ORIGINAL ARTICLE

Prevalence of Hypertension among Urban Poor with and without Diabetes - A Study from South India

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Abstract

Objective: Hypertension and Diabetes are considered as two leading risk factors of mortality in the world. According to an ICMR-INDIAB study, prevalence of hypertension in Tamil Nadu was higher in urban population than the rural population. Hence this study was planned to estimate the prevalence and distribution of hypertension among the urban poor with and without diabetes.

Methods: A community based cross-sectional study was conducted among two backward communities in North Chennai, Tamil Nadu. A total of 330 participants with and without diabetes, were recruited after screening 1272 subjects and self reported diabetes cases of 235. Measurement of blood pressure was done in both groups based on American Heart Association (AHA) criteria and diagnosis of diabetes was made based on the previous history of diabetes and WHO criteria.

Results: Prevalence of hypertension (Stage II) among the people with diabetes and without diabetes was reported 44.8%, and 42.6% respectively (p= 0.046). Obesity and overweight were significantly associated with prevalence of hypertension among people with diabetes (p= 0.021). Distribution of stage II hypertension among males and females were 46.2% and 42.80% respectively. There was significant gender difference in the prevalence of HTN (p = 0.043).

Conclusion: Prevalence of hypertension was found to be higher among the diabetic group compared to the non- diabetic group (44.8% vs 42.6%), though the difference between the two was not very substantial. We therefore conclude that half of the urban poor are hypertensive even if they are not diabetic.

Introduction

Hypertension (HTN) and Diabetes Mellitus (DM) are the two leading risk factors of mortality in the whole world. Hypertension occurs relatively with few symptoms and it remains largely under-detected, especially in developing countries where routine screening at health care is extremely underutilized. There is evidence that blood pressure reduction has been associated with a decreased risk of diabetes related complications.[1]

High blood pressure is reportedly accountable for 13% of deaths and high blood glucose is accountable for 6% globally.[2] Hypertension is said to kill nearly 1.5 million people in the South-East Asia region. Two third of the global hypertensive cases are living in the developing countries. It is estimated that, by 2025, there will be 1.56 billion adults living with hypertension in the world.[3] Elevated blood pressure (BP) is a major risk factor for ischemic heart disease, peripheral vascular diseases, stroke, myocardial infarction, and renal failure.[4] It is a vital global public health issue and considered as leading cause of cardiovascular diseases and premature death. According to the World Health Organization report of 2011, 32.5% of the Indian population were reported to have high blood pressure. Almost equal prevalence was reported in men and women, 33.2% and 31.7% respectively.[5] Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) study reported that overall prevalence of hypertension in India was 26.3% and the state wise prevalence of hypertension in Tamil Nadu was 31.5% in 2014.[6] Additionally there is an increasing prevalence of hypertension in the Indian population, especially among the urban population.[7] Study from Nepal reported that higher prevalence of hypertension was observed among people with low educational status.[8] Also there is evidence that prevalence of hypertension and poor treatment of hypertension was higher among people in the lower socioeconomic strata, and especially in the lower occupational categories.[9,10] Contradictory to above studies, a multicentric study from India reported that there is a correlation between higher educational status and prevalence of hypertension in elderly people.[11] Also there are various studies report that prevalence of hypertension was significantly associated with high socioeconomic status.[12,13]

Various studies have reported that high blood pressure increase the risk of long-term micro and macro vascular complications such as heart disease, stroke, kidney failure, peripheral vascular disease, and can cause death among people with type 2 diabetes mellitus.[14,15] The Twin Epidemic (SITE) Study by R.J. Shashank et.al reported that existence of hypertension as higher among diabetic patients (59.3%) than the non-diabetic subjects (39%).[16] Similar studies reported of a high prevalence of hypertension in diabetes than non-diabetes.[17,18] Also it was found that control of hypertension slows down the progression of diabetic complications.[19,20] Recommendations from American Diabetes Association and the European Association for the Study of Diabetes noted that destructive

