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Ambulatory Blood Pressure Monitoring Use in the Diagnosis and Management of Hypertension

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Abstract

Background: The classic definition of HTN is based on office blood pressure (OBP) (CBP) measurements, yet The measurements in the office may not reflect the true BP levels**.** Ambulatory blood pressure measurement (ABPM) is a non- invasive method for continuous hourly monitoring of blood pressure for 24 hours during patients' routine activities.

Objectives: to evaluate the role of ambulatory blood pressure monitoring (ABPM) in the diagnosis, to guide the accurate management of hypertension and to raise awareness of the benefit using ABPM in the reduction of cardiovascular event, stroke and end-organ damage.

Participants and methods: A cohort retrospective study of 208 patients {69 known hypertensive patients on treatment and 139 participants with high office blood pressure measurement, (OBPM)}, at Misurata primary health care clinic. They were referred by their physicians to apply ambulatory blood pressure measurement hourly for 24 hours during the period from January 2022 till June 2023. ABPM results were used to describe patients' characteristics, different types of hypertensions, the control of the hypertensive state by treatment, and the presence of cardiovascular risk factors, were documented and analyzed.

Results: According to average 24 hour records of ambulatory blood pressure measurements (ABPM), the patterns of blood pressure that were recorded were: 46 normotensives (22.1%), 162 sustained hypertensive (77.8%). 69 of them were known cases on treatment, 37 were controlled hypertension 53.6% (treated normalized hypertension), 30 uncontrolled hypertensions (43.4%), and 10 patients with pseudo resistant hypertension (14.49%).

White Coat Hypertension were recorded in 22 patients (15.8%) and 24 patients had White Coat Effect (14.8%), 1 patient Isolated Nocturnal Hypertension, and 2 patients were Masked Hypertension.

Regarding the Nocturnal pattern of hypertensive patients, there was 68 dippers (41.9%), 75 non-dippers (46.2%), 2 extreme dippers (1.2%), 17 reversed dipping (10.49%), 21 cases have morning surge (12.9%).

Conclusion: The present study demonstrated convincing evidence regarding the usefulness of ABPM as the gold standard for the diagnosis of new cases of hypertension in Libya. And preventing misdiagnosis in approximately one-third of all treated and untreated subjects, detect cases of under-treatment, overtreatment and identify cases of pseudo-resistance (white coat effect), as well as detecting morning surge and night -time blood pressure variations which is an important cardiovascular risk factor.

I) Introduction:

The global incidence of hypertension was estimated to be 1.13 billion cases in 2015, the overall prevalence of hypertension in adults is around 30-45 % *(Mills et al. 2016).* High blood pressure is the leading risk factor for cardiovascular diseases globally with 13% attributable deaths and is causing a major increase in loss of disability-adjusted life years *(The task force for the management of arterial hypertension 2019).*

In 2018, an analysis of blood pressure screening recorded that the prevalence of hypertension in Libya was 40.6%. *(Beaney, et al. 2020).* Presently the diagnosis of hypertension in Libya is generally based on office blood pressure measurement (OBPM), using mainly a mercury sphygmometer, a method that can be liable to errors and misinterpretation. Most clinicians use OBPM of more than 140\90 to diagnose hypertensive disorders, which may not reflect the true blood pressure (BP) level of the patient *(Myers et al., 1979.)*. Several studies documented irrefutable evidence confirming that the 24-hour ambulatory blood pressure (ABPM), and particularly the nighttime blood pressure (BP) measurements were superior to (OBPM), in predicting total cardiovascular mortality and cause-specific cardiovascular complications in patients with hypertension *(Huang et al., 2023).*

Ambulatory blood pressure monitoring (ABPM) allows measurement of BP cross-classifying individuals with their OBPM, thereby differentiating masked hypertension from office normo-tension and white-coat hypertension from office hypertension. Another unique feature of ABPM is that only this approach can reveal BP variation over the whole day, morning BP surge, and the responsiveness of blood pressure to physical and mental stressors. *(Kario et al.,2011. Yang et al.,2019).*

Patients with white-coat hypertension (WCH) have elevated office blood pressure and normal out-of-office blood pressure, whereas those with masked hypertension have normal office blood pressure and elevated out-of-office blood pressure *(Pierdomenico, Cuccurullo, 2011)*. Diagnosis of WCH according to European guidelines encompasses subjects with office systolic/diastolic blood pressure readings of ≥140/90 mm Hg and a 24-hour blood pressure <130/80 mm Hg. It occurs in 15% to 30% of subjects with an elevated office blood pressure, more frequently in women, older adults, nonsmokers. (O'Brien et al.; 2013).

