

## Current scenario of masked and white coat hypertension in medical professionals in Bundelkhand region

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### Abstract

**Background & Objective:** Medical profession is believed to be one of most stressful profession. Present study was done to evaluate current scenario of masked and white coat hypertension among medical professional in Bundelkhand region.

**Methods:** This cross-sectional observational study was conducted at department of Medicine, M.L.B. Medical College, Jhansi, over a period between Jan 2014 to June 2015 on 300 medical professionals which included undergraduates, PG students, Consultants, Nursing staff and ministerial staffs. All patients underwent history taking, physical examination, laboratory analysis, office BP and ABPM.

**Results:** 4 groups were identified based on office and ambulatory blood pressure monitoring:

- i) True normotensive patients (BPs are normal both clinically and by ABPM) 197 (65.7%).
- ii) True hypertensive patients (both office and ABPM were high 23 (7.7%).)
- iii) White coat hypertensive patients (clinical BP were above limits, but ABPM were normal) 73 (24.3%).
- iv) Masked hypertensive patients (clinical BP were normal, but ABPM were high 7 (2.3%).

Out of 300 subjects, there were 158 UG students, 49 PG students, 6 consultants, 66 nursing staff and 21 ministerial staff. White coat hypertension was more prevalent in undergraduates.

Out of total 147 subjects, who were pre-hypertensives by office blood pressure, 140 subjects (95.2%) were true normotensive and 7 (4.8%) were having masked hypertension. None of the pre-hypertensive subject was having true hypertension. Out of total 96 subjects, who were hypertensives by office blood pressure, only 23 (23.9%) subjects were true hypertensive and majority of 73 subjects (76.1%) were having white coat hypertension.

**Conclusion:** White coat hypertension was more prevalent in undergraduates and masked hypertension was more seen in nursing staff in this study. We did not find any target organ damage in white coat hypertensives and masked hypertensives. They don't warrant antihypertensive treatment at this stage. These subjects may develop hypertension and target organ damage in upcoming years but earlier than the normal subjects. These subjects should be followed for development of hypertension and target organ damage.

**Keywords:** White coat, hypertension, masked hypertension, medical professional, Bundelkhand

## Introduction

Hypertension is one of the leading causes of global burden of disease. Approximately 7.6 million deaths (13-15% of total) and 92 million disability adjusted life years worldwide were attributable to high blood pressure in 2001. The prevalence of hypertension in the last six decades has increased from 2% to 25% among urban residents and from 2% to 15% among the rural residents in India. According to Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, the overall prevalence of hypertension in India by 2020 will be 159.46/1000 population. Hypertension doubles the risk of cardiovascular diseases, including coronary heart disease, congestive heart failure, ischemic and hemorrhagic stroke, renal failure and peripheral arterial disease <sup>[1]</sup>. Patients with blood pressure greater than 140 mm Hg systolic and 90 mm Hg diastolic with no definable cause are said to have primary, essential or idiopathic hypertension. 90% of all hypertensive's fall into this group <sup>[1]</sup>. White coat hypertension is a phenomenon in which patient exhibits elevated blood pressure in a clinical setting but not in other settings. It is believed that this is due to the anxiety some people experience during a clinic visit. It has an estimated prevalence ranging 12-53%. The term "masked hypertension" can be used to describe the contrasting phenomenon, where blood pressure is elevated during daily living, but not in an office setting <sup>[6]</sup>. Both masked and white coat hypertension are frequently missed during office BP measurement by physician in clinics.

Ambulatory blood pressure monitoring (ABPM) involves measuring blood pressure at regular intervals (usually every 20-30 minutes) over a 24 hour period while patients undergo normal daily activities, including sleep. In adults, ambulatory, rather than office BP, is correlated more strongly with left ventricular mass in both hypertensive and normotensive individuals <sup>[2]</sup>. Ambulatory monitoring of blood pressure over 24 hours may provide a stronger predictor of cardiovascular morbidity and mortality than office- based measures.

## Material & Methods

This cross-sectional observational study was conducted at department of Medicine, M.L.B. Medical College, Jhansi, over a period between Jan 2014 to June 2015 on 300 medical professionals which included undergraduates, PG students, Consultants, Nursing staff and ministerial staffs. Institutional ethical clearance was obtained from the college ethical committee and individual consent was taken from each subject.