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Table 1: Demographic and clinical details

	DM	Non-DM	p value
Mean age (years)	44.16 ± 8.2	43.6 ± 11.6	0.613
Female	125 (75.8%)	125 (75.8%)	1.00
Male	40 (24.2%)	40 (24.2%)	
Smoking			
Current smoker	6 (3.6%)	3 (1.8%)	0.279
Ex-smoker	8 (4.8%)	1 (0.6%)	
Never	151 (91.5%)	161 (97.6%)	0.190
Alcoholism			
Current user	10 (6.1%)	9 (5.5%)	0.712
Ex-user	11 (6.7%)	6 (3.6%)	0.187
Never	140 (84.8%)	150 (90.9%)	
Mean BMI	26.3 ± 5	27.9 ± 6	0.009
Mean systolic BP	133.7 ± 16.6	127.6 ± 18.6	0.002
Mean diastolic BP	86.5 ± 10.4	85.5 ± 14	0.452
Previous history HTN	46 (27.9%)	27 (16.4%)	0.013
Abnormal waist circumference male	2 (5%)	1 (2.50%)	
Abnormal waist circumference female	79 (63.2%)	78 (62.4%)	

Table 3: Prevalence of hypertension and obesity among diabetic and non-diabetic population

	DM n (%), *p value	Non-DM n (%), *p value
Prevalence of hypertension		
Normal blood pressure	20 (12.10%)	36 (21.80%)
Elevated blood pressure	7 (4.20%)	9 (5.50%) * 0.558
Stage I hypertension	64 (38.80%)	50 (30.30%) * 0.012
Stage II hypertension	74 (44.80%)	70 (42.40%) * 0.046
Gender difference		
Male & Female		
Normal blood pressure	2 (5.0%), 18 (14.40%)	5 (12.5%),31 (24.8%)
Elevated blood pressure	1 (2.5%), 6 (4.80%) *0.756	2 (5.0%), 7 (5.6%) *0.537
Stage I hypertension	19 (47.5%), 45 (36%) *0.075	14 (35.0%), 36 (28.8%) *0.119
Stage II hypertension	18 (45.0%), 56 (44.8%) *0.164	19 (47.5%), 51 (40.8%) *0.122
Obesity		
Under weight	5 (3%)	6 (3.6%) *0.532
Normal BMI	29 (17.6%)	23 (13.9%)
Overweight	35 (21.2%)	23 (13.9%) *0.627
Obesity	96 (58.2%)	113 (68.5%) *0.203

p ≤ 0.05 is considered as significant

management of cardiovascular risk factors, which include high blood pressure and obesity, may be even more beneficial in patients with T2DM because of their increased risk of cardiovascular morbidity and mortality.[21]

This study attempts to find out the prevalence of hypertension among diabetic and non-diabetic urban poor.

Methods

This community based cross-sectional study was conducted among two backward communities (Panamarathotty and Jeevarathnam nagar) in North Chennai, Tamil Nadu. A total of 1272 apparently healthy individuals in the age group of 20-80 years were screened for diabetes with Indian diabetes Risk Score (IDRS) and 235 confirmed diabetes cases were reported during the screening. The diagnosis of diabetes was made based on the following criteria. Fasting venous blood sample was collected and 2-hour 75 g Oral Glucose Tolerance Test (OGTT) was performed for selected participants. Self-reported diabetes cases and those who tested positive on OGTT (≥126 mg/dl - fasting or ≥ 200 mg/dl - 2 hour) were considered as diabetics and the fasting value <110 mg/dl and two- hour value < 140 mg/dl or IDRS risk score less than 30 or random blood sugar less than 120 mg/dl were considered as non-diabetics.[22,23] Pre-diabetics and pregnant women were excluded from the study.

The study participants were categorized into two groups, Group-1 being subjects with diabetes (DM) and Group-2; subjects without diabetes (Non-DM). Sampling was done based on the list of diabetic and non-diabetic patients obtained from the total screening. Every 2nd patient from the diabetic list and every 7th patient from the non-diabetic list were randomly selected. Sample size was calculated based on a pilot study done among the existing population which found that 50% of the diabetics and 35% of non-diabetics were hypertensive. Using two sample proportion formula, (95% confidence level, 80% power, proportion of hypertension in group I being 50% and group II being 35%); the estimated sample size came to 167. A total of 330 participants have been recruited for two groups with 165 subjects in each. Blood Pressure was measured in both groups using OMRON automatic blood pressure monitor (HEM-7111). AHA 2017 guidelines were used to diagnose the hypertension.[24]

Structured interview schedule was prepared and informed written consent was obtained from the participants. Each participants were interviewed by trained field investigator and data on socio demographic details such as age, gender, behavioural risk factors such as smoking, alcoholism, anthropometric measurements such height,weight, waist circumference were collected. Body Mass Index (BMI) was classified based on the Asian-Pacific cutoff points.[25] The study was conducted between February and July 2018. The study was approved by the institution's ethics committee.

Statistical Analysis

Data were entered in MS Excel and statistical analysis was done using SPSS software version 20. Mean and standard deviation were used for reporting continuous variable and frequencies were used for categorical variables. Chi square test and t-test were used to test statistical significance. Binary logistic regression was done to identify the association with hypertension and its risk factors. In which blood pressure >140/90 and <140/90 was dependent variable and age, diabetic status, gender, behavioural habits, body mass index, waist circumference were independent variables. A p value of less than 0.05 was considered as statistically significant.

Results

Data of 330 participants with and without diabetes (165 DM and 165 Non-DM) were analyzed in this study. Mean age of the DM subjects was 44.16±8.2 and Non-DM was 43.6±11.6. Age was comparable in both groups (p= 0.613). Male female ratio was similar in both groups 40:125. Regarding the behavioural risk factors, majority of the participants reported they did not have any behavioural risk habits such as smoking or alcoholism. BMI was found higher among non-diabetic group compared to diabetic group 27.9±6 and 26.3±5 respectively (p=0.009). There was significant difference in the systolic pressure of both groups. Higher systolic blood pressure was seen people with diabetes than people

Table 2: Prevalence and distribution of hypertension among total population

Variables	n (%)		p values
Prevalence of hypertension			
Normal blood pressure	56 (17.0%)		
Elevated blood pressure	16 (4.8%)		
Stage I hypertension	114 (34.5%)		
Stage II hypertension	144 (43.6%)		
Distribution of hypertension	**Male**	**Female**	
Normal blood pressure	7 (8.80%)	49 (19.6%)	
Elevated blood pressure	3 (3.80%)	13 (5.2%)	0.523
Stage I hypertension	33 (41.30%)	81 (32.4%)	0.017
Stage II hypertension	37 (46.2%)	107 (42.8%)	0.043

$p \leq 0.05$ is considered as significant.

without diabetes (p=0.002). However diastolic pressure was found similar in both groups (p=0.452). Among the total participants 27.9% of diabetics and 16.4% of the non-diabetics reported a previous history of hypertension. Abnormal waist circumference was found more among females than males. In both the groups 95% of the males had normal waist circumference (<102 cm) and among females 63.20% diabetics and 62.40% non-diabetics were reported abnormal waist circumference (>88 cm). Details are shown in Table 1.

