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Original Research Article

Prevalence and risk factors of hypertension among adults in Lucknow, India

Syed Esam Mahmood[1], JP Srivastava[2], Pankaj Bhardwaj[3], Zeeshan Haider Zaidi[4], KP Mathur[5]

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Abstract

Background: In India, recent community surveys have documented that prevalence of hypertension has gone up amongst urban and rural inhabitants. A strong association between change in lifestyle and increase in prevalence of hypertension has been reported. **Objectives:** Prevalence of hypertension and identification of associated risk factors amongst adults in rural and urban areas of District Lucknow was studied. **Methods:** The cross sectional field study involved a survey of 753 respondents, aged 18 years and above using stratified random sampling and Probability Proportionate to Size technique. A study instrument which included behavioral risk factor questionnaire and physical measurements of height, weight, waist circumference, hip circumference and blood pressure was used to collect data. Chi- square test and regression analysis were used to analyze data. **Results:** The overall prevalence of hypertension was found to be 25.89%. Prevalence of hypertension was significantly higher among individuals, aged 40 years and above, with high body mass index, increased waist circumference and waist hip ratio and those with high salt intake,(P<.001). Statistically significant associations were also found within people living in urban areas, amongst Muslims and those with higher socioeconomic profile. Also similar associations were found amongst those with high fat intake and adverse food intake, (P<.05). **Conclusions:** Lifestyles do have an impact on levels of blood pressure. This can be tackled by lifestyle modifications.

Key words: Prevalence, Hypertension, Risk factors, Lifestyle modifications

Authors:
1 Associate Professor, Community Medicine, Government Medical College, Banda, UP, 2 Professor & Head, Community Medicine, Era's Lucknow Medical College, Lucknow 3 Associate Professor, Department of Community Medicine and Family Medicine, All India Institute of Medical Sciences, Jodhpur 4 Assistant Professor cum Statistician, Community Medicine, Era's Lucknow Medical College, Lucknow 5. Professor, Community Medicine, Saraswati Medical College, Unnao, UP

Corresponding Author:
Dr. Syed Esam Mahmood,
C-5, Ahliyabainagar, Kalyanpur, Lucknow-226022, UP.
Email id: semahmood@gmail.com

Introduction

Hypertension is becoming an important public health problem worldwide. It is reported to be the fourth contributor to premature death in developed countries and the seventh in developing countries. [(1)]

Reports indicate that nearly 1 billion adults had hypertension in 2000; this is predicted to increase to 1.56 billion by 2025**.** [(2)]

It is the commonest cardiovascular disorder affecting about 20% adult populations worldwide. It is an important risk factor for cardiovascular mortality accounting for 20-30% of all deaths. [(3)]

Cardiovascular diseases caused 2.3 million deaths in India in the year 1990; this is projected to double by 2020. Hypertension is responsible for 57% of stroke deaths and 24% of coronary heart disease deaths in India**.** [(4)]

Indian urban population studies in the mid-1950s used older WHO guidelines for diagnosis (BP ≥160 and/or 95 mmHg) and reported hypertension prevalence of 1.2-4.0%. Subsequent studies reported

a steadily increasing prevalence from 5% in 1960s to 12-15% in 1990s. [5]

Hypertension prevalence is lower in the rural Indian population, although there has been a steady increase over time as well. Recent studies have shown a high prevalence of hypertension among urban adults. The prevalence of hypertension during the last three to six decades in India has increased by about 30 times among urban residents and by about 10 times among the rural residents**.** [6]

A strong correlation has been reported between changing lifestyle factors (unhealthy diet, physical inactivity, alcohol and tobacco use) and the increase in hypertension. Recently, Chennai Urban Rural Epidemiology Study reported prevalence of hypertension to be 20% as per US Seventh Joint National Committee on Prevention, Detection, Evaluation and Treatment of Hypertension criteria**.** [7]

Ten common risk factors such as unhealthy diet, physical inactivity, smoking, alcohol use, tobacco use, overweight, raised blood pressure, raised total cholesterol levels and raised blood sugar are the most prevalent risk factors among the world population. [8]

The prevalence of hypertension will increase even further unless broad and effective preventive measures are implemented.

The literature on prevalence and risk factors of hypertension in Lucknow was scarce, thereby the present study was undertaken to find out prevalence of hypertension and to identify the risk factors associated amongst adult population aged 18 years and above in field practice areas of the Department of Community Medicine, Era's Lucknow medical college & Hospital, Lucknow.

Material and methods

The cross sectional study was carried out in villages of Kakori block and mohallas of old Lucknow city. Optimal sampling size was calculated on the basis of prior prevalence rate of hypertension of 36.4%. [9] The sample size was calculated by the formula $4PQ/L^2$ where P is the prevalence, Q is 100-P and L is the permissible error i.e.10% of P. Sample size came out to be 750 which was equally divided for urban and rural areas (375 for each). A total of 753 individuals gave consent and participated in the study.

Stratified random sampling was used to select the study subjects. Demographically, the population residing in villages of Kakori block as well as the Mohallas of old Lucknow city have people of different religion, socioeconomic status and other different characteristics. Similar characteristics of people lives in one mohalla/area (strata). So, because of this non homogenous nature of sample, as well as for better representation of each group, stratified sampling was used.

All mohallas and villages in the study area were primary sample units (PSU) i.e. strata. All adults from the PSUs selected formed sampling units. Number of adults to be taken for the survey from each village and mohalla was decided according to Probability Proportionate to Size (PPS) technique. A household wise complete list of eligible sampling unit i.e. adults of age 18 years and above, was prepared separately for all villages and mohallas. Serial numbers were allotted by sequence to the households in each of the list.

Then the first household was selected randomly from Random Number Table and the eligible candidates were taken. Similarly, the next household was randomly picked up and the eligible candidates of that household were taken. This procedure was repeated till the desired numbers of eligible persons were selected. In case of non availability of the adult in selected household due to any reason, next household was selected for the survey in order to attain the adequate sample size. All adults in the final household were covered even if the required number of adults exceeded. The survey was done by the first author himself.

A structured pretested and predesigned questionnaire was used to assess study subjects' self-reported behavioral and lifestyle risk factors for hypertension (Smoked and smokeless tobacco used, alcohol consumed, level of physical activity done and detailed dietary history were recorded), the measurement of subject's blood pressure and anthropometrical parameters.

Following **Operational Definitions** were put to use in the present study:

1. **Hypertension**- means systolic BP $\geq$ 140mmHg and/or mean diastolic BP $\geq$ 90mmHg or history of anti hypertensive treatment fifteen days before the survey.
2. **Current smoking-** someone who in the preceding month of the survey, smoked in any form either daily or occasionally
3. **Non-smoker:** someone who had never smoked at all.

4. **Current smokeless tobacco use**- reported consumption of smokeless tobacco in any form in the preceding month of the survey either daily or occasionally.
5. **Alcohol consumption**- reported consumption of alcohol in the year preceding the survey.
6. **Adverse food intake** was defined as consumption of adverse foods items at least twice a week.
7. **Physical inactivity**- was defined as mostly sitting during working hours and leisure time, using motorized vehicle for travelling and not walking or using bicycle for at least 30 minutes daily.
8. **Overweight/obesity**- body mass index level of > 25 $Kg^{/m2}$ and >30 $Kg^{/m2}$ respectively.

Modified Prasad's classification was applied to measure the individual's socioeconomic status. [10] Questions to assess salt intake were asked to determine the average number of days required to consume one pack of salt by one household as used in another study. [11]

Fat intake was calculated using 24 hour recall dietary survey method amongst individuals. High fat intake was defined as more than 20gms of fat consumed per day both for men and women. [12, 13, and 14]

History of frequency of consumption of adverse foods items such as cheese, butter, fried local foods, red meat, eggs, chicken, fish, aerated soda or sugar, sweetened drinks, pizza, burger, French fries, bakery items, samosa, namkeen etc was also taken. [12]

For physical examination, standardized calibrated mercury column type sphygmomanometer; stethoscope, common weighing machine and measuring tape were used.

During the course of the interview, two measurements of blood pressure on each study participant with a mercury column sphygmomanometer were made using a standardized technique 30 minutes apart in sitting position. [3] The first blood pressure measurement was recorded after obtaining sociodemographic information from the study subject, while the second recorded after a brief clinical examination.

Blood pressure measurements were made on the left arm of each study subject, using a cuff of appropriate size at the level of the heart. The cuff pressure was inflated 30 mm Hg above the level at which radial pulse disappeared, then deflated slowly at the rate of about 2mm per sec and the readings were recorded to the nearest 2 mm Hg. In case where the two readings differed by over 10 mm of Hg, a third reading was obtained, and the three measurements were averaged. The pressures at which sound appeared and disappeared were taken as systolic blood pressure (SBP) and diastolic blood pressure (DBP) respectively.

Blood pressure was classified as normal (SBP <120 and DBP <80 mmHg), pre-hypertension (SBP = 120-139 and/or DBP = 80-89 mmHg), stage I hypertension (SBP = 140-159 and/or DBP = 90-99 mmHg), and stage II hypertension (SBP > 160 and/or DBP > 100 mmHg) as per US Seventh Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VII) criteria. [15]

Body weight was measured (to the nearest 0.5kg) with the subject standing motionless on the weighing scale, feet about 15cm apart and weight equally distributed on each leg. Subjects were instructed to wear minimum outwear (as culturally appropriate) and no footwear while there weight was being measured.

Height was measured (to the nearest 0.5cm) with the subject standing in an erect position against a vertical surface, and the head positioned so that the top of the external auditory meatus was level with the inferior margin of the bony orbit (Frankfurt's plain).

Body Mass Index was calculated as weight in kilograms divided by weight in meters squared. Based on their BMI, individuals were classified into four groups: thin (BMI <18.5), normal (BMI=18.5-24.9), overweight (BMI = 25.0-29.9) and obese (BMI > 30.0) as per WHO. [16]

Waist circumference was measured with a standard measuring tape, while subjects were lightly clothed, at a level midway between the lower margin of the last rib and iliac crest in centimeters (to the nearest 0.1cm). Waist circumference (WC) cut-offs were taken as 90 cms for males and 80 cms for females to define abdominal obesity using South Asia Pacific Guidelines. [17]

Hip circumference (HC) was measured at the maximum circumference over the buttocks in centimeters (to the nearest 0.1cm) with the subject in standing position.

Waist hip ratio was calculated as waist circumference divided by hip circumference. The cut-off used for the waist-hip ratio (WHR) for males was 0.9 and for females it was 0.8 to define obesity. [18]

Data entry and statistical analysis were performed using the Microsoft Excel and SPSS windows version 14.0 software. Tests of significance like Pearson's Chi- square test, Students t test and ANOVA were applied to find out the results. Univariate logistic regression analysis was done using systolic and diastolic blood pressure as the dependent variable and the various risk factors identified as independent variables. Multiple logistic regression analysis was done using hypertension as the dependent variable and the risk factors found significant as independent variables. The Odds ratios with 95% confidence intervals were calculated to assess the association between the independent variables and hypertension. For testing multi

collinearity, dummy variables were created for each category except the first one that was taken as a reference category. Then the dependent variable from logistic regression analysis was used as a dependent variable in the linear regression. The tolerance was calculated for each independent variable, using the formula, Tolerance = 1 – Rsq, where Rsq is the coefficient of determination for the regression of that variable on all remaining independent variables.

Result

Overall, 195 (25.89%) of 753 respondents studied were hypertensive. The overall, mean blood pressures were 123.39 ± 20.24/79.24 ± 11.61 mm Hg respectively.

Table 1: Hypertension in relation to socio-demographic characteristics

Socio demographic Characteristics	Total (n=753)		Chi-Square (df), P-value
	No. Studied	No. of Hyperten-sives	
Place*			
Urban	380	117 (30.78%)	16.794 (2), **.000**
Rural	373	78 (20.91%)	
Age group (years)*			
18-30	238	24 (10.08%)	54.587 (4), **.000**
31-40	224	60 (26.78%)	
41-50	110	39 (35.45%)	
51-60	100	39 (39.00%)	
> 60	81	33 (40.74%)	
Marital status*			
Married	570	153 (26.84%)	10.732 (2), **0.005**
Unmarried	105	15 (14.28%)	
Divorced/ Evermarried/ Widowed	78	27 (34.61%)	
Religion*			
Hindus	328	63 (19.20%)	13.550 (1), **.000**
Muslims	425	132 (31.05%)	
Socio-economic class			
I	25	10 (40.0%)	9.712 (4) , **0.046**
II	52	15 (28.84%)	
III	104	35 (33.65%)	
IV	346	89 (25.72)	
V	226	46 (20.35%)	
Educational status			
Illiterate	381	99 (25.98%)	14.091 (7), 0.05
Less than primary	46	16 (34.78%)	
Primary	84	17 (20.23%)	
Middle school	66	12 (18.18%)	
High school	60	17 (28.33%)	
Intermediate	38	15 (39.47%)	
Graduate	63	12 (19.04%)	
Postgraduate	15	7 (46.66%)	

*** These significant variables were further included in the logistic regression model**

The prevalence of hypertension was found to be higher in urban areas (30.8%) than rural areas (20.9%) (P-value <.001). The proportion of hypertension showed an increasing trend with age (p-value <.001). Statistically significant associations were found amongst Muslims (P<.001) and those with higher socioeconomic profile (P<.05). [Table 1].

A significantly higher proportion of respondents with a high BMI were found to be hypertensive (51.93%) as compared to those with a normal or low BMI (18%). (P-value <.001) [Table 2].

Highly significant differences in the proportion of hypertension was seen in respondents with an increased waist circumference (54.16% men and 36.03% women) as compared to those with a normal or low waist circumference (17.35% men and 15.46% women), and among respondents with a high waist hip ratio (39.30% men and 30.12% women) as compared to those with a normal or low waist hip ratio (11.90% men and 10.36% women) (P-value <.001). The overall percentage of centrally obese individuals found hypertensive was 40%. [Table 2]

Statistically significant associations were found amongst those with high salt intake (P<.0001) , fat intake (P<.05) and adverse food intake (P<.05). [Table 2]

In urban area, hypertensives had a higher BMI, waist circumference and waist hip ratio. They also more likely consumed a high fat and salt diet and adverse diet as compared to the hypertensives in rural area [Table 2].

Thirty seven out of 133 (27.81%) respondents with current smoking habit (daily) studied were found to be hypertensive as compared to none out of three who smoked occasionally, the difference being statistically insignificant.(P-value >.05) [Table 3]

Univariate logistic regression analysis was done using either systolic blood pressure or diastolic blood pressure as the dependent variable. All variables found significant were further tested in a forward multiple logistic regression analysis. Age, high salt intake, body mass index and waist hip ratio were found to be significant predictors to hypertension in the study population [Table 4].

The study variables in the regression were examined for collinearity. The tolerance came out to be high for each variable. Therefore multicollinearity was not present in the model.

Table 2: Hypertension in relation to modifiable risk factors

Risk factors	Rural (n_1=373)		Urban (n_2=380)		Total (n=753)		Chi-Square (df), P-value
	No. Studied	No. of Hypertensives	No. Studied	No. of Hypertensives	No. Studied	No. of Hypertensives	
Body mass index:*							
<18.5	120	17 (14.17%)	65	2 (3.07%)	185	19 (10.27%)	86.510(3), **.000**
18.5-24.9	196	40 (20.40%)	186	42 (22.58%)	382	82 (21.46%)	
25-30	47	17 (36.17%)	88	50 (56.81%)	135	67 (49.62%)	
>30	10	4 (40.0%)	41	23 (56.09%)	51	27 (52.94%)	
Waist circumference:*							
Men (≥90)	25	11 (44%)	47	28 (59.57%)	72	39 (54.16%)	40.670(1), **.000**
Men (<90)	179	32 (17.87%)	86	14 (16.27%)	265	46 (17.35%)	
Women (≥80)	59	18 (30.5%)	163	62 (38.03%)	222	80 (36.03%)	22.526(1), **.000**
Women (<80)	110	17 (15.45%)	84	13 (15.47%)	194	30 (15.46%)	
Increased Waist hip ratio:*							
Men (>0.9)	90	30 (33.33%)	83	38 (45.78%)	173	68(39.30%)	OR= 4.08
Women (>.08)	119	30 (25.21%)	213	70 (32.86%)	332	100 (30.12%)	p-value=**.000**
Smoking status							
Smokers	104	22 (21.15%)	32	15 (46.87%)	136	37 (27.20%)	.148(1)
Non-smokers	269	56 (20.81%)	348	102 (29.31%)	617	158 (25.60%)	0.7
Current smokeless tobacco use:							
Present	90	16 (17.77%)	111	42 (37.83%)	201	58 (28.85%)	1.251(1)
Absent	283	62 (21.9%)	269	75 (27.88%)	552	137 (24.81%)	0.263
Alcohol consumption							
Present	25	7 (28.0%)	5	2 (40.0%)	30	9 (30.0%)	.274(1)
Absent	348	71 (20.40%)	375	115(30.66%)	723	186 (25.72%)	0.601
Physical activity							
Sedentary	137	30 (21.89%)	141	52 (36.87%)	278	82 (29.49%)	2.976(2),
Active	236	48 (20.33%)	239	65 (27.19%)	475	113 (23.78%)	0.084
High fat intake*							
Present	197	51 (25.88%)	275	86 (31.27%)	472	137 (29.02%)	6.453(1), **.011**
Absent	176	27 (15.34%)	105	31 (29.52%)	281	58 (20.64%)	
Salt Intake/day*							
< 5 gm	358	68 (18.99%)	374	112 (29.94%)	732	180 (24.59%)	OR= 7.666
> 5 gm	15	10 (66.67%)	6	5 (83.33%)	21	15 (71.42%)	p-value=**.000**
Adverse food intake*							
Present	121	28(23.14%)	299	95 (31.77%)	420	123 (29.28%)	5.685(1),
Absent	252	50 (19.84%)	81	22 (27.16%)	333	72 (21.62%)	**0.017**

Table 3: Hypertension in relation to current smoking habit

Current smoking habit	Rural (n_1=104)		Urban (n_2=32)		Total (n=136)	
	No. studied	No. of hypertensives	No. studied	No. of hypertensives	No. studied	No. of hypertensives
Daily	102	22 (21.56%)	31	15 (48.38%)	133	37 (27.81%)
Occasionally	2	0 0.00%	1	0 0.00%	3	0 0.00%
Total	104	22 -21.15%	32	15 (46.87%)	136	37 -27.20%
Chi-Square (df)	.557(2)		5.307(2)		1.331(2)	
P-value	0.757		0.07		0.514	

Table 4: Multivariate logistic regression analysis of predictors of hypertension in the total study sample

Predictor	β coeff	Odd's ratio	95% CI	P-value
Place Rural=1, Urban=2)	-0.003	0.997	.628-1.58	0.99
Age (<40 yrs=1, >40yrs=2)	0.984	2.674	.833-3.90	**0**
Marital status (Married=1, Single=2)	0.045	1.047	.683-1.60	0.834
Religion (Hindu=1, Muslim=2)	0.484	1.623	.932-2.82	0.087
Socioeconomic status (Low=1, Better off=2)	0.396	1.485	.975-2.26	0.065
Body mass index (High=1, Normal=2)	-1.26	0.284	.179-0.44	**0**
Waist circumference (High=1, Normal=2)	0.163	1.177	.728-1.90	0.507
Waist hip ratio (Increased=1, Normal=2)	-0.875	0.417	.382-3.13	**0.001**
High fat intake (Yes=1, No=2)	0.235	1.265	.844-1.89	0.255
High salt intake (Yes=1, No=2)	1.417	4.124	.220-7.66	**0**
Adverse food intake (Yes=1, No=2)	-0.091	0.913	.541-1.54	0.734

Discussion

The prevalence of hypertension has been increasing in India, both in rural and urban regions. Factors which are attributable to these changes are rapid urbanization, lifestyle changes, dietary changes including use of fast foods and increasing salt intake and increased life expectancy. Similar trends were found in our study also.

The high prevalence of hypertension and pre-hypertension in the present study is similar to the trends reported worldwide. [2] Similar prevalence of pre-hypertension (47 per cent) has also been reported in the study conducted in Chennai among urban adults. [7]

The prevalence of hypertension was found to be higher in urban areas (30.8%) than rural areas (20.9%). Similar trends have been reported by other Indian studies. [19, 6]

The proportion of hypertension was found to increase steadily with the increase in age. These findings are coherent with studies carried in Wardha [20], Mizoram [21] and South India [22]. Such changes of blood pressure with age might be due to changes in vascular system

Higher proportion of divorced, ever married or widowed were found to be hypertensive as compared to those married and unmarried. Similar findings were reported by a study conducted in Assam. [23] Apparently psychosocial factors affect biological, neuroendocrine and immune systems. [24]

The percentage of hypertensives among the illiterate respondents was observed slightly higher as compared to the literate ones. However there was no significant association with education in the present study. Obviously the level of education is related to the protection of hypertension. Education was found to be significantly associated to hypertension in the Wardha study [20].

Higher prevalence of hypertension was found in upper, upper-middle and middle classes, as compared to lower-middle and lower classes. Similar findings were reported among Chennai urban adults belonging to the low socio economic group based on household, income, occupation (8.4%) as compared to prevalence in the middle socio economic group (15%). [25] Societies that are in transitional stage of economic and epidemiological change have higher prevalence of hypertension among upper socioeconomic groups. [3]

BMI was found to be significantly associated with hypertension. Persons having BMI more than or equal to 25 had a higher risk of hypertension. Similar findings were reported by studies conducted in Orissa [26] and West Bengal [27].

Higher proportion of centrally obese respondents (40%) were found hypertensive. Similar findings were reported by studies conducted in Maharashtra [11] and West Bengal [27]. Also a higher proportion of respondents with a high waist hip ratio (39.30% men and 30.12% women) were found hypertensive. Similar observations were reported in a study conducted in rural Wardha [20]. 38.5% of hypertensives had a waist-hip ratio equal to or more than the cut-off point, i.e. 0.8 for females and 0.9 for

males. Similar findings was observed by studies conducted in Gujarat [28] and West Bengal [27].

Although the prevalence of hypertension was higher among smokers as compared to non smokers, there was no significant association with smoking in our study. Smoking was found to be significantly associated to hypertension in the Maharasthra study [11].

Similarly, there was no association with smokeless tobacco use in our study as found in the studies conducted in Maharasthra [11], Mizoram [21] and Gujrat [28].

We also did not find any relationship between alcohol consumption and hypertension (P >0.05). Possibly most of our subjects did not consume alcohol. Alcohol was found to be significantly associated to hypertension in the studies conducted in Maharasthra [11], Assam [23], Orissa [26] and Mizoram [21]

Lower prevalence of hypertension was found among respondents who were physically active as compared to those who had a sedentary lifestyle. However there was no association with physical activity in our study as seen in the Wardha study [20]. The positive effect of physical training in both primary and secondary prevention of hypertension has been confirmed. [3]

In the study population a higher proportion of respondents with high fat intake were found hypertensive as compared to those with normal fat intake. Diet and nutrition have been linked to high blood pressure. Composite diets have been demonstrated to reduce the risk of hypertension. [29]

Higher proportion of respondents (71.42%) with high salt intake were found hypertensive. The similar findings were reported by the study conducted in Assam. [23] Salt intake has been directly correlated with prevalence of hypertension in many populations. [29]

We can have projections from the study that lifestyle modifications may lead to decrease in blood pressure of an individual. This study also emphasizes the need for large, nationwide, multicentric, prospective, and supervised epidemiological studies as presently there is an increase in cases of hypertension in our country.