The misdiagnosis of subjects with white-coat hypertension as being truly hypertensive can result in them being penalized for employment and insurance rating, as well as being prescribed unnecessary lifelong treatment with potential side effects that may be seriously debilitating, especially in the elderly *(ManciaBombelli, Cuspidi, Grassi 2017).*

The circadian rhythm of BP has been documented in most normotensive and hypertensive individuals. Rhythmic variations in BP require great interest as several cardiovascular diseases, such as myocardial infarction, stroke, arrhythmia, and sudden cardiac death, are linked to CR dysregulations. These events often occur in patients whose BP fails to decline during the night. Such patients are called non-dippers Historically, a nocturnal BP drop lower than 10% has been largely accepted to define patients with abnormal circadian rhythm (non-dippers*). (Cuspidi et al. 2017,Hower, 2018)*

Patients with Isolated Nocturnal Hypertension (INH) and those who were non-dipper are at more risk to cardiovascular events and stroke than daytime BP and this can be detected only by the use of

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ABPM, and they can be targeted with treatment. The same can be applied to the subjects with Morning surge. Also many patients who were found to be non-dipper hypertensive cases have associations with obstructive sleep apnea syndrome. *(Hermida, et al., 2011, Yang et al., 2017, Cuspidi et al., 2019).*

II) Participants and method:

A retrospective cohort study, the records of 208 participants (107 males and 101 females) average (50 and 46 years respectively)., attended primary care hypertension follow-up clinics in Misrata city, during the period of January 2022 till June 2023, were revised for the evaluation of the role of ambulatory blood pressure measurements (ABPM) in the diagnosis and management of participants with high blood pressure readings. There were 69 known hypertensive patients on treatments, and 139 had high office blood pressure measurements (OBPM). The blood pressure was monitored at an hourly interval during the day and night for 24 hours period during normal physical activity. ABPM was performed according to standard instructions using validated 24-h ABPM devices (**Contec** manufacture is a handheld 24h ABPM, which is designed according to oscillography theory. It is an automated device which will measure multiple BP readings every 15-30 minutes to 1 hour over one or two days during the patient's normal activities). In our study the measurement interval times were set at one- hour intervals for 24-h (daytime and night-time). The monitors are provided with three cuffs (child size, adult, and large adult sizes). The adult BP cuff was worn on the non-dominant arm with cuff size determined by the upper arm circumference.

Patient characteristics, medication intake and specific cardiovascular risk factors were registered. Interpretation of ABPM profile included mean daytime, night-time (sleep) and 24-hour hourly measurements, and consideration of diary information and time of drug treatment.

In our study we used the latest upper limits of normality as recommended by the Joint National Committee on Prevention, Detection, and Treatment of High Blood Pressure 2004, (JNC-VI) which are < 135/85 mmHg while patients are awake and < 120/70 mmHg while patients were asleep, and the 24 hours mean of < 130/80 mmHg. ABPM is useful in detecting Masked Hypertension (MH) which is defined when office BP levels are normal in an untreated subject and (ABPM) BP levels are elevated (average daytime >135/85). It is found in 10-20% of subjects and more common in diabetic patients. The CV risk in patients with MH is similar to the risk in patients with sustained HTN.