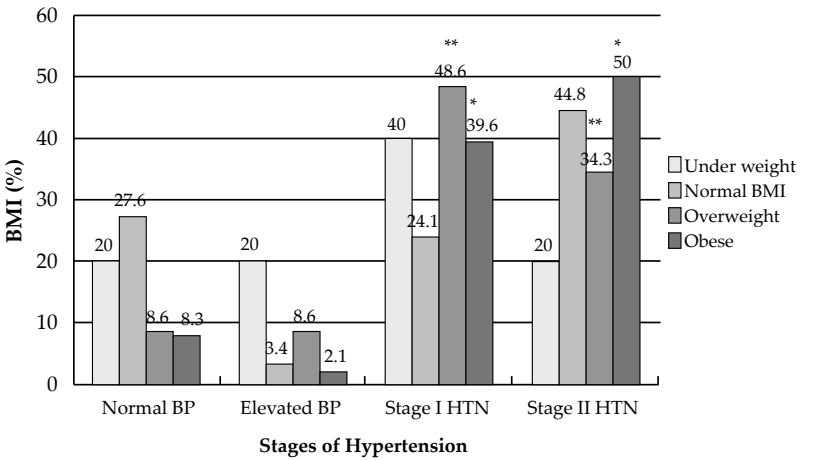
Prevalence and Distribution of Hypertension

According to AHA 2017 classification, prevalence of stage II HTN among total population was 43.6%. Out of this 44.8% were diabetic and 42.4% were non-diabetic. There was significant difference in the prevalence of HTN among diabetic and non-diabetic subjects (p= 0.046), despite a small difference in the percentage between the two. Prevalence of hypertension was found more among males than the females. Stage 1 hypertension was reported among 41.30% males and 32.40% females (p=0.017), Stage II hypertension was reported among 46.30% of the males and 42.80% females (p= 0.043). There was significant gender difference in prevalence of HTN. Among the diabetic subjects, 45% males were hypertensive and 44.80% of the females were hypertensive and among non-diabetic subjects, 47.50% males were hypertensive and 40.80% of the females were hypertensive (Tables 2 and 3).

Table 4: BMI and hypertension

Body Mass Index (BMI)	Normal BP	Elevated BP	Stage 1 HTN	Stage II HTN	Total
Under weight <18.5	4 (33.3)	1 (8.3)	3 (25.0)	4 (33.3)	12 (3.6)
Normal 18.5-22.9	15 (29.4)	1 (2.0)	15 (29.4)	20 (39.2)	51 (15.4)
Overweight 23-24.9	7 (12.1)	6 (10.3)	26 (44.8)	19 (32.8)	58 (17.5)
Obese ≥25	30 (14.4)	8 (3.8)	70 (33.5)	101 (48.3)	209 (63.3)

Values are n (%)



*p=0.021, **p=0.245, compared with Stage II hypertension. *p=0.005, **p=0.015, compared with Stage I hypertension. $p \leq 0.05$ is considered as significant.

Fig. 1 : BMI and hypertension among diabetic group

Prevalence of Obesity

Prevalence of obesity (≥25 kg/m^2) reported among urban poor was 63.3% (Table 4). Prevalence was found to be similar in both diabetic and non-diabetic groups (58.2% vs 68.5%). Details are shown in Table 3.

Association with Obesity and Hypertension

Among the total obese subjects 48.3% were stage II hypertensive and 33.5% were stage I hypertensive. Among the overweight category 32.8% stage II hypertensive and 44.8% were stage I hypertensive (Table 4).

Among the diabetic group, obesity was associated with stage II hypertension (p= 0.021) but among the non-diabetic group, obesity was not associated with stage II hypertension (p=0.129). Similarly, in diabetic group obesity and overweight were associated with stage I hypertension (p= 0.005, p= 0.015) but in non-diabetic subjects there was no significant association with hypertension and obesity or overweight.

In the diabetic subjects, 50% of the hypertensive (stage II) were obese, and in non-diabetic subjects, 46.9% of the hypertensive (stage II) were obese. Likewise in the diabetic group 34.3% of the hypertensive (stage II) were overweight and 30.4% hypertensive (stage II) were overweight in the non-diabetic group. Details are shown in Figures 1 and 2.

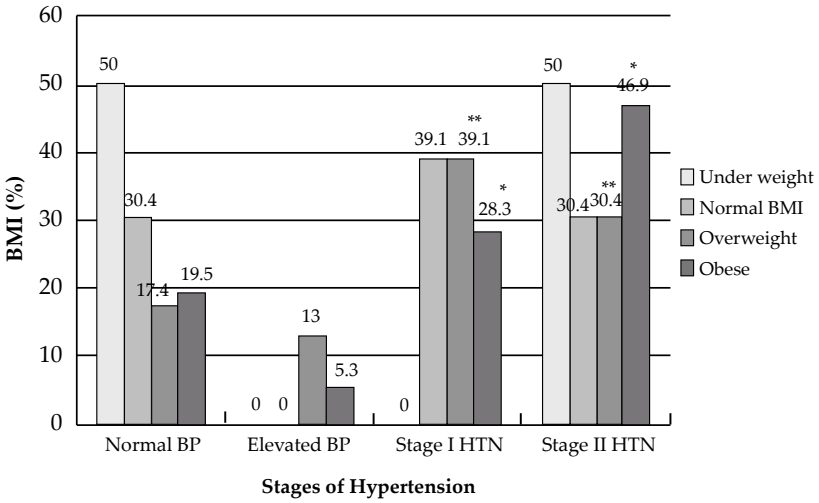
Association with various risk factors and hypertension

Binary logistic regression analysis showed that age, alcohol consumption, body mass index were significantly associated with prevalence of hypertension. Gender, history of diabetes waist circumference were not significantly associated with prevalence of hypertension (Table 5).

Discussion

The cross-sectional study of prevalence of hypertension among urban poor revealed that there is a greater risk of developing hypertension even if they are not diabetic. Many studies had reported that prevalence of hypertension is associated with socio-economic status, especially higher socio-economic status.[10-13] However, this statement is no longer true.

The present study reported that overall prevalence of hypertension among urban poor was 43.60%, this prevalence is more or less equal to TWIN epidemic study (2010) by Joshi SR et al which had reported 46.0%



*p=0.129, **p=0.495, compared with stage II hypertension, *p=0.830, **p=0.473, compared with stage I hypertension; p ≤ 0.05 is considered as significant.

Fig. 2: BMI and hypertension among non-diabetic group

Table 5: Results of binary logistic regression dependent variable BP<140/90 vs >140/90

Significant variables	β	S.E.	Odds ratio	P value
Age (years)	-0.042	0.012	0.958 (0.936-0.982)	0.001
Status Of Diabetes	0.387	0.240	1.473(0.921-2.356)	0.106
Gender	0.136	0.323	1.145 (0.608-2.157)	0.675
Smoking habits	-0.127	0.369	0.881 (0.427-1.816)	0.730
Alcoholism	0.607	0.288	1.835 (1.044-3.225)	0.035
Tobacco usage	-1.094	0.598	0.335 (0.104-1.081)	0.067
Body Mass Index	-0.761	0.206	0.467 (0.312-0.699)	<0.0001
Waist Circumference (Male)	0.390	0.415	1.478 (0.655-3.332)	0.347
Waist Circumference (Female)	0.365	0.306	1.440 (0.790-2.625)	0.234

p ≤ 0.05 is considered as significant

prevalence of hypertension.[16] A Study on Chennai Urban Population Study (CUPS) 2003 revealed that prevalence of hypertension among general population was 21.1%. Also in the Chennai Urban Rural Epidemiology Study (CURES) 2007, prevalence of hypertension was reported 20%. Both studies were conducted in a 5 years gap, but there is not much change in the prevalence of hypertension among the Chennai population.[26,27] But the prevalence of hypertension among urban poor of the same city was reported as having doubled among the general population in the last 10 years.

