* 1999; 28: 667–675.
19. Sorel JE, Ragland DR, Syme L et al. Educational Status and Blood Pressure: The Second National Health and Nutrition Examination Survey, 1976 –1980, and the Hispanic Health and Nutrition Examination Survey, 1982–1984. *Am Jr of Epid.* 1992;135: 1339–1348.
20. Regidor E, Gutiérrez-Fisac JL, Banegas JR, et al. Association of adult socioeconomic position with hypertension in older people. *J Epid Commun Hlth.* 2006; 60(1): 74–80.
21. Grimsrud A, Stein DJ, Seedat S et al. The Association between Hypertension and Depression and Anxiety Disorders: Results from a Nationally-Representative Sample of South African Adults. *PLoS ONE.* 2009; 4(5): e5552. doi:10.1371/journal.pone.0005552.
22. Diez Roux AV, Chambless L, Merkin SS et al. Socioeconomic disadvantage and change in blood pressure associated with aging. *Circulation.* 2002 Aug 6;106(6):703-710.
23. Chockalingam A, Ganesan N, Venkatesan S et al. Patterns and predictors of pre-hypertension among “healthy” urban adults in India. *Angiology.* 2005; 56: 557-63.
24. Anand MP. Prevalence of hypertension amongst Mumbai executives. *J Assoc Physicians India.* 2000; 48 : 1200-1201.

25. Zachariah MG, Thankappan KR, Alex SC et al. Prevalence, correlates, awareness, treatment, and control of hypertension in a middle-aged urban population in Kerala. *Indian Heart J.* 2003; 55 : 245-51.
26. Whelton SP, Chin A, Xin X et al. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Ann Intern Med.* 2002; 136 : 493-503.
27. Thawornchaisit P, de Looze F, Reid CM et al. Health risk factors and the incidence of hypertension: 4-year prospective findings from a national cohort of 60 569 Thai Open University students. *BMJ Open.* 2013;3: e002826. doi:10.1136/bmjopen-2013-002826. <http://bmjopen.bmj.com/content/3/6/e002826.full.pdf+html> (cited 2013 Sept 17)
28. Bassett DR Jr, Fitzhugh EC, Crespo CJ et al. Physical activity and ethnic differences in hypertension prevalence in the United States. *Prev Med.* 2002; 34 : 179-86.
29. Momin MH, Desai VK, Kavishwar AB. Study of sociodemographic factors affecting prevalence of hypertension among bank employees of Surat City. *Indian J Public Health.* 2012;56:44-8.
30. Appel LJ, Brands MW, Daniels SR et al. Dietary approaches to prevent and treat hypertension: A scientific statement from the American Heart Association. *Hypertension.* 2006;47(2):296-308.
31. Fraser G. Risk factors and disease among vegans. In: Fraser G, ed. Diet, life expectancy, and chronic disease. Studies of Seventh-day Adventists and other vegetarians. New York, NY: Oxford University Press, 2003:231-9.
32. Armstrong B, van Merwyk AJ, Coates H. Blood pressure in Seventh-day Adventist vegetarians. *Am J Epidemiol.* 1977;105:444 - 449.
33. Sacks FM, Rosner B, Kass EH. Blood pressure in vegetarians. *Am J Epidemiol.* 1974;100:390 -398.
34. Sacks FM, Kass EH. Low blood pressure in vegetarians: effects of specific foods and nutrients. *Am J Clin Nutr.* 1988;48:795- 800.
35. Poulsen PL, Ebbelohj E, Hassen KW et al. Effects of smoking on 24-h ambulatory blood pressure and autonomic function in normalbuminuric insulin dependent diabetes mellitus patients. *Am J Hypertens.* 1998;11:1093-9.
36. Mikkelsen KL, Wiinberg N, Hoegholm A et al. Smoking related to 24-h ambulatory blood pressure and heart rate: A study in 352 normotensive Danish subjects. *Am J Hypertens.* 1997;10 (5 Pt 1):483-91.
37. Shanthirani CS, Pradeepa R, Deepa R et al. Prevalence and risk factors of hypertension in a selected South Indian population - the Chennai Urban Population Study. *J Assoc Physicians India.* 2003; 51: 20-7.
38. Lago RM, Singh PP, Nesto RW. Diabetes and hypertension . *Nat Clinical Pract Endo& Metab.* 2007; 3(10): 667. doi:10.1038/ncpendmet0638. <http://www.nature.com/nrendo/journal/v3/n10/pdf/ncpendmet0638.pdf> (cited 2013 Sept 17)
39. Geiss LS, Rolka DB, Engelgau MM: Elevated blood pressure among U.S. adults with diabetes, 1988-1994. *Am J Prev Med.* 2002;22:42- 48.
40. Sowers JR, Epstein M, Frohlich ED: Diabetes, hypertension, and cardiovascular disease: an update. *Hypertension.* 2001;37:1053-1059.
41. Davidson K, Jonas BS, Dixon KE et al. Do Depression Symptoms Predict Early Hypertension Incidence in Young Adults in the CARDIA Study? *Arch Intern Med.* 2000;160:1495-1500.

42. Jonas BS, Franks P, Ingram DD. Are symptoms of anxiety and depression risk factors for hypertension? Longitudinal evidence from the National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study. *Arch of Fam Med*. 1997; 6: 43–49.
43. Coelho R, Hughes AM, Fernandes da Fonseca A et al. Essential hypertension: The relationship of psychological factors to the severity of hypertension. *Jr of Psychosom Res*.1989; 33: 187–196.
44. Paterniti SMD, Alperovitch AMD, Ducimetiere PP et al. Anxiety But Not Depression Is Associated With Elevated Blood Pressure in a Community Group of French Elderly. *Psychosom Med*. 1999; 61: 77–83.
45. Yan LL, Liu K, Matthews KA et al. Psychosocial Factors and Risk of Hypertension: The Coronary Artery Risk Development in Young Adults (CARDIA) Study. *JAMA*. 2003; 290: 2138–2148.
46. Shinn EH, Poston WSC, Kimball KT et al. Blood pressure and symptoms of depression and anxiety: a prospective study. *Am Jr of Hyp*. 2001;14: 660–664.
47. Jones-Webb R, Jacobs DR, Flack JM et al. Relationships between Depressive Symptoms, Anxiety, Alcohol Consumption, and Blood Pressure: Results from the CARDIA Study. *Alcoholism: Clin and Expl Res*. 1996; 20: 420–427.
48. Levenstein S, Smith MW, Kaplan GA. Psychosocial Predictors of Hypertension in Men and Women. *Arch Intern Med*. 2001; 161: 1341–1346.
49. Wiehe M, Fuchs S, Moreira L et al. Absence of association between depression and hypertension: results of a prospectively designed population-based study. *Jr of Human Hyp*. 2006; 20: 434–439.
50. Scherrer JFMA, Xian HP, Bucholz KKP et al. A Twin Study of Depression Symptoms, Hypertension, and Heart Disease in Middle-Aged Men. *Psychosom Med*. 2003; 65: 548–557.