Assessment of Medication Adherence to JNC-7 Guidelines and Risk Factors for Hypertension in a South Indian Tertiary Care Hospital

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ABSTRACT

Objective: The objective of the study was to assess the drug utilization pattern, medication adherence to Joint National Committee (JNC-7) treatment guidelines and risk factors for hypertension (HTN) in a south Indian tertiary care teaching hospital. **Methods:** A prospective study was conducted on 1000 subjects (with or without hypertension) from November 2015 to April 2016 in a general medicine department. Drug utilization pattern, medication adherence was assessed by comparing with the JNC-7 guidelines and the odds ratios were calculated in univariate regression analysis for risk factors. **Results:** Stage 1 hypertension (47.30%) was most predominant than stage 2 hypertension (24.28%) and hypertension emergency (12.23%) according to the SBP of JNC-7 guidelines. Hypertension was significantly higher in the subjects of age above 40 years (92.6%, $P < 0.0001$), married (99.6%, $P < 0.0001$), educated (59.5%, $P = 0.066$), known family history (father, $P = 0.009$; mother, $P < 0.0001$; father and mother, $P < 0.0001$), physical inactivity (74.8%, $P < 0.001$), monthly income above Rs. 10,000 (34.5%, $P < 0.0001$), co-morbidities (diabetes, $P < 0.0001$; history of cardiovascular diseases, $P < 0.0001$; chronic kidney disease, $P < 0.0001$), alcohol consumption (19.2%, $P = 0.007$), smoking (23%, $P = 0.0005$), tea consumption (twice or more per day, $P = 0.027$), and intake of junk foods (thrice or more in a week, $P < 0.0001$) than normotensive subjects. Angiotensin receptor blockers (17.98%) are most widely prescribed drugs followed by calcium channel blockers (10.07%) and ß-blockers (6.29%) in monotherapy (38.63%). Angiotensin receptor blocker + diuretic combination (24.64%) was mostly used in two drug combination therapy (36.11%). The overall rate of adherence was 24.9% (Pre hypertension, $P < 0.01$); 80.3% (Stage 1 hypertension, $P < 0.001$); 73.93% (Stage 2 hypertension, $P < 0.001$) and 50% (Hypertension emergency, $P < 0.05$). Univariate regression analysis showed that age (above 40 years), female gender, married, widowed, generalized obesity, moderate to high economic status (Above 10, 000/month), family history, diabetes, history of cardiovascular diseases, chronic kidney disease, physical inactivity, smoking, alcohol consumption and junk food (weekly thrice or more, odds ratio: 17.69, 95% confidence interval: 2.373-131.8, $P < 0.0001$) intake were significantly associated with HTN. **Conclusion:** The present study results suggested that medication adherence to JNC-7 was optimal. Junk foods, age (above 60 years), diabetes, alcohol, smoking, marital status and high economic status are the main risk factors for hypertension.
Key words: Odds Ratio, Hypertension, Risk Factors, Medication Adherence, Junk Foods, JNC-7.

INTRODUCTION

Hypertension (HTN) is a major public health problem and is a leading risk factor for non-communicable diseases globally and is responsible for 13% of global

deaths.[1,2] The age, obesity, excess salt intake, tobacco use, lack of physical activity and excess alcohol consumption are the major risk factors for HTN.[3] In adults, HTN is a major risk factor for cardiovascular disease (coronary heart disease and stroke), chronic renal disease and diabetes. Evidence from large clinical trials now suggests that lowering blood pressure effectively prevents these adverse outcomes.[4]

Many guidelines (AHA, American Heart Association; ACC, American College of Cardiology; CDC, Centers for Disease Control and Prevention; ADA, American Diabetes Association and JNC-7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; ESH, European Society of Hypertension; ESC, European Society of Cardiology) exist for the management of hypertension.[5] But the most widely used recommendations are ADA and JNC-7.[6,7] The overall principles common to these guidelines are to implement life style modifications in addition to pharmacotherapy to control BP in patients with hypertension. Patient's optimal adherence with antihypertensive drug therapy is essential for preventing serious complications with hypertension over the long term. JNC-7 guidelines are considered as the "gold standard" for the management of hypertension.

Therefore, the present study was planned to assess the medication adherence to JNC-7 guidelines and risk factors for hypertension in a south Indian tertiary teaching hospital to improve the patients care because suboptimal adherence leads to adverse clinical outcomes.

MATERIALS AND METHODS

The present prospective study was carried out at in and outpatients department of Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Vijayawada, Andhra Pradesh, South India. The study was initiated after approval by the Institutes Ethical Review Committee, KVSR Siddhartha College of Pharmaceutical Sciences (SCOPS), Vijayawada, India. KVSR SCOPS was recognized by All India Council of Technical Education (AICTE) and Pharmacy Council of India (PCI), New Delhi, Govt. of India. The protocol approval number is KVSRSCOPS/IEC/2015/002.

Selection of Participants

Patients of either sex diagnosed with or without hypertension of any duration (as per JNC-7 guidelines) and willing to participate were included in the study. A total of 1000 patients (556 patients with hypertension and 446 patients without hypertension) were enrolled in the study. Based on the JNC-7 guidelines, the hypertensive patients were classified into prehypertension (SBP, 120-139 mmHg; DBP, 80-89 mmHg), stage 1 hypertension (SBP, 140-159 mmHg; DBP, 90-99 mmHg), stage 2 hypertension (SBP, 160-179 mmHg; DBP, 100-119 mmHg) and hypertension emergency (SBP, ≥ 180 mmHg; DBP, ≥ 120 mmHg).

Data Collection

Physicians were requested to report the clinical and biochemical data not exceeding 6 months before the observation. Biochemical parameters were derived from the latest laboratory investigation reports documented in the clinical records. A total of 556 prescriptions were collected from hypertension patients. Each prescription includes the drug, quantity, duration, and date of dispensing. Each antihypertensive medication was categorized into one of the following classes: thiazide-type diuretics, angiotensin converting enzyme inhibitors (ACEIs) or angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs), β-blockers and other antihypertensive agents.

Medication Adherence was assessed by comparing with JNC-7 treatment guidelines. The information regarding sociodemographics (age, sex, marital status, education, family history of known hypertension, BMI, monthly income and co-morbid conditions) and lifestyle characteristics (residential area, alcohol consumption, smoking status, food habits, stress at work place and physical activity) were collected by interviewing the participant to identify the possible risk factor. All the relevant data were collected in a predesigned paper case record form with prior consent of the participant.

Statistical analysis

Statistical analyses were performed using SPSS version[20] (SPSS Inc., Chicago, IL, USA) and Graph Pad Prism 5.0 software (San Diego, CA). Estimates were expressed as mean $\pm$ SD. One-way analysis of variance or Student's 't'-test were used to compare groups for continuous variables and χ^2-test was used to compare proportions between the two groups. Univariate logistic regression analysis was used to examine the association between various exposures (age, gender, place of residence, generalized obesity, cigarette smoking, alcohol consumption, income status and literacy level) and outcome (HTN). P-value < 0.05 was considered significant.

Table 1: Clinical characteristics of patients with hypertension

Variable	Patients with HTN (N = 556) %
Gender	
Male	268 (48.256)
Female	288 (51.743)
Age (Years)	
Mean ± SD	57.08 ± 11.37
0-20	0
21-40	41 (7.374)
41-60	313 (56.294)
Above 61	202 (36.330)
Body weight (Kg)	
Mean ± SD	72.573 ± 13.224
Type of hypertension according to SBP as per JNC-7	
Prehypertension (120-139 mmHg)	90 (16.187)
Stage 1 hypertension (140-159 mmHg)	263 (47.302)
Stage 2 hypertension (160-169 mmHg)	135 (24.280)
Hypertension emergency (≥180 mmHg)	68 (12.230)
Type of hypertension according to DBP as per JNC-7	
Prehypertension (80-89 mmHg)	121 (21.762)
Stage 1 hypertension (90-99 mmHg)	230 (41.366)
Stage 2 hypertension (100-119 mmHg)	183 (32.913)
Hypertension emergency (≥120 mmHg)	22 (3.956)
Co-morbidities	
Diabetes mellitus	211 (38.0)
History of CVDs	13 (2.3)
Thyroid disorders	3 (0.5)
Diabetes and CVDs	51 (9.2)
Diabetes and thyroid	28 (5.0)
Diabetes and other	83 (14.9)
CVD and Other	65 (11.7)
PCOS	4 (0.7)
Chronic kidney disease	21 (3.8)
Others	45 (8.1)
Duration of hypertension (Years)	
<5	290 (52.158)
5-10	153 (27.517)
>10	113 (20.323)
Frequency of health check ups	
Monthly once	176 (31.654)
1-3 months	88 (15.827)
4-6 months	129 (23.201)
>6 months	163 (29.316)
Following HTN education	
Yes	326 (58.633)
No	230 (41.366)

HTN, Hypertension; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; CVDs, Cardiovascular Diseases; PCOS, Poly Cystic Ovarian Syndrome; SD, Standard Deviation; JNC, Joint National Committee.

RESULTS

A total of 1000 subjects (556 with hypertension and 444 without hypertension) were included in the study and the clinical characteristics of hypertension were presented in Table 1. Hypertension was significantly higher in females (51.74%) than in males (48.25%). The mean ± SD age was 57.08 ± 11.37 years and the mean ± SD body weight was 72.57 ± 13.22 Kg in hypertension. Stage 1 hypertension (47.30%) was most predominant than stage 2 hypertension (24.28%) and hypertension emergency (12.23%) according to the SBP of JNC-7 guidelines. Diabetes mellitus (38.0%) and cardiovascular diseases (11.7%) are the most common co-morbidities in hypertension patients followed by chronic kidney diseases (3.8%). Most of the patients (58.63%) are strictly following and aware of hypertension education.