ICMR- INDIAB study reported that 31.5% of urban populations of Tamil Nadu are hypertensive. Hypertension was significantly higher among urban residence than the rural residence in Tamil Nadu.[6] The present study reported that prevalence of HTN was more among people with diabetes than non-diabetes, however a study from US reports that hypertension was seen in 50% of the people with diabetes than the people without diabetes.[28]

A study from India reported that prevalence of hypertension was higher among women in the urban areas as compared to rural areas. The same study also reported that significant determinants of hypertension among urban population were, place of living, high dietary fat, low fiber intake and obesity.[7] In the present study prevalence of hypertension was more among men compared to women. Also we found that majority (63%) of the urban poor were obese and 17.5% are overweight. A study by Vigneswari et al reported that prevalence of obesity was 57.3% among urban poor (2015).[29] The present study found that obesity and hypertension were statistically significant among people with diabetes, where as in non-diabetics; obesity and hypertension were statistically not significant. A study from south India reported that intake of salty food and adding additional salt to meal was significantly associated with increased risk of pre-hypertension. Those who are taking salty food daily/weekly twice or thrice/occasionally were found with high probability of getting hypertension as compared to those who did not take salty food.[30]

Conclusion

Hypertension is highly prevalent among urban poor. Prevalence was found to be higher among people with diabetes than the people without diabetes, though the difference between the two was not very substantial. Prevalence of hypertension was significantly associated with obesity in people with diabetes but obesity was not associated with people without diabetes. Then why the non-diabetic urban poor are hypertensive? There is the need to do further research among the urban poor in the area of vascular diseases, dietary habits, psychosocial factors such as stress and sleep apnea which are considered common causes for hypertension.

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References

1. UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macro-vascular and microvascular complications in type 2 diabetes: UKPDS 38. *BMJ* 1998; 317:703–13.
2. World Health Organization: Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. [internet] [Updated 2010 December ; cited 2018 July 24] Available from: www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf.
3. World Health Organization. Hypertension.Factsheet [Internet]. [cited 2018 July 7]. Available from: http://www.searo.who.int/entity/noncommunicable_diseases/media/non_communicable_diseases_hypertension_fs.pdf?ua=1.
4. Whitworth JA: World Health Organization (WHO) 2003/ International Society of Hypertension (ISH) statement on management of hypertension. *J Hypertens* 2003; 21:1983–92.
5. World Health Organization. Noncommunicable disease country profile 2014. [Internet] [cited 2018 July 17]. Available from: http://www.who.int/nmh/countries/ind_en.pdf?ua=1.
6. Bhansali A, Dhandania VK, Deepa M, Anjana RM, Joshi SR, Joshi PP, et al. Prevalence of and risk factors for hypertension in urban and rural India: the ICMR–INDIAB study. *J Hum Hypertens* 2015; 29:204–9.
7. Gupta R, Gupta VP. Hypertension epidemiology in India: lessons from Jaipur Heart Watch. *Curr Sci* 2009; 97:349–55.
8. Sharma SK, Ghimire A, Radhakrishnan J, Thapa L, Shrestha NR, Paudel N, et al. Prevalence of hypertension, obesity, diabetes, and metabolic syndrome in Nepal. *Int J Hypertens* 2011; 2011:1-8.
9. Lang T, Degoulet P, Ménard J. Socio-economic influences on treatment.In: Buhler FR, Laragh JH, ed. Handbook of Hypertension: The Management of Hypertension, vol 13. Amsterdam: Elsevier Science Publishers BV; 1990; 411-24.
10. Gaudemaris RD, Lang T, Chatellier G, Larabi L, Lauwers-Cancès V, Maitre A, et al.Socioeconomic inequalities in

hypertension prevalence and care, The IHPAF Study. *Hypertension* 2002; 39:1119-25.

11. Hypertension Study Group. Prevalence, awareness, treatment and control of hypertension among the elderly in Bangladesh and India: a multicentric study. *Bulletin of the World Health Organization* 2001; 79:490-98.
12. Kokiwar PR, Gupta SS, Durge PM. Prevalence of hypertension in a rural community of central India. *J Assoc Physicians India* 2012; 60:26-9.
13. Malhotra P, Kumari S, Kumar R, Jain S, Sharma BK. Prevalence and determinants of hypertension in an un-industrialised rural population of North India. *J Hum Hypertens* 1999; 13:467-72.
14. Nakano S, Ito T, Furuya K, Tsuda S, Konishi K, Nishizawa M, et al. Ambulatory blood pressure level rather than dipper/non dipper status predicts vascular events in type 2 diabetic subjects. *Hypertens Res* 2004; 27:647–56.
15. Stratton IM, Cull CA, Adler AI, Matthews DR, Neil HA, Holman RR. Additive effects of glycaemia and blood pressure exposure on risk of complications in type 2 diabetes: a prospective observational study (UKPDS 75). *Diabetologia* 2006; 49:1761-69.
16. Joshi SR, Saboo B, Vadivale M, Dani SI, Mithal A, Kaul U et al. Prevalence of diagnosed and undiagnosed diabetes and hypertension in India-results from the Screening India's Twin Epidemic (SITE) Study. *Diabetes Technol Ther* 2012; 14: 8-15.
17. Veientlena S, Prabu P. Prevalence of hypertension and determination of its risk factors In Korangrapady, Udupi District, Coastal Karnataka, India. *Asian J Pharm Clin Res* 2018; 11:517-21.
18. Gopalakrishnan S, Rama R, Savitha A K.Determinants of hypertension among urban adult population in Kancheepuram district of Tamil Nadu. *Int J Community Med Public Health* 2017; 4:1552-57.
19. Schrier RW, Estacio RO, Esler A, Mehler P. Effects of aggressive blood pressure control in normotensive type 2 diabetic patients on albuminuria, retinopathy and strokes. *Kidney Int* 2002; 61:1086–97.
20. SPRINT Research Group, Wright JT Jr, Williamson JD, Whelton PK, Snyder JK, Sink KM, et al. A randomized trial of intensive versus standard blood-pressure control . *N Engl J Med* 2015; 373:2103-16. doi: 10.1056/NEJMoa1511939.
21. Whelton PK, Carey RM, Aronow WS, Casey DE Jr., Collins KJ, Dennison Himmelfarb C, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/ AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2017; S0735-1097:41519-1.
22. Report of a WHO/IDF Consultation. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia. [cited 2018 Sep 24] Available from: http://www.who.int/diabetes/publications/Definition%20and%20diagnosis%20of%20diabetes_new.pdf.
23. Mohan V, Deepa R, Deepa M, Somannavar S, Datta M. A Simplified Indian Diabetes Risk Score for Screening for Undiagnosed Diabetic Subjects. *J Assoc Physicians India* 2005; 53:759-62.
24. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C,et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA. Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults. A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension* 2018; 71:1269-324. doi:10.1161/HYP.0000000000000066.
25. Lim JU, Lee JH, Kim JS, Hwang YI, Kim TH, Lim SY, et al. (2017). Comparison of World Health Organization and Asia-Pacific body mass index classifications in COPD patients. *Int J Chron Obstruct Pulmon Dis* 2017; 12:2465-75. doi:10.2147/COPD.S141295.
26. Shanthirani CS, Pradeepa R, Deepa R, Premalatha G, Saroja R, Mohan V. 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.
27. 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). *J Assoc Physicians India* 2007; 55:326-32.
28. Sowers JR, Epstein M, Frohlich ED. Diabetes, hypertension, and cardiovascular disease: an update. *Hypertension* 2001; 37:1053–59.
29. Vigneswari A , Manikandan R , Satyavani K, Archana S, Rajeswari R, Viswanathan V. Prevalence of Risk Factors of Diabetes Among Urban Poor South Indian Population. *J Assoc Physicians India* 2015; 63:32-3.
30. Kini S, Kamath VG, Kulkarni MM, Asha Kamath A, Shivalli S. Pre-Hypertension among Young Adults (20–30 Years) in Coastal Villages of Udupi District in Southern India: An Alarming Scenario. *PLoS ONE* 2016; 11:e0154538. doi:10.1371/journal.pone.0154538.