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References

1. R Pradeepa, V Mohan. Hypertension & pre-hypertension in developing countries. Indian J Med Res December 2008; 128: 688-690
2. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet 2005; 365: 217-23.
3. Hypertension control. Technical Report Series: World Health Organization; 1996. Report No.: 862.
4. Rodgers A, Lawes C, MacMahon S. Reducing the global burden of blood pressure related cardiovascular disease. J Hypertens 2000; 18:S3-6.
5. Gupta R, Prakash H, Majumdar S, Sharma S, Gupta VP. Prevalence of coronary heart disease and coronary risk factors in an urban population of Rajasthan. Indian Heart J 1995; 47:331-8
6. Gupta R. Trends in hypertension epidemiology in India. Journal of Human Hypertension 2004; 18:73–78
7. Mohan V, Deepa M, Farooq S, Datta M, Deepa R. Prevalence, Awareness and Control of Hypertension in Chennai - The Chennai Urban Rural Epidemiology Study (CURES – 52). JAPI 2007; 55:326-332
8. Reducing Risks, Promoting Healthy Life - The World Health Report. Geneva: World Health Organization; 2002.
9. Das SK, Sanyal K, Basu A. Study of urban community survey in India: growing trend of high prevalence of hypertension in a developing country. International Journal of Medical Sciences 2005; 2:70–8
10. Agarwal AK. Social classification: The need to update in the present scenario. Indian J Community Med 2008; 33:50-1
11. Agrawal VK, Bhalwar R, Basannar DR. Prevalence and determinants of Hypertension in a rural community. MJAFI 2008; 64: 21-25
12. NIMS, I.C.M.R.: IDSP NCD Risk Factors Survey. Interviewers guide.
13. Gopalan C., Rama Sastri B.V. and Balasubramanian S.C. Nutritive Value of Indian Foods. 11th Ed. National Institute of Nutrition, ICMR, Hyderabad (2004).
14. I.C.M.R.: Nutrient requirements and recommended dietary allowance for Indians. NIN, Hyderabad (1989).
15. JNC VII Express: Prevention, detection, evaluation and treatment of high blood pressure. In: http://www.nhlbi.nih.gov/ guidelines /hypertension/express.pdf; 2003. Accessed on 15th November 2009.

16. Physical status: The use and interpretation of anthropometry. Technical report series. Geneva: World Health Organization; 1995. Report No.: 854.
17. Steering Committee of the WHO Western Pacific Region, IASO & IOTF. The Asia-Pacific perspective: Redefining obesity and its treatment. Australia: 2000.
18. Webb G. Nutrition: A health promotion approach. 2002:186.
19. Hypertension study Group. Prevalence, Awareness, treatment and control of hypertension among elderly in Bangladesh and India: a multicentric study. Bulletin of the World Health Organization, 2001, 79(6) 490-500
20. Deshmukh PR, Gupta SS, Dongre AR, Bharambe MS, Maliye C, Kaur S, Garg BS. Relationship of anthropometric indicators with blood pressure levels in rural Wardha. Indian J Med Res2006; 123: 657-664
21. Hazarika N C, Mahanta J, Shah B, Kalita H C, Biswas D. Study on hypertension and CHD in Mizoram. ICMR 2003 – 2006:12-13
22. Prasanth T S, Vijayakumar K.Prevalence of Systemic Hypertension among the rural residents of Kerala. Calicut Medical Journal 2008; 6(3):1-4
23. Hazarika NC, Biswas D, Mahanta J. Hypertension in the elderly population of Assam. J Assoc Physicians India 2003; 51:567-73
24. Cappell CL, Herrmann J, McGee N, Rosenfeld D. The quality of life in the Chicago Collar counties: work, family, and well-being. The Annual Meetings of the Midwest Sociological Society, St. Louis: April 6, 2001.
25. Mohan V, Shanthirani S, Deepa R, Premalatha G, Sastry NG, Saroja R. Chennai Urban Population Study (CUPS No. 4). Intra-urban differences in the prevalence of the metabolic syndrome in southern India - the Chennai Urban Population Study (CUPS No. 4). Diabet Med 2001; 18:280-7
26. Patnaik L, Sahani NC, Sahu T, Sethi S. A study on hypertension in urban slum of Brahmapur, Orissa. Journal of Community Medicine 2007; 3 (1):1-10
27. Bose K, Ghosh A, Royand S, Gangopadhyay S. Blood pressure and waist circumference: An empirical study of the effects of waist circumference on blood pressure among Bengalee male jute mill workers of Belur, West Bengal, India. J Physiol Anthropol Appl Human. 2003; Sci 22 (4): 169–173
28. Mehan MB, Srivastav N, Panya H. Profile of non communicable disease risk factors in an Industrial setting. J Postgrad Med September 2006; 52:167-73
29. Reddy K S, Katan M B. Diet, nutrition and the prevention of hypertension and cardiovascular diseases. Public Health Nutrition 2004; 7(1A):167–186.