The ABPM reports were submitted to the treating physicians. The study did not include adolescents, children, and pregnant patients, as they are managed in special care clinics

III) Results:

Table I: Demographic distribution of the participants

Demographic data	No. %
Male	107 (51.4%)
Female	101 (48.56%)
Average age	48 years
Female average age	46 years
Male average age	50 years
Total sample size	208

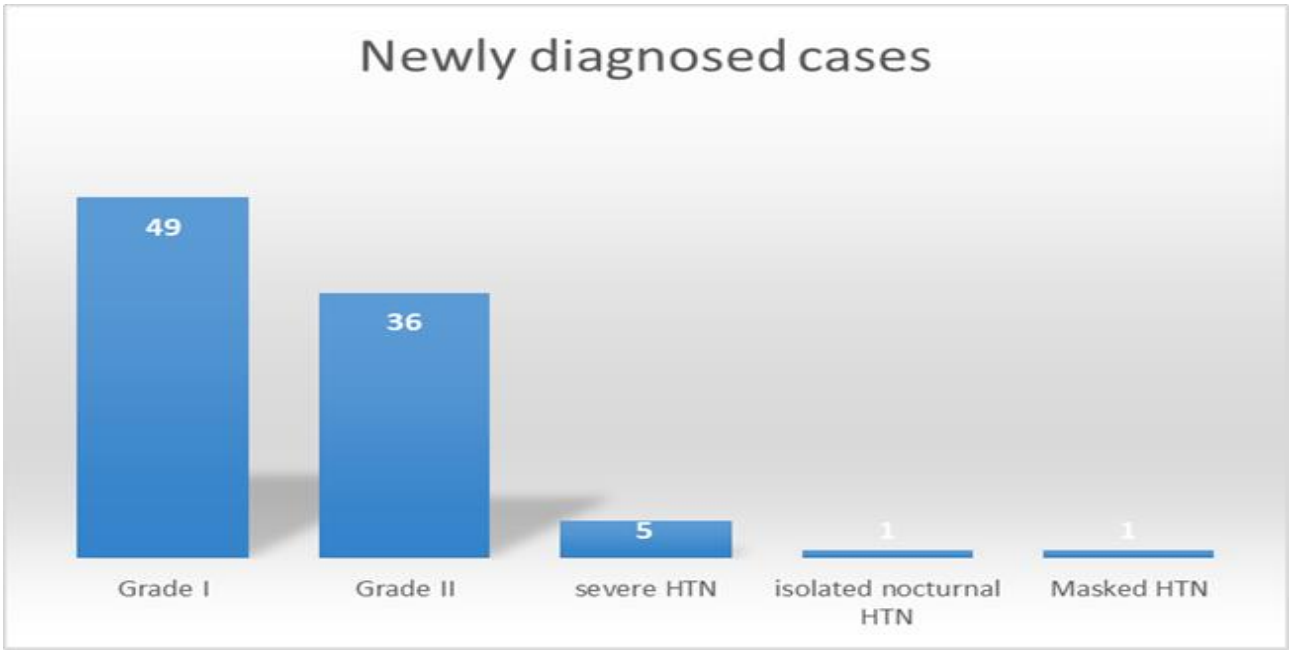
In the present study of 208 participants with high blood pressure office reading, male represented slightly more than half of the study population (107, 51.4%), with average age (50 years). and 101 female (48.6%) with average age of 46 years. Table I

Normotensive patients represented nearly quarter of the participants (22,1%), more than half of them were females. One -third of the sample were known hypertensive on treatment, with nearly equal male to female distribution. Forty-four percent were newly diagnosed hypertensive patients. Table II

Blood Pressure status	Female No.	% (101 cases)	Male No.	% (107 cases)	Total (208 cases)
Normotensive	27	27.7%	19	17.7%	46 (22.1%)
Known hypertensive on treatment	35	34.7%	34	31.8%	69 (33.2%)
Newly diagnosed	39	37.6%	54	50.5%	93 (44.7%)
Total	101	100%	107	100%	208 (100%)

White Coat Hypertension was diagnosed in 22 participants. They had high office blood pressure > 140/90 mmHg but by ABPM their average day time blood pressure readings were recorded to be < 130/80 mmHg accordingly they were not hypertensive patients. Twenty-four of the known hypertensive patients had White Coat Effect detected by ABPM who were diagnosed as resistