

## Original Research Article

# Frequency of masked hypertension in non-obese diabetics and obese diabetics

Donakonda Arun Kumar\*, Tejeswini C. J.

Department of Medicine, JSS hospital, Mysuru, Karnataka, India

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**\*Correspondence:**

Dr. Donakonda Arun Kumar,

E-mail: [arunkumardonakonda@gmail.com](mailto:arunkumardonakonda@gmail.com)

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### ABSTRACT

**Background:** Masked hypertension defined as clinic BP <140/90mmHg but home BP is in the hypertensive range of >135/85mmhg. It is an emerging clinical entity. Several risk factors, including sex, age, diabetes, obesity, smoking, have been associated with it. Masked hypertensives are usually under-treated and are at risk of cardiovascular complications. As the prevalence is high it is necessary to determine its frequency. Objectives was to evaluate the frequency of masked hypertension in non-obese diabetics and obese diabetics who had never been treated for hypertension.

**Methods:** The study was carried out in JSS hospital, Mysore over a period of 2 years from 2014 to 2016. The study was designated as a comparative and exploratory study. 200 people each of non-obese diabetics and obese diabetics were selected based on inclusion and exclusion criteria. Clinic SBP and DBP was recorded and self-monitoring automatic BP apparatus was given to record home SBP and DBP. Each patient was categorized into either of the four groups normotension, sustained hypertension, masked hypertension and white coat hypertension.

**Results:** Frequency of masked hypertension among non-obese diabetics and obese diabetics is 16% and 20% respectively. Average clinic SBP, DBP home SBP and DBP among non-obese diabetics with masked hypertension are 133.06, 83.15, 139.06 and 84.45 respectively when compared to normotensive which are 113.44, 71.46, 109.81, 70.86 respectively (significant p value of <0.0001). Average clinic SBP, DBP home SBP and DBP among obese diabetics with masked hypertension are 135.60, 84.13, 140.63, and 86.93 respectively when compared to normotensive which are 117.80, 74.10, 115.59, 72.71 respectively (significant p value of <0.0001).

**Conclusions:** In summary, present study demonstrated frequency of masked hypertension among non-obese diabetics and obese diabetics was higher when compared with other studies done on general population. There are no studies done on masked hypertension among obese and non-obese diabetics for proper comparison of data from current study. As the frequency is higher in both non-obese diabetic and obese diabetic groups in current study it signifies the importance of recording the home blood pressures to detect masked hypertension.

**Keywords:** Masked hypertension, Non-obese diabetics, Obese diabetics

### INTRODUCTION

#### *Masked hypertension*

Thomas Pickering defined masked hypertension for first time in 2002. The definition of masked hypertension

proposed by European society of hypertension is a condition in which a patient's clinic BP is <140/90 mmHg but home blood pressure readings are in the hypertensive range of >135/85 mmhg.<sup>1</sup> Masked hypertension is an emerging clinical entity with under-recognized prevalence and increased cardiovascular risk. With widespread availability of home blood pressure

monitoring more evidence of its detection and prognostic implications is emerging.

Several conventional risk factors, including sex, age, diabetes, obesity and job stress, have been suggested to be associated with masked hypertension. Other factors also play a role in BP increase, including smoking and alcohol. patients with masked hypertension and sustained hypertension are at equivalent risk for developing CV disease.<sup>2</sup> Patients with masked hypertension are usually under-treated and are at risk of cardiovascular complications and as the prevalence is high it is necessary to determine its frequency.

There are no Indian studies regarding the frequency of masked hypertension in general population and in particular in patients of obesity and diabetes. This study

focuses on identifying frequency of masked hypertension in non-obese diabetics and obese diabetics.

*Causes of masked hypertension*

- Lifestyle factors such as smoking, alcohol, physical activity, stress
- Factors which cannot be modified such as age and gender.