Tables 2 and 3 shows the socio demographic and life style characteristics of subjects with and without HTN, respectively. The prevalence of HTN was significantly higher in females (51.8%, $P<0.05$) than in males. Hypertensive subjects were older (mean ± SD age was 57 ± 11.46 years) and had a greater BMI (>25 kg/m2, $P<0.0009$).

Hypertension was significantly higher in the subjects of age above 40 yrs (92.6%, P<0.0001), married (99.6%, $P<0.0001$), educated (59.5%, P=0.066), known family history (father, $P=0.009$; mother, $P<0.0001$; father and mother, $P<0.0001$), physical inactivity (74.8%, $P<0.001$), monthly income above Rs.10,000 (34.5%, $P<0.0001$), co-morbidities (diabetes, $P<0.0001$; history of cardiovascular diseases, $P<0.0001$; chronic kidney disease, P < 0.0001), alcohol consumption (19.2%, P=0.007), smoking (23%, P=0.0005), tea consumption (twice or more per day, P=0.027), and intake of junk foods (thrice or more in a week, P<0.0001) than normotensive subjects. Family history of known hypertension (brother and sister, P=0.881), thyroid disorders (P=1.000), PCOD (P=1.000), urban residence (P=0.319, food (vegetarian and non-vegetarian, P=0.574), coffee consumption (P=0.423), fruits (thrice or more in a week, P=0.149) and soft drinks (thrice or more in a week, P=0.171) are not significantly associated with the prevalence of hypertension.

Drug utilization pattern was assessed and presented the results in Table 4. Angiotensin receptor blockers (17.98%) are most widely prescribed drugs followed by calcium channel blockers (10.07%) and β-blockers (6.29%) in monotherapy (38.63%). Angiotensin receptor blocker + diuretic combination (24.64%) was mostly used in two drug combination therapy (36.11%). In triple combination (6.8%) therapy, the most prescribed combination was calcium channel blockers + angiotensin receptor blockers + Diuretics (3.59%). ARBs + Diuretics + β-blockers + CCBs combination (1.43%) was most prescribe combination in four drug combination therapy (2.14%). Antihypertensive medication was compared with JNC-7 guidelines for its optimal adherence and the results present in the Table 5. The overall rate of adherence was 24.9% (Pre hypertension, $P<0.01$); 80.3% (Stage 1 hypertension, $P<0.001$); 73.93% (Stage 2 hypertension, $P<0.001$) and 50% (Hypertension emergency, $P<0.05$).

Univariate regression analysis was performed to determine the odds ratios for the modifiable and no modifiable risk factors for hypertension (Table 6).

The analysis showed that age (between 40-60) years (odds ratio: 3.638, 95% confidence interval: 2.449-5.405, $P<0.0001$), age above 60 years (odds ratio: 5.689, 95% confidence interval: 3.693-8.763, $P<0.0001$), female gender (odds ratio: 1.287, 95% confidence interval: 1.002-1.653, P=0.048), married (odds ratio: 13.13, 95% confidence interval: 3.059-56.31, $P<0.0001$), widowed (odds ratio: 101.5, 95% confidence interval: 15.55-662.3, $P<0.0001$), BMI (odds ratio: 1.529, 95% confidence interval: 1.189-1.967, P=0.0009), moderate to high economic status (odds ratio: 4.677, 95% confidence interval: 3.281-6.666, $P<0.0001$), family history (father, odds ratio: 1.698, 95% confidence interval: 1.150-2.507, P=0.009; mother, odds ratio: 2.816, 95% confidence interval: 1.675-4.732, $P<0.0001$; both mother and father, odds ratio: 3.238, 95% confidence interval: 1.747-6.001, $P<0.0001$), diabetes mellitus (odds ratio: 6.695, 95% confidence interval: 4.038-11.10, $P<0.0001$), history of cardiovascular diseases (odds ratio: 3.830, 95% confidence interval: 1.393-10.53, P=0.006), co-existence of diabetes and thyroid (odds ratio: 2.750 95% confidence interval: 1.357-5.572, P=0.007), chronic kidney disease (odds ratio: 10.83, 95% confidence interval: 3.429-34.19, $P<0.0001$), physical inactivity (odds ratio: 1.906, 95% confidence interval: 0.930-1.538, $P<0.0001$), smoking (odds ratio: 1.809, 95% confidence interval: 1.298-2.520, P=0.0005), alcohol consumption (odds ratio: 1.618, 95% confidence interval: 1.141-2.294, P=0.0076) and junk food (weekly thrice or more) intake (odds ratio: 17.69, 95% confidence interval: 2.373-131.8, $P<0.0001$) were significantly associated with HTN.

Table 2: Sociodemographic characteristics of patients with and without hypertension.			
Variable	Patients without HTN (N = 444) n (%)	Patients with HTN (N = 556) n (%)	P-value[a]
Gender			
Male	242 (54.5)	268 (48.2)	Ref
Female	202 (45.5)	288 (51.8)	0.048
Age			
Mean ± SD	52.621 ± 6.485	57 ± 11.46	0.03
Below 40 years	112 (25.2)	41 (7.4)	Ref
Above 40 years	332 (74.8)	515 (92.6)	<0.0001
Marital Status			
Unmarried	21(4.7)	02 (0.4)	Ref
Married	423 (95.3)	554 (99.6)	<0.0001
Education			
Uneducated	154 (34.7)	225 (40.5)	Ref
Educated	290 (65.3)	331 (59.5)	0.066
Family History			
No family history	339 (76.3)	344 (61.9)	Ref
Father	47 (10.6)	81 (14.5)	0.009
Mother	21 (4.7)	60 (10.8)	<0.0001
Brother & sister	23 (5.2)	25 (4.5)	0.881
Father & mother	14 (3.2)	46 (8.3)	<0.0001
Body mass index (BMI)			
<25 kg/m2	260 (58.6)	267 (48.0)	Ref
>25 kg/m2	184 (41.4)	289 (52.0)	<0.0009
Nature of work			
Physically inactive	42 (9.4)	73 (13.1)	Ref
Daily labour	78 (17.6)	100 (18.0)	0.226
House wife	140 (31.5)	197 (35.4)	0.379
Private job	118 (26.6)	118 (21.2)	0.022
Business	27 (6.1)	11 (2.0)	0.0003
Govt job	39 (8.8)	57 (10.3)	0.571
Socioeconomic status			
Lower class	399 (89.9)	364 (65.5)	Ref
Upper class	45 (10.1)	192 (34.5)	<0.0001
Co-morbidities			
No	66 (14.9)	32 (5.8)	Ref
Diabetes mellitus	65 (14.6)	211 (38.0)	<0.0001
History of CVDs	7 (1.6)	13 (2.3)	0.010
Thyroid disorders	6 (1.3)	3 (0.5)	1.000
Diabetes and CVDs	53 (11.9)	51 (9.2)	0.022
Diabetes and thyroid	21 (4.7)	28 (5.0)	0.007
Diabetes and other	98 (22.1)	83 (14.9)	0.041
CVD and Other	10 (2.3)	65 (11.7)	<0.0001
PCOS	8 (1.8)	4 (0.7)	1.000
Chronic kidney disease	4 (0.9)	21 (3.8)	<0.0001
Others	106 (23.9)	45 (8.1)	0.674

Table 3: Life style characteristics of patients with or without hypertension.			
Variable	Patients without HTN (N = 444) n (%)	Patients with HTN (N=556) n (%)	P-value[a]
Residential area			
Rural	294 (66.2)	351 (63.1)	Ref
Urban	150 (33.8)	205 (36.9)	0.319
Drinking of Alcohol			
No	387 (87.2)	449 (80.8)	Ref
Yes	57 (12.8)	107 (19.2)	0.007
Smoking Status			
No	381 (85.8)	428 (77.0)	Ref
Yes	63 (14.2)	128 (23.0)	0.0005
Food Habits (Diet)			
Vegetarian	36 (8.1)	51 (9.2)	Ref
Mixed (Vegetarian & Non-vegetarian)	408 (91.9)	505 (90.8)	0.574
Frequency of taking Tea per day			
Not even once	142 (32.0)	146 (26.3)	Ref
Once	80 (18.0)	94 (16.9)	0.502
Twice or more	222 (50.0)	316 (56.8)	0.027
Frequency of taking coffee per day			
Not even once	352 (79.3)	417 (75.0)	Ref
Once	44 (9.9)	71 (12.8)	0.133
Twice or more	48 (10.8)	68 (12.2)	0.423
Frequency of taking Fruits per week			
Not even once	38 (8.6)	67 (12.1)	Ref
Once	111 (25.0)	141 (25.3)	0.195
Twice	145 (32.6)	164 (29.5)	0.068
Thrice or more	98 (22.1)	120 (21.6)	0.149
Occasionally	52 (11.7)	64 (11.5)	0.218
Frequency of Soft drinks per week			
Not taking	279 (62.8)	386 (69.4)	Ref
Once	41 (9.2)	31 (5.6)	0.017
Twice	07 (1.6)	15 (2.7)	0.386
Thrice or more	03 (0.7)	11 (2.0)	0.171
Occasionally	114 (25.7)	113 (20.3)	0.036
Frequency of Junk foods per week			
Not taking	213 (48.0)	289 (52.0)	Ref
Once	112 (25.2)	93 (16.7)	0.003
Twice	19 (4.3)	26 (4.7)	1.000
Thrice and more	01 (0.2)	24 (4.3)	<0.0001
Occasionally	99 (22.3)	124 (22.3)	0.626
Stress at work place			
No	159 (35.8)	191 (34.4)	Ref
Yes	285 (64.2)	365 (65.6)	0.640
Physical Activity			
Active	196 (44.1)	140 (25.2)	Ref
Inactive	248 (55.9)	416 (74.8)	<0.0001

Table 4: Drug utilization pattern of antihypertensive agents in mono and combination therapies.

Therapy	N, (%)
Monotherapy	**269 (38.63)**
Angiotensin Receptor Blockers (ARBs)	100 (17.98)
Calcium Channel Blockers (CCBs)	56 (10.07)
β-blockers	35 (6.29)
Diuretics	13 (2.33)
α-agonists	6 (1.07)
Angiotensin Converting Enzyme (ACE) Inhibitors	5 (0.89)
Double Combination	**201 (36.11)**
ARBs + Diuretics	137 (24.64)
ARBs + β-blockers	21 (3.77)
CCBs + β-blockers	20 (3.59)
ARBs + CCBs	11 (1.97)
β-blockers + Diuretics	8 (1.43)
ACE Inhibitors + Diuretics	4 (0.71)
Triple Combination	**38 (6.8)**
CCBs + ARBs + Diuretics	20 (3.59)
ARBs + Diuretics + Diuretics	8 (1.43)
ARBs + Diuretics + β-blockers	8 (1.43)
CCBs + Diuretics + β-blockers	2 (0.35)
Four Drug Combination	**12 (2.14)**
ARBs + Diuretics + β-blockers + CCBs	8 (1.43)
Diuretics + CCBs + ARBs + Diuretics	4 (0.71)
Combination with other drugs	**85 (15.2)**

DISCUSSION

HTN currently affects about one billion people worldwide[8] and it is estimated that this could increase to 1.56 billion people by 2025.[9] Most of the developing countries including India report a marked increase in the prevalence of HTN.[10] India already has the second largest number of people in the world with diabetes[11] and the prevalence of HTN is also rising.[12] Hypertension depends on the gender of the patient. Zhao *et al.* (2015) reported that the prevalence of hypertension was slightly higher in females (52%, P=0.978) than in males (42%).[13] Another study results are correlated with Zhao *et al.* (2015). They reported that the prevalence was higher in females (14.3%, P=0.81) than in males (13.8%).[14] In the present study also the hypertension prevalence was significantly higher in females (51.8%, P=0.048) than in males (48.2%). There is a direct proportional relationship between the increase in age and the presence of hypertension. Previous studies reported that the hypertension prevalence was at 45.5 ± 16.1 and 54 ± 15 years, respectively.[15,16] In the present study the mean ± SD age was 57 ± 11.46 years in hypertension (P=0.03).

Arjun *et al.* (2014) reported that the prevalence of hypertension was significantly higher in married people (81.6%) when compared to unmarried.[17] Hypertension prevalence was higher in married people in the present study (99.6%, P<0.0001). The prevalence of hypertension was higher in literates.[17,18] The present study results also agreed that prevalence was higher in education (above 10th standard, 59.5%). Family history plays a major role in the prevalence of hypertension.[19] The prevalence was higher with known family history in the present study (8.3%, P<0.001). Bhansali *et al.* (2015) reported that the prevalence of hypertension was higher in BMI (>25 kg/m).[1] In the present study also the prevalence was higher in BMI (>25 kg/m², P<0.0009). Hypertension prevalence was higher in upper class people (18.9%, P<0.001) when compared to lower class (7.8%).[18] The present study results revealed that the hypertension was more prevalent in upper class people (34.5%, P<0.001). Hypertension prevalence was significantly higher in diabetes (25.6%, P<0.0001) and cardiovascular (17.1%, P<0.001) diseases.[16] Another study also supported that the diabetes (24.6%) and cardiovascular diseases (4.9%) are sig-

nificantly associated with hypertension.[20] The present study results also revealed that the hypertension prevalence was higher in diabetes (38%, $P<0.0001$) and cardiovascular (11.7%, $P<0.0001$).

The prevalence of hypertension was higher in urban population when compared to rural in India. Alcohol was significantly associated with the prevalence of hypertension in India.[1] MacMohan *et al* (1987) reported that the significant increase of blood pressure over time in heavy alcohol consumers[21] while in the present study, the prevalence of hypertension was higher in alcoholics (19.2%, $P<0.007$) compared to non-alcoholics (12.8%). Bhansali *et al.* (2015) reported that the hypertension prevalence was higher in smokers in India.[1] Smoking (10.2%, $P<0.05$) was significantly associated with hypertension.[20] In the present study, the prevalence of hypertension was significant in smokers (23.0%, $P=0.0005$) when compared to non-smokers (14.2%). Mixed diet people (99.4%) are significantly associated with the hypertension prevalence when compared to vegetarians.[17] About 90.8% hypertensive patients are mixed diet people in the present study. Tea and coffee are not significantly associated with the prevalence of hypertension.[22] In the present study also these are not significantly associated with hypertension. Fruits and soft drinks are significantly associated with the prevalence of hypertension.[23] But in the present study these are not significantly associated with the hypertension prevalence.

The overall goal of treating hypertension is to reduce hypertension associated morbidity and mortality.[24] The Seventh Report of the JNC on the Detection, Evaluation, and Treatment of High Blood Pressure is the most prominent evidence-based clinical guideline for the management of hypertension, supplemented by the 2007 American Heart Association (AHA) Scientific Statement on the treatment of hypertension. As per 2007 AHA guidelines, ACEIs, ARBs, CCBs, thiazide diuretic, or a two-drug combination are recommended for first-line therapy for stage 1 and stage 2 hypertension.[25] This is in contrast to the JNC-7 guidelines that placed preference on using a thiazide diuretic over other agents for most patients, and also included a β-blocker as a potential first-line option followed by ACEIs, ARBs, CCBs, and thiazide diuretics.[26] The overall rate of adherence was 24.9% (Pre hypertension, $P<0.01$); 80.3% (Stage 1 hypertension, $P<0.001$); 73.93% (Stage 2 hypertension) and 50% (Hypertension emergency) in the present study. Previous studies show that a simple evidence-based guideline appears to be effective in raising the quality of antihypertensive ther-

apy in United States of America[27] and China.[28] The present study results revealed that the physicians in south Indian hospitals are strictly following the evidence based guidelines (JNC-7) to improve the patient care like America and China.

Age is the major risk factor for hypertension. Reddy *et al.* reported that the prevalence of hypertension was significantly associated with the age above 40 years (odds ratio: 30.2, 95% confidence interval: 26.3-34.1).[29] The present study results also suggested that the age above 40 years was the significant risk factor for hypertension (odds ratio: 3.368, 95% confidence interval: 2.449-5.405, $P<0.0001$). Marriage is the significant risk factor in hypertension. Married people (odds ratio: 13.462, 95% confidence interval: 1.818-100, $P=0.011$) are extremely associated with hypertension when compared to unmarried people.[30] The present study results are also supported that married people (odds ratio: 13.13, 95% confidence interval: 3.059-56.31, $P<0.0001$) are more risk at hypertension. Being widower (odds ratio: 3.20, 95% confidence interval: 1.05-3.35) is the significant risk factor for hypertension.[31] Panesar *et al.* reported that the widowed are significantly associated with the hypertension (odds ratio: 14.86, 95% confidence interval: 1.187-200, $P=0.036$).[30] The present study results also revealed that the risk (odds ratio: 101.5, 95% confidence interval: 15.55-662.3, $P<0.0001$) was significantly higher the widowed of south Indian population.

Literate (odds ratio: 0.83, 95% confidence interval: 0.70-0.99, $P=0.03$) was not significantly risk factor of hypertension.[32] In the present study also it was not significantly associated with the hypertension (odds ratio: 0.781, 95% confidence interval: 0.603-1.022, $P=0.066$). Greater the BMI (≥ 27.50 kg/m^2), more the risk (odds ratio: 5.14, 95% confidence interval: 3.89-6.80) of hypertension in the south Indian population.[31] Panesar *et al.* (2013) reported that the BMI (≥ 25 kg/m2) is significantly associated with the hypertension (odds ratio: 6.801, 95% confidence interval: 0.868-52.63, $P=0.068$).[30] The present study results also indicated that the BMI (odds ratio: 1.529, 95% confidence interval: 1.189-1.967, $P=0.0009$) as the risk for hypertension. Family history is the major risk factor for hypertension. The risk was higher in both parents (odds ratio: 3.614, 95% confidence interval: 1.348-9.709, $P=0.011$) are known hypertensive than one parent (odds ratio: 0.401, 95% confidence interval: 0.149-1.075, $P=0.069$) positive.30 The prevalence of hypertension (odds ratio: 1.76, 95% confidence interval: 1.45-2.14, $P<0.05$) was higher in known family history of hyperten-

Table 5: Adherence of antihypertensive medication to JNC-7 treatment recommendations				
Hypertension type	Recommendations	Adherence rate (%)	Non-Adherence rate (%)	P-Value
Pre Hypertension	No drug indicated	24.9	75.1	*P* < 0.01
Stage 1 Hypertension		80.3	19.7	*P* < 0.001
	Thiazide type Diuretics for most			
	For many consider			
	ACEIs	4.0		
	ARBs	43.8		
	BBs	11.3		
	CCBs	16.3		
	Other	4.9		
Stage 2 Hypertension		73.93	26.07	*P*< 0.001
	Drug Combinations for most			
	(Usually thiazide type)			
	ACEIs + Diuretics	13.3		
	ARBs + Diuretics	42.19		
	BBs + Diuretics	6.64		
	CCBs + Diuretics	4.8		
	Other combinations	7.0		
Hypertensive Emergency		50	50	*P*<0.05
	Nifedipine SL	9		
	Furosemide i.v.	12.8		
	Metoprolol i.v.	28.2		

ARBs, Angiotensin Recerptor Blockers; CCBs, Calcium Channel Blockers; BBs, β-blockers; ACEIs, Angiotensin Converting Enzyme Inhibitors.

Table 6: Modifiable and nonmodifiable risk factors for hypertension in univariate regression analysis.		
Variable	OR (95% CI)	P-value
Age		
Between 41- 60 years	3.638 (2.449-5.405)	<0.0001
Above 60 years	5.689 (3.693-8.763)	<0.0001
Female gender	1.287 (1.002-1.653)	0.048
Married	13.13 (3.059-56.31)	<0.0001
Widowed	101.5 (15.55-66.23)	<0.0001
Educated (Above 10th standard)	0.781 (0.603-1.012)	0.066
Body mass index (>25 kg/m2)	1.529 (1.189-1.967)	0.0009
Monthly income (Above Rs. 10,000)	4.677 (3.281-6.666)	<0.0001
Family history		
Father	1.698 (1.150-2.507)	0.009
Mother	2.816 (1.675-4.732)	<0.0001
Father & mother	3.238 (1.747-6.001)	<0.0001
Brother & sister	1.071 (0.596-1.925)	0.881
Co-morbidities		
Diabetes mellitus	6.695 (4.038-11.10)	<0.0001
History of CVDs	3.830 (1.393-10.53)	0.006

Thyroid disorders	1.031 (0.242-4.393)	1.000
Diabetes and CVDs	1.985 (1.121-3.513)	0.022
Diabetes and Thyroid	2.750 (1.357-5.572)	0.007
Diabetes and other	1.747 (1.045-2.920)	0.041
CVD and other co-morbid conditions	13.41 (6.093-29.50)	<0.0001
PCOD	1.031 (0.288-3.682)	1.000
Chronic Kidney Disease	10.83 (3.429-34.19)	<0.0001
Urban residence	1.145 (0.881-1.487)	0.319
Physically inactivity	1.906 (0.930-1.538)	<0.0001
Mixed (Vegetarian and non-vegetarian)	0.026 (0.017-0.039)	<0.0001
Alcohol	1.809 (1.298-2.520)	0.0076
Smoking	1.066 (0.820-1.385)	0.0005
Stress	1.235 (0.652-1.604)	0.640
Fruits	0.671 (0.442-1.021)	0.063
Tea & Coffee		
Daily once tea	1.215 (0.770-1.915)	0.419
Daily twice tea	1.464 (0.987-2.169)	0.070
Daily thrice & even more tea	1.146 (0.709-1.850)	0.625
Daily once coffee	1.591 (0.948-2.671)	0.089
Daily twice coffee	1.122 (0.651-1.930)	0.782
Daily thrice coffee	2.870 (0.871-9.445)	0.102
Tea & coffee daily once	2.609 (0.781-8.713)	0.160
Tea & coffee daily twice	1.043 (0.203-5.349)	1.000
Tea & coffee daily thrice & even more	1.739 (0.400-7.559)	0.494
Soft drinks		
Soft drinks (weekly once)	0.546 (0.334-0.893)	0.017
Soft drinks (weekly twice)	1.549 (0.623-3.850)	0.386
Soft drinks (weekly thrice or more)	2.650 (0.732-9.591)	0.123
Soft drinks (Occasionally)	0.716 (0.529-0.969)	0.036
Junk foods		
Weekly once	0.612 (0.441-0.848)	0.003
Weekly twice	1.009 (0.543-1.870)	1.000
Weekly thrice and more	17.69 (2.373-131.8)	<0.0001
Occasionally	0.923 (0.671-1.269)	0.626

sion.[33] In the present study also family history (father, odds ratio: 1.698, 95% confidence interval: 1.150-2.507, P=0.009; mother, odds ratio: 2.816, 95% confidence interval: 1.675-4.732, $P<0.0001$; both father and mother, odds ratio: 3.238, 95% confidence interval: 1.747-6.001, $P<0.0001$) was the major risk factor. Diabetes mellitus (odds ratio: 6.9, 95% confidence interval: 5.5-8.7) was the significant risk factor in hypertension.[29] In the present study also it was a risk factor for hypertension.

Physical inactivity (odds ratio: 2.21, 95% confidence interval: 1.51-3.24, $P<0.0001$) was a significant risk factor for hypertension.16 Another study also reported that physical inactivity (odds ratio: 1.59, 95% confidence interval: 1.02-2.47, P=0.04) was the risk factor of hypertension.20 In the present study also physical inactivity (odds ratio: 1.906, 95% confidence interval: 0.930-1.538, $P<0.0001$) significantly contributed to hypertension. Alcohol consumption (odds ratio: 1.64, 95% confidence interval: 1.51-1.78, $P<0.05$) is the significant risk factor in hypertension.[15] The risk of hypertension was increased with alcohol (odds ratio: 1.21, 95% confidence interval: 0.74-1.38, $P<0.05$) consumption.16 The present

study results are also suggested that the alcohol consumption (odds ratio: 1.618, 95% confidence interval: 1.141-2.294, P=0.0076) was the risk factor for hypertension. Smoking (odds ratio: 1.66, 95% confidence interval: 1.10-2.52, P=0.016) was the risk factor for hypertension.[16] Reddy *et al* reported that the smoking was the risk factor in hypertension (odds ratio: 3.8, 95% confidence interval: 3.1-4.6).[29] The present study results were also correlated with the smoking (odds ratio: 1.809, 95% confidence interval: 1.298-2.520, P=0.0005) as the risk factor for hypertension.

Stress is a significant risk factor for hypertension, but in the present study it was not significantly associated with hypertension (odds ratio: 1.235, 95% confidence interval: 0.652-1.604, P=0.640). It was supported by the previous study.[22] They found that stress (odds ratio: 0.592, 95% confidence interval: 0.478-0.732) was not significantly associated with the hypertension. Fruits and soft drinks are significant risk factors for hypertension.[23] Ram *et al.* (2011) reported that the fruit, vegetable and legume intake were inversely associated with hypertension (females, odds ratio: -2.15, 95% confidence interval: 1.82-2.35; males, odds ratio: -2.18, 95% confidence interval: 1.88-2.41).15 In the present also fruit consumption (odds ratio: 0.671, 95% confidence interval: 0.442-1.021, P=0.063) was not significantly associated with hypertension. But in the present study these are not significantly associated with the hypertension. Tea (odds ratio: 1.450, 95% confidence interval: 1.090-1.930) and coffee (odds ratio: 0.970, 95% confidence interval: 0.742-1.313) are not significant risk factors for hypertension.22 In the present study also these are not significant risk factors for hypertension (Table 6). Junk food (weekly thrice or more) intake (odds ratio: 17.69, 95% confidence interval: 2.373-131.8, *P*<0.0001) were significantly associated with HTN.

CONCLUSION

The present study results indicated that the physicians are strictly following the JNC-7 guidelines to prescribe antihypertensive agents, because the medication adherence was optimal in all the types of hypertension. Junk foods, age (above 40 years), diabetes, alcohol, smoking, marital status and high economic status are the main risk factors for hypertension.

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KEY FINDING

Hypertension prevalence was significantly higher in females compared to males ($P<0.048$).

Diabetes mellitus (38.0%) was the major co-morbidity with hypertension followed by cardiovascular diseases (14.7%).

Age, family history, BMI, socioeconomic status, alcohol, smoking and junk foods are significantly associated with hypertension.

Angiotensin receptor blockers (17.98%) are most widely used drugs in monotherapy (38.63%) followed by calcium channel blockers (10.07%).

In double combination therapy (36.11), the most commonly prescribed combination was angiotensin receptor blockers + diuretics (24.64%).

According to JNC-7 guidelines, the overall rate of medication adherence was 24.9% (prehypertension, $P<0.01$), 80.3% (stage 1 hypertension, $P<0.001$), 73.93% (stage 2 hypertension, $P<0.001$) and 50% (hypertension emergency, $P<0.05$).

Junk foods (weekly thrice or more), diabetes mellitus, chronic kidney disease, cardiovascular diseases, family history, socioeconomic status, age, alcohol, smoking, BMI and physical inactivity are the major risk factors for hypertension.

SOURCE OF FUNDING

CONFLICT OF INTEREST

The authors declare that this research does not have any conflict of interest with anyone or any Institute.

ABBREVIATION USED

HTN: Hypertension; JNC-7: Joint National Committee-7; AHA: American Heart Association; ACC: American College of Cardiology; CDC: Centers for Disease Control and Prevention; ADA: American

Diabetes Association; ESH: European Society of Hypertension; ESC: European Society of Cardiology; ACEIs: Angiotensin Converting Enzyme Inhibitors; ARBs: Angiotensin Receptor Blockers; CCBs: Calcium Channel Blockers; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; CVDs: Cardiovascular Diseases; PCOS: Poly Cystic Ovarian Syndrome.

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