Subjects with secondary hypertension were excluded from this study. All subjects were asked to fill a questionnaire regarding their demographic data. Relevant clinical history was taken for cardiovascular diseases, cerebrovascular diseases, diabetes and peripheral vascular diseases.

Subjects were further evaluated, both by office blood pressure monitoring and ambulatory blood pressure monitoring. They were classified into 4 groups. Group A (true normotensives) included those subjects who were normotensive by both methods; Group B (true, or sustained hypertension) included hypertensive by both methods; Group C (white coat hypertension) included hypertensive by office measurement and normotensive by ambulatory measurement; and Group D (masked hypertension) included normotensive by office measurement and hypertensive by ambulatory measurement. Subjects of true hypertensive, white coat hypertension and masked hypertension were further evaluated for target organ damage. Target organ damage was evaluated by serum creatinine and urine microalbumin, fundus examination <sup>[5]</sup>, serum lipid profile, ECG <sup>[4]</sup>, history of transient ischemic attacks, stroke and

visual blindness episodes were taken. All those subjects who were detected to be having white coat hypertension were further exposed to Hamilton anxiety score [3] which is a 14 questionnaire system to analyze anxiety levels.

**Table 1:** 4 groups based on office and ambulatory blood pressure

Office Blood Pressure	Ambulatory Blood Pressure	
	Normal	Hypertension
Normal	True Normotensive (Group A)	Masked Hypertension (Group D)
Hypertension	White Coat Hypertension (Group C)	True Hypertension (Group B)

### Nocturnal Dipping status

The reduction in early morning blood pressure compared with average daytime pressure is referred to as the night-time dip. Ambulatory blood pressure monitoring may reveal a blunted or abolished overnight dip in blood pressure. Non-dipping blood pressure is associated with a higher risk of left ventricle hypertrophy and cardiovascular mortality [7, 9]. Classification of dipping in blood pressure is based on American Heart Association [8].

$$\text{Dip} = 1 - \frac{\text{SBP sleeping}}{\text{SBP awake}} \times 100$$

<0% = Reverse Dipper, 0-10% = Non-Dipper, 10-20% = Dipper, >20% = Extreme dipper

To know the sensitivity and specificity of office blood pressure and ambulatory blood pressure a receiver operating curve was formed from the following values of all the 300 subjects-

- 24 hr average Ambulatory systolic blood pressure.
- 24 hr average Ambulatory diastolic blood pressure.
- Office systolic blood pressure.
- Office diastolic blood pressure Statistical analysis.

Data collected was systematically tabulated and analysis was done using standard statistical software Graph Pad prism 6. The Student's t-test/Z test for continuous normally distributed variables was used. For categorical data, the chi-square test was used and Fisher's exact test was used for small numbers. For the variables not normally distributed, Wilcoxon's Mann-Whitney test was used. ROC curve was used for sensitivity and specificity of various parameters.  $p < 0.05$  was considered as statistical significant at 95% confidence intervals.

### Observation & Results

Out of 300 subjects, there were 158 UG students, 49 PG students, 6 consultants, 66 nursing staff and 21 ministerial staff. Majority 121 (40.3%) subjects belong in age group 15-25 yrs. Majority of male subjects [93 subjects (31%)] belong in age group 15-25 yrs and majority of female subjects [31 subjects (10.33%)] belong in age group >45 yrs.

**Table 2:** Group-wise Distribution of office blood pressure (n=300)\*

Medical professionals	Normal Blood Pressure (<120/80 mmHg)	Pre-Hypertension (120-139/80-89 mmHg)	Stage I Hypertension (140-159/90-99 mmHg)	Stage II Hypertension (>160/100 mm Hg)	Total
UG Students	35 (11.7%)	74 (24.7%)	44 (14.7%)	5 (1.7%)	158 (52.7%)
PG Students	10 (3.3%)	28 (9.3%)	11 (3.7%)	0 (0%)	49 (16.3%)
Consultants	0 (0%)	2 (0.7%)	4 (1.3%)	0 (0%)	6 (2%)
Nursing Staff	11 (3.7%)	33 (11%)	14 (4.7%)	8 (2.7%)	66 (22%)
Ministerial Staff	1 (0.3%)	10 (3.3%)	9 (3%)	1 (0.3%)	21 (7%)
Total	57 (19%)	147 (49%)	82 (27.3%)	14 (4.7%)	300 (100%)

\*n= total no of subjects

On office blood pressure measurement majority 35 subjects (11.7%) had normal office blood pressure in UG students. Majority of pre-hypertension 75 subjects (25%) and stage I hypertension 43 subjects (14.3%) was also seen in UG students' group. Majority of stage II hypertension in 8 subjects (2.7%) was seen in nursing staff group.

Mean office blood pressure of consultants, nursing staff and ministerial staff was slightly higher than UG & PG students' groups.

**Table 3:** Group-wise distribution of 24 hr average ambulatory blood pressure (n\*=300)

Groups	Optimal Blood Pressure (24 hr average blood pressure <125/75 mm Hg)	Normal Blood Pressure (24 ER Average blood pressure 125-129/75-79 mm Hg)	Pre-Hypertension (24 HR Average blood pressure 130-134/80-84 mm Hg)	Hypertension (24 hr average blood pressure >135/85 mm Hg)	Total
UG Students	130 (43.3%)	20 (6.7%)	4 (1.3%)	3 (1%)	158 (52.7%)
PG Students	40 (13.3%)	6 (2%)	1(0.3%)	2 (0.7%)	49 (16.3%)
Consultants	4 (1.3%)	0 (0%)	2 (0.7%)	0 (0%)	6 (2%)
Nursing Staff	37 (12.3%)	8 (2.7%)	3 (1%)	18 (6%)	66 (22%)
Ministerial Staff	10 (3.3%)	3 (1%)	4 (1.3%)	4 (1.3%)	21 (7%)
Total	221 (73.7%)	37 (12.3%)	14 (4.7%)	28 (9.4%)	300 (100%)

\*n= total no of subjects

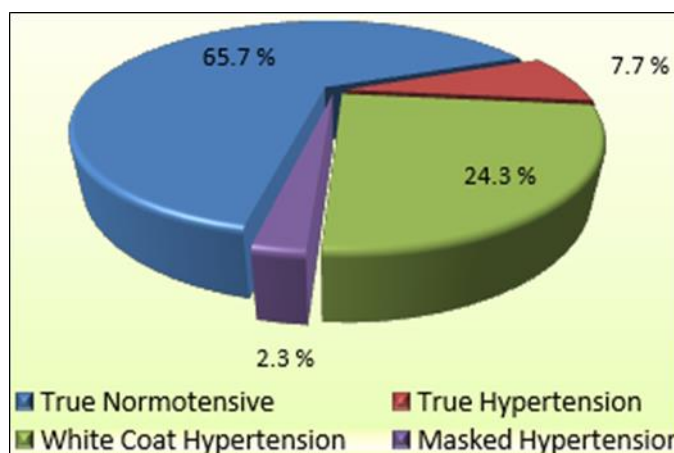
In 24 hrs average ambulatory blood pressure measurement, majority 221 (73.6%) subjects were having optimal blood pressure and hypertension was seen in 28 (9.4 %) subjects. Normal blood pressure was seen in 37 (12.3%) subjects and 14 subjects (4.7%) were pre-hypertensive. By ambulatory blood pressure monitoring majority 130 (43.3%) subjects were of optimal 24 hr average blood pressure in UG students' group. Majority of pre-hypertension in 4 (1.3%) subjects was seen equally in UG and ministerial staff group. Hypertension was more prevalent 18 (6%) subjects in nursing staff group.

**Table 4:** ABPM parameters (mean  $\pm$  SD) of all five groups

ABPM parameters	UG Students (n=158)	PG Students (n=49)	Consultants (n=6)	Nursing Staff (n=66)	Ministerial staffs (n=21)	F value	p Value
<b>Day time avg BP</b>							
SBP (in mm Hg)	118.40 $\pm$ 8.47	119.91 $\pm$ 9.90	129 $\pm$ 7.18	126.4 $\pm$ 15.95	128.52 $\pm$ 11.78	9.52	<0.0001
DBP (in mm Hg)	73.46 $\pm$ 7.36	75.71 $\pm$ 7.23	80.33 $\pm$ 7.68	77.5 $\pm$ 9.60	81.476 $\pm$ 9.36	7.00	<0.0001
<b>Night time avg BP</b>							
SBP (in mm Hg)	111.13 $\pm$ 10.50	112.42 $\pm$ 9.83	112.5 $\pm$ 10.39	116.1 $\pm$ 16.95	117.33 $\pm$ 13.42	2.62	=0.03

DBP (in mm Hg)	66.88±9.78	67.63±9.17	66.67±5.50	69.5±13.17	70.61±11.16	1.11	=0.34
<b>24 hr avg BP</b>							
SBP (in mm Hg)	116.08±8.29	117.36±8.79	124.67±6.47	123.02±14.93	125.28±11.50	8.16	<0.0001
DBP (in mm Hg)	71.24±7.23	73.04±7.06	77.33±5.92	74.98±9.49	78.43±8.88	5.99	<0.0001
<b>24 hr avg PR/PP</b>							
PR (per min)	76.60±8.57	80.36±9.69	73.83±6.79	80.58±9.01	81.14±5.93	04.29	=0.002
PP (per min)	44.98±6.65	44.42±5.84	48±8.02	48.12±9.65	46.95±7.24	2.81	=0.02

Comparing the mean ABPM parameters of these groups, anova test revealed statistically significant ( $p < 0.0001$ ) different day time & 24 hrs average systolic blood pressure (SBP) as well as diastolic blood pressure (DBP) among all groups. Difference in night time systolic blood pressure (SBP) was also statistically significant ( $p = 0.03$ ) among these groups but night time diastolic blood pressure (DBP) was similar. Difference in 24 hrs average pulse rate and pulse pressure was also statistically significant in all groups.



**Fig 1:** Prevalence of true hypertension, white coat hypertension and masked hypertension

Total subjects in Group A (True Normotensive) were 197 (65.7%), Group B (True Hypertension) were 23 (7.7%), Group C (White Coat Hypertension) were 73 (24.3%) and Group D (Masked Hypertension) were 7 (2.3%).

Further to find out the determinants of true hypertension, white coat hypertension and masked hypertension in medical personnel, group B (true hypertension), C (white coat hypertension) & D (masked hypertension) were compared with group A (true normotensive).

**Table 5:** Distribution of dipping status of four groups

Dipping status	True Normotensive (n=197)	True Hypertension (n=23)	WCH (n=73)	Masked Hypertensive(n=7)
Dipper	63 (32%)	6 (26.08%)	23 (31.5%)	0 (0%)
Extreme dipper	4 (2.03%)	6 (26.08%)	1 (1.36%)	0 (0%)
Reverse dipper	19 (9.64%)	5 (21.73%)	15 (20.54%)	1 (14.28%)
Non-dipper	111 (55.34%)	6 (26.08%)	34 (49.34%)	6 (85.7%)

Dipping status was evaluated in all four groups and we found inconclusive results in true Normotensive, true hypertension and white coat hypertension group. In true Normotensive group out of 197 subjects dipping was seen in 63 (32%) subjects and 111 (55.34%) subjects

were non-dipper. In true hypertension group out of 23 subjects there were 6 (26.08%) dipper and 6 (26.08%) non-dipper.

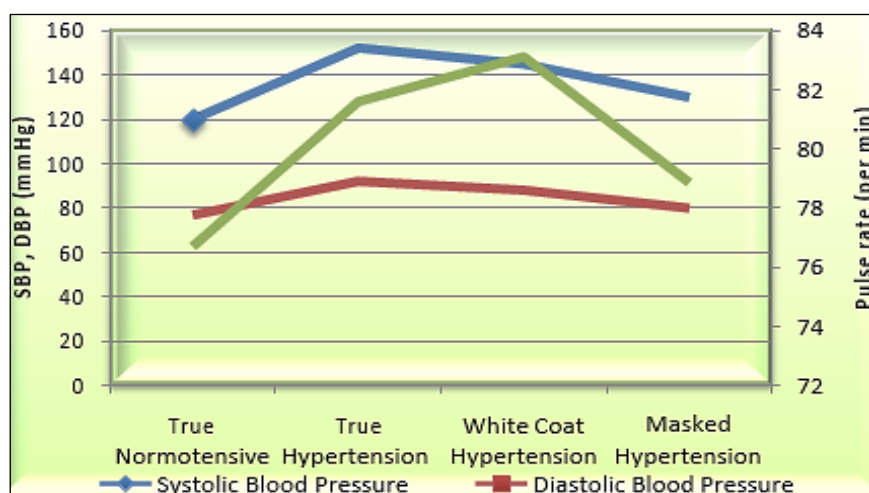
While In masked hypertension group out of 7 subjects there were 6 (85.7%) non-dipper. This suggest that estimating non-dipper by ABPM is helpful in predicting masked hypertension.

**Table 6:** Distribution of occupation

Conclusion	UG Students (n=158)	PG Students (n=49)	Consultants (n=6)	Nursing Staff (n=66)	Ministerial staffs (n=21)	$\chi^2$ value	p value
True Normotensive	108 (36%)	35 (11.6%)	3 (1%)	40 (13.3%)	11 (3.7%)	60.074 df=12	<0.0001
True Hypertensive	2 (0.7%)	0 (0%)	2 (0.7%)	15 (5%)	4 (1.3%)		
White Coat Hypertensive	47 (15.7%)	12 (4%)	1 (0.3%)	7 (2.3%)	6 (2%)		
Masked Hypertensive	1 (0.3%)	2 (0.7%)	0 (0%)	4 (1.3%)	0 (0%)		

Majority [108(36.3%)] of True normotensives were seen in UG students' group. Majority of True Hypertension [15 subjects (5%)] was seen in nursing staff group. Majority of White Coat Hypertension [47 subjects (15.7%)] was seen in UG students' group. Majority of Masked Hypertension [4 subjects (1.3%)] was seen in nursing staff group.  $\chi^2$  test revealed these groups were statistically highly significant ( $p<0.0001$ ).

Overall, white coat hypertension was present in highest percentage amongst UG students. True hypertension and masked hypertension was highest among nursing staff.



**Fig 3:** Office blood pressure measurements of four groups

Systolic and diastolic blood pressure of true hypertension group was higher than other groups. Difference between systolic blood pressure of true normotensive group and other three groups was statistically significant ( $p<0.0001$ ). Similarly difference between diastolic blood pressure of true normotensive group and other three groups was statistically significant ( $p<0.0001$ ). The mean Heart rate and pulse rate was found to be on higher side in White Coat Hypertension group (group C) which was statistically significant ( $p<0.0001$ ). This is indicative of high anxiety level in subjects with white coat hypertension.

## Ambulatory blood pressure monitoring

Table 7: ABPM parameters (mean  $\pm$  SD) of four groups

ABPM parameters	True Normotensive (Group A) (n=197)	True Hypertension (Group B) (n=23)	White Coat Hypertension (Group C) (n=73)	Masked Hypertension (Group D) (n=7)
<b>Day time avg. BP:</b>				
SBP (mmHg)	117.22 $\pm$ 8.86	144.78 $\pm$ 9.86 IZI=12.81; $p<0.0001$	123.35 $\pm$ 7.64 IZI=5.6; $p<0.0001$	138.57 $\pm$ 2.69 IZI=17.84; $p<0.0001$
DBP (mmHg)	73.77 $\pm$ 7.73	87.04 $\pm$ 7.63 IZI=38.64; $p<0.0001$	75.28 $\pm$ 6.97 IZI=1.53; $p<0.12$	85 $\pm$ 3.46 IZI=7.91; $p<0.0001$
<b>Night time avg. BP:</b>				
SBP (mmHg)	108.8 $\pm$ 9.41	129.73 $\pm$ 10.61 IZI=9.05; $p<0.0001$	116.73 $\pm$ 13.22 IZI=4.7; $p<0.0001$	133.14 $\pm$ 5.20 IZI=38.64; $p<0.0001$
DBP (mmHg)	65.40 $\pm$ 8.04	77.56 $\pm$ 11.16 IZI=5.07; $p<0.0001$	70.05 $\pm$ 13.45 IZI=2.77; $p<0.005$	81.28 $\pm$ 2.92 IZI=12.77; $p<0.0001$
<b>24 hrs avg. BP:</b>				
SBP (mmHg)	114.54 $\pm$ 8.47	140.52 $\pm$ 6.54 IZI=17.42; $p<0.0001$	121.01 $\pm$ 6.71 IZI=6.53; $p<0.0001$	137 $\pm$ 2.51 IZI=19.97; $p<0.0001$
DBP (mmHg)	71.09 $\pm$ 7.27	84.56 $\pm$ 7.31 IZI=8.36; $p<0.0001$	73.41 $\pm$ 6.89 IZI=2.42; $p<0.0001$	83.85 $\pm$ 3.76 IZI=8.43; $p<0.0001$
<b>24 hrs avg. PR/PP:</b>				
PR (per min.)	78.59 $\pm$ 9.08	80.82 $\pm$ 6.61 IZI=0.93; $p=0.35$	76.67 $\pm$ 9.04 IZI=1.53; $p=0.12$	81 $\pm$ 4.24 IZI=0.69; $p=0.48$
PP (per min.)	43.47 $\pm$ 5.85	56.04 $\pm$ 10.31 IZI=8.57; $p<0.0001$	48.05 $\pm$ 6.61 IZI=5.36; $p<0.0001$	53.28 $\pm$ 5.82 IZI=4.32; $p<0.0001$

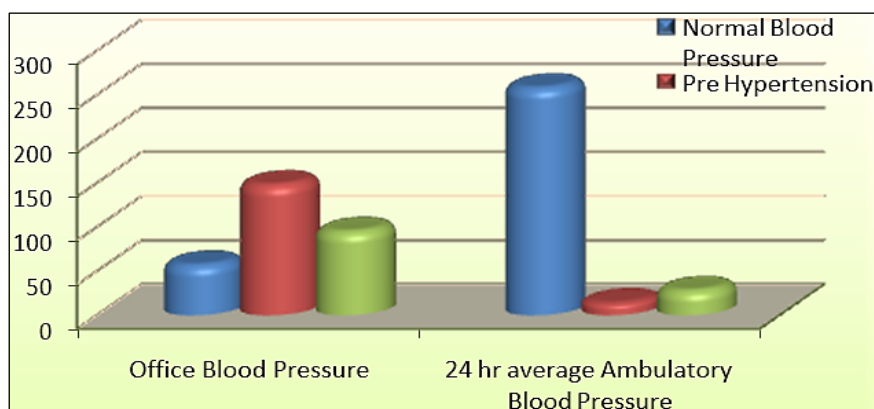
The mean day time, night time and 24 hr average Systolic as well as Diastolic blood pressure of true hypertension & masked hypertension group was higher than other two groups. Z test revealed this difference in systolic and diastolic blood pressure was statistically highly significant ( $p<0.0001$ ).

Table 8: Distribution of anxiety status of all five groups

Anxiety status	UG Students (n=158)	PG Students (n=49)	Consultants (n=6)	Nursing Staff (n=66)	Ministerial staffs (n=21)	X <sup>2</sup> or f value	p value
Mild anxiety (<17)	128 (81.01%)	46 (93.87%)	5 (83.33%)	65 (98.48%)	19 (90.47%)	15.62 df=4	0.0035
Moderate anxiety (18-24)	30 (18.99%)	3 (6.13%)	1 (16.67%)	1 (1.52%)	2 (9.53%)		
Severe anxiety (25-30)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)		
HRS	9.15 $\pm$ 6.09	7.24 $\pm$ 5.28	6.67 $\pm$ 5.75	5.62 $\pm$ 3.04	8.90 $\pm$ 5.72	5.48	<0.0001

Severe anxiety was not seen in any subject. Moderate anxiety was highest in UG students' group [30 subjects (18.99%)]. Hamilton rating scale was also highest in UG students' group with mean value of 9.15  $\pm$  6.09. This is suggestive of high level of anxiety present in UG students as compared to other groups. Comparing the anxiety level of all groups,  $\chi^2$  test revealed the difference in anxiety level was statistically significant ( $p=0.003$ ) among all groups.

### Comparison of results of office blood pressure and ambulatory blood pressure



**Fig 4:** Comparison of office blood pressure and 24 hrs average ambulatory blood pressure

All the 57 subjects who were normotensive by office blood pressure measurement, on further evaluation by ambulatory blood pressure monitoring they were true normotensives suggesting that sensitivity and specificity of office blood pressure is high for detecting true normotensives.

Out of total 147 subjects, who were pre-hypertensives by office blood pressure, 140 subjects (95.2%) were true normotensive and 7 (4.8%) were having masked hypertension. None of the pre-hypertensive subject was having true hypertension. These 7 subjects (4.8%) with masked hypertension were missed by office blood pressure measurement and they should be treated to prevent cardiovascular morbidity and target organ damage. This shows as importance aspect of ambulatory blood pressure monitoring in detecting masked hypertension.

Out of total 96 subjects, who were hypertensives by office blood pressure, only 23 (23.9%) subjects were true hypertensive and majority of 73 subjects (76.1%) were having white coat hypertension.

**Table 9:** Target organ damage in all four groups

Target organ		Normotensive (n=197)	True Hypertensive (n=23)	WCH (n=73)	Masked Hypertension (n=7)
S. Creatinine	>1.5	0	3 (13%)	0	0
	<1.5	197	20 (87%)	73	7
Retinopathy	Present	0	4 (21%)	0	0
	Absent	197	19 (79%)	73	7
LVH	Present	0	2 (9.5%)	0	0
	Absent	197	21 (90.5%)	73	7
Stroke	Present	0	0 (0%)	0	0
	Absent	197	23 (100%)	73	7

Target organ damage was assessed in all the four groups. No target organ damage was found in true normotensive, white coat hypertensive and masked hypertensive group. While in hypertensive group out of 23 subjects S. creatinine was >1.5 in 3 subjects (13%), retinopathy was seen in 4 subjects (21%) and LVH was seen in 2 subjects (9.5%).

### Discussion

The prevalence of hypertension in India is reported as ranging from 10 to 30.9% [30]. The average prevalence of hypertension in India is 25% in urban and 10% in rural inhabitants [31]. Prevalence of hypertension has increased during last decade. Prevalence of masked and white



coat hypertension in medical professionals is still not known in India. The high prevalence of prehypertension (49%) and hypertension (32%) in medical professionals in the current study, confirms this increasing trend. In this study ABPM identified a subgroup of 7(2.3%) medical professional with masked hypertension. Out of which 6 masked hypertensive subjects were non-dipper. Non-dipping blood pressure may be associated with a higher risk of left ventricle hypertrophy and cardiovascular mortality<sup>[10]</sup>. This warrants detection of non-dipper by ABPM in patients with masked hypertension. In the masked hypertension subjects, no involvement of target organ was seen at the time of enrolment in this study. Rapid urbanization, lifestyle changes, stress, dietary changes and increased life expectancy are factors that can be attributed to the rising trend of masked hypertension in medical staff. Prevalence of hypertension in this study is compatible to the prevalence reported in previous studies in non-medical professional<sup>[13, 14]</sup>. Similar prevalence of prehypertension (45%) has also been reported in a survey conducted in nine States of India by the National Nutrition Monitoring Bureau<sup>[11]</sup>. Prevalence of pre-hypertension was also found to be high (40-60%) by Dr. Mohan cures study at Chennai<sup>[12]</sup>.

The prevalence of white coat hypertension in this study was 73(24.3%). White coat hypertension was more prevalent among medical undergraduates 47(15.7%). Factors that could selectively raise BP might be anxiety, smoking, alcohol, drinking, sedentary habits or greater reactivity to daily life stressors. It is still not clear whether presence of white coat hypertension portends future risk for cardiovascular complications. While some studies suggested WCH as a risk factor<sup>[17, 18]</sup>, others showed that patients with WCH had favourable prognosis<sup>[15, 16]</sup>. Thus, the prognostic significance of WCH remains controversial. Besides these conflicting issues, there are few studies comparing these 4 groups of patients. In one of these studies, 4 groups of patients were compared longitudinally with respect to cardiovascular mortality and stroke. The authors showed that subjects with WCH were similar to subjects with true normotensive. However, risk was significantly higher for subjects with masked hypertension and true hypertension. In another study, it was shown that the incidence and risk of cardiovascular death showed a progressive increase from subjects with true normotensive to subjects with WCH, masked hypertension, and true hypertensive, independent of age and gender. No target organ damage was seen in undergraduates in our study. Still need for follow-up in later life is warranted.

The prevalence of true hypertension in this study was 7.7% (23 subjects). The dipping status in this study was inconclusive in hypertension group. While various target organ damage in the form of raised s. creatinine in 3 subjects (13%), retinopathy in 4 subjects (21%), LVH in 2 subjects (9.5%) were seen in true hypertension group only. Early detection of target organ damage in the hypertensive subjects could prevent long term complications.

The present knowledge on the clinical significance of masked hypertension is still limited. Some investigators reported more extensive target organ damage in masked hypertension subjects compared with Normotensive individuals, which was not found in this study. This discrepancy can be attributed to fact that these subjects were not followed long enough. Still Counselling of the pre-hypertensives on lifestyle modification and its role in controlling hypertension should also be emphasized.

This study has some limitations that deserve mention. Firstly, since the study is cross-sectional, cause and effect relationships cannot be suggested. Secondly, the measurements were made only once, raising the question of reproducibility. Thus, serial measurements would be better for the interpretation of results. Thirdly, the results could not be generalized to other patients such as those with diabetes and taking medications since these patients were excluded.

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