*Prevalence of masked hypertension*

The first conducted study was the Ohasama study in a small Japanese town, which reported that 10.4% of subjects with normal screening blood pressures had masked hypertension.<sup>3</sup> The second study was the PAMELA study, which showed prevalence of 9%.<sup>4</sup>

**Table 1: Prevalence of masked hypertension in various studies.**

Author	Population	N	ABP criterion	Prevalence (%)
Imai et al <sup>3</sup>	Ohasama	969	133/78	10
Sega et al <sup>4</sup>	PAMELA	3,200	125/79	9
Bjorklund et al <sup>5</sup>	70-years-old men	578	135/85	14
Liu et al <sup>6</sup>	Healthy volunteers	234	135/85	21
Selenta et al <sup>7</sup>	Healthy volunteers	319	135/85	23

*Target organ damage and prognosis*

A study done in 1999 showed that patients with masked hypertension had a higher left ventricular mass and more carotid atherosclerosis than true normotensives, and thus were similar to true hypertensives.<sup>6</sup> Ohkubo et al reported that in the Ohasama study cardiovascular and stroke mortality and morbidity were increased to the same degree in both masked and sustained hypertensive group when compared with normotensive group.<sup>8</sup> Mancia et al reported that subjects with masked hypertension had a higher prevalence of cardiovascular and all-cause mortality compared with the subjects with normal clinic blood pressure.<sup>9</sup>

*Implications of masked hypertension*

From the above information, it seems clear that masked hypertension should be considered seriously, and is a phenomenon worthy of further investigation. If it is accepted that ambulatory or home blood pressure gives a better prognosis than the clinic blood pressure, and that the correlation between the two is only moderate, it is logical to propose that there will be a significant number of people who are truly hypertensive, but in whom the diagnosis is missed by clinic blood pressure measurement. But how frequently this phenomenon occurs, and how such individuals should be identified, remains a problem. Clearly, one cannot argue for

screening of the general population, but there are many patients who are referred for suspected hypertension who turn out to have normal clinic pressures on repeat testing.

Perhaps some of them would benefit from ambulatory or home blood pressure monitoring to rule out masked hypertension. The implications of the concept that there are a substantial number of people in the general population who have undiagnosed and untreated hypertension which puts them at increased risk of cardiovascular disease and its related morbidity and mortality. Thus, it would significantly change the number of people in the population who have “hypertension” that requires treatment.

*Practical implications of masked hypertension*

It will be inappropriate to say that everyone should be screened with ambulatory blood pressure monitoring. Before one translate these considerations into clinical practice we need more prospective data to show that masked hypertension as one of the cause of increase cardiovascular risk.

Ideally, one should also know if treating such patients will lowers their risk or not. It also need better means of identifying such individuals and guidelines, such as the role of home and ambulatory blood pressure monitoring. There are also important implications for treated patients.

Whether or not patients with controlled clinic blood pressure but uncontrolled home or ambulatory pressures should be labelled as having masked hypertension is debatable, since the diagnosis of hypertension has already been made, but the problems are the same, namely that in these patients the conventionally recorded clinic pressure underestimates their cardiovascular and other risk. But their existence strengthens the need for recommending ambulatory or home blood pressure monitoring as part of the routine care for patients with hypertension.

#### *Diabetes and masked hypertension*

Diabetes and hypertension are interrelated diseases, each predisposing to the development of other and to the future manifestations of cardiovascular disease morbidity.<sup>10,11</sup> The current international database on ambulatory blood pressure monitoring in relation to cardiovascular outcomes (IDACO) study includes a large number of patients with diabetes mellitus, among them many were found to have MH-both on and off antihypertensive treatment. These individuals were recruited in communities from 11 different countries using standard protocols for clinic blood pressure and ambulatory blood pressure monitoring, and with a median follow-up of 11 years for cardiovascular events.

They analysed 9691 subjects from the population-based 11-country international database on ambulatory blood pressure in relation to cardiovascular outcomes. Prevalence of masked hypertension in untreated normotensive subjects was higher among diabetic subjects (29.3%) when compared to nondiabetic subjects (18.8%). Over a median of 11.0 years of follow-up, the adjusted risk for a composite cardiovascular end point in untreated diabetic-masked hypertensive subjects tend to be higher than in normotensive subjects and was similar to untreated stage 1 hypertensives but less than stage 2 hypertensive subjects.

In contrast, cardiovascular risk was not significantly different in antihypertensive-treated diabetic-masked hypertensives, as compared with the normotensive comparator group, stage 1 hypertensives, and stage 2 hypertensives. In conclusion of the IDACO study, MH occurred in 29% of untreated diabetic subjects, which had comparable cardiovascular risk to subjects with stage 1 hypertension, and would require considerable reduction in their blood pressures.<sup>12</sup>

In contrast, antihypertensive-treated diabetics with masked hypertension on 24-hours ambulatory blood pressure monitoring had cardiovascular risk that was almost equal when compared to treated normotensives and stage 1 and stage 2 hypertensive subjects, suggesting that a significant percentage of these subjects had sustained hypertension that mimicked masked hypertension in the presence of normal office blood pressure and elevated ambulatory blood pressure. Hence,

masked hypertension should be used carefully in the context of antihypertensive therapy.

#### *Masked hypertension in obesity*

Masked hypertension has been proven to be associated with an increased risk for cardiovascular disease related morbidity and mortality. One study was done in Japan the Ohasama study, to examine the direct associations of obesity-related anthropometric indices, like WC, with masked hypertension.<sup>13</sup> Subjects in this population-based study included 395 residents who are above 35 years from a place called Ohasama, a rural Japanese community. They measured blood pressure at home (HBPM). In this multivariate analysis Ohasama study, waist circumference, body mass index (BMI) and waist-to-hip ratio were significantly associated with increased risk of masked hypertension.

However, there are only few studies regarding the association between masked hypertension and waist circumference or metabolic syndrome. There were sex-specific associations of WC and BMI with MH in some studies. Waist circumference and BMI in men were significantly higher in subjects with masked hypertension compared with those subjects with sustained normotension, suggesting that men with high waist circumference or BMI should measure their home blood pressure to diagnose masked hypertension. The higher prevalence of MH in men than in women also supports the importance of Home and clinic BP measurement in detection of masked hypertension in men.

Whereas according to some studies high waist circumference and high BMI in women were not significantly associated with masked hypertension; high BMI in women was significantly associated with white-coat hypertension and sustained hypertension. In conclusion, people with high WC or BMI should measure their home blood pressure to detect masked hypertension and to predict future sustained hypertension. Furthermore, early-stage, non-pharmacologic intervention, such as lifestyle modification, might be useful for these individuals. Home blood pressure measurements should be taken especially in abdominally obese people because of their high probability of masked or sustained hypertension.

## **METHODS**

Patients who came to outpatient department in JSS hospital Mysore satisfying inclusion and exclusion criteria from October 2014-October 2016. Type of study was survey/exploratory study and comparative study.

#### *Inclusion criteria*

- Age 18-60 years
- Patients who are not a known hypertensive
- Obese diabetics

- Non-obese diabetics.

**Exclusion criteria**

- History of smoking or
- Alcoholic
- Hypertension.

Method of collection of data (including sampling procedure and statistical methods) sample size calculation: method of sampling-stratified random sampling. Minimum sample size=400. 200-obese diabetics. 200-non-obese diabetics. Among patients who came to medicine department as outpatient during the years 2014-2016 and those who are not a known hypertension was identified. Based on inclusion and exclusion criteria subjects were enrolled into the study. Obese patients were selected based on the:

International diabetic federation criteria of obesity for south Asian ethnicity, waist circumference >90cm for men and >80cm for women. Diabetes patients are selected who are already diagnosed and on any specific therapy. 200 non-obese diabetic patients and 200 obese diabetic patients are selected, and frequency of masked hypertension and white coat hypertension in both groups was evaluated and compared using statistical methods.

Participants were explained about details of study and informed consent was obtained. A detailed history and clinical examination was done and data was being entered in to a pretested proforma. Using noninvasive automatic blood pressure device home BP was recorded to enrolled subjects. It was being done at free of cost to subjects. Patients were educated regarding the use of the apparatus and also a pictorial presentation regarding the use of apparatus was given to patients.

**Statistical analysis**

- Descriptive statistics

- Chi-square test
- Somers d test
- Contingency table analysis.

**RESULTS**

200 non-obese diabetics and 200 obese diabetics were studied over a 2-years period (2014-2016) and each patient was categorized into either of the 4 groups normotension (NT), sustained hypertension (HTN), masked hypertension or white coat hypertension (WCH) based on their clinical and home blood pressures.

- In present study frequency of masked hypertension among non-obese diabetics and obese diabetics is 16% and 20% respectively
- Average clinic SBP, DBP, home SBP and DBP in mmhg among non-obese diabetics with masked hypertension are 133.06, 83.15, 139.06, and 84.45 respectively when compared to normotensive which are 113.44, 71.46, 109.81, 70.86 respectively (significant p value of <0.0001)
- Average clinic SBP, DBP, home SBP and DBP in mmhg among obese diabetics with masked hypertension are 135.60, 84.13, 140.63, and 86.93 respectively when compared to normotensive which are 117.80, 74.10, 115.59, 72.71 respectively (significant p value of <0.0001).

**Table 2: Frequency of normotension, hypertension, masked hypertension and white coat hypertension among non-obese and obese diabetics.**

	Diabetics				P
	Non-obese (200)		Obese (200)		
	N	%	N	%	
NT	124	62.0%	104	52.0%	0.037
HTN	40	20.0%	48	24.0%	0.4
MH	32	16.0%	40	20.0%	0.2
WCH	4	2.0%	8	4.0%	0.02

**Table 3: Comparison of clinic SBP, DBP, home SBP, DBP among non-obese diabetics.**

	Non-obese diabetics								P
	Normal		HTN		MH		WCH		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Clinic SBP AVG	113.44	10.53	143.73	3.90	133.06	4.60	141.00	1.00	<0.0001
Clinic DBP AVG	71.46	5.31	93.93	5.21	83.15	4.27	88.00	0.00	<0.0001
Home SBP AVG	109.81	10.45	140.03	4.25	139.06	3.60	133.33	0.58	<0.0001
Home DBP AVG	70.86	5.22	89.20	5.18	84.45	3.78	84.00	0.00	<0.0001

**DISCUSSION**

Masked hypertension is an emerging clinical entity with under recognised prevalence and is associated with

increased cardiovascular risk. With wide spread availability of self-monitoring of home blood pressure more and more evidence of its detection is budding. Several risk factors like sex, age, diabetes, obesity,

smoking, alcohol etc are implicated to be associated with masked hypertension. Patients with masked hypertension

are undertreated or not treated and are at risk for future cardiovascular complications.

**Table 4: Comparison of clinic SBP, DBP, home SBP, DBP among obese diabetics.**

	Obese diabetics								
	Normal		HTN		MH		WCH		P
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Clinic SBP AVG	117.80	11.26	145.92	4.17	135.60	2.76	142.63	0.74	<0.0001
Clinic DBP AVG	74.10	6.12	94.40	3.91	84.13	3.44	91.25	1.39	<0.0001
Home SBP AVG	115.59	11.21	143.21	4.36	140.63	3.48	133.38	0.74	<0.0001
Home DBP AVG	72.71	5.80	90.58	4.18	86.93	3.04	83.38	1.19	<0.0001

Although white coat hypertension is known since long time and was generally accepted at low risk for cardiovascular complications compared to sustained hypertension, they are usually at high risk for developing sustained hypertension in the future. Very few studies are available regarding the prevalence of masked hypertension and white coat hypertension in general population and in particular in obese and diabetic population. Current study makes an important contribution to the literature of masked hypertension and especially in non-obese diabetic and obese diabetic population. Ours is a prospective study to evaluate the frequency of masked hypertension among non-obese diabetics and obese diabetics and comparing the both groups.

Current study included a total of 200 non-obese diabetics and 200 obese diabetics selected based on inclusion and exclusion criteria. Patients' clinic blood pressure was measured and an automatic blood pressure was given to the patient to record their home blood pressures. Average of total 6 readings (3 morning and 3 evening) was taken for home BP. Based on both home and clinic blood pressures each subject is categorised into one of the four groups normotension, sustained hypertension, masked hypertension and white coat hypertension. This study used criteria of SBP>140mmHg for clinic and SBP>135mmHg for home to label as hypertensives. In present study, frequency of MH among non-obese diabetics and obese diabetics are 16% and 20% respectively.

When compared with other studies which were done on general population like OHASAMA study with prevalence of 10%, PAMELA study with prevalence of 9%, and in study done by Bjorkund et al with prevalence of 14% present study has more prevalence in both non obese diabetic groups and obese diabetic groups suggesting obesity and diabetes as one of the risk factors.<sup>3-5</sup> Even in the above other studies the prevalence is varying because of the use of different cut offs for BP readings and different number of average readings which were taken into consideration.

But there are very few studies of masked hypertension in diabetic population. One current study is IDACO study which showed prevalence of masked hypertension of 29.3% in diabetics compared to prevalence of 18.8% among non-diabetics.<sup>14</sup> But current study showed a prevalence of 16% and 20% among non-obese and obese diabetics. IDACO study has used only average of 2 readings where as in this study we used an average of 6 readings, and excluded smokers and alcoholics from the study which may be the cause of lesser prevalence when compared to IDACO study.

Prevalence of white coat hypertension among diabetics as per kramer et al is 14.4%.<sup>15</sup> But in present study we found frequency of masked hypertension of only 2 % among non-obese diabetics and 4% among obese diabetics. sample size may be the limitation of current study. In current study among non-obese diabetics' average of clinic SBP, DBP, home SBP and DBP among normotension group is 113.4mmHg, 71.46mmHg, 109.81mmHg, and 70.86mmHg respectively and among masked hypertensive group is 133.06mmHg, 83.15mmHg, 139.06mmHg and 84.45mmHg respectively with significant p value of <0.0001 on comparing the both.

In current study among obese diabetics' average of clinic SBP, DBP, home SBP and DBP among normotension group is 117.4mmHg, 74.10mmHg, 115.59mmHg, and 72.71mmHg respectively and among masked hypertensive group is 135.60mmHg, 84.13mmHg, 140.63mmHg and 86.93mmHg respectively with significant p value of <0.0001 on comparing the both. In current study on comparison, all readings of average clinic SBP, DBP, home SBP and DBP among non-obese diabetics which are 133.06mmHg, 83.15mmHg, 139.06mmHg, and 84.45mmHg respectively are lesser than obese diabetics which are 135.60mmHg, 84.13mmHg, 140.63mmHg and 86.93mmHg respectively.

Limitations of the study was larger study needed to make an appropriate comparison.



## CONCLUSION

In summary, currently study demonstrated frequency of masked hypertension of 16% and 20% among non-obese diabetics and obese diabetics, which is higher when compared with other studies done on general population.

There are no studies done on masked hypertension among obese and non-obese diabetics for proper comparison of data from current study.

As the frequency is higher in both Non-obese diabetic and obese diabetic groups of current study it signifies the importance of recording the home blood pressures to detect masked hypertension as it is associated with cardiovascular risk. Present study findings regarding WCH of 2% and 4% frequency among non-obese diabetics and obese diabetics cannot be compared with other data as nobody has done any study among these groups. Study data is pioneer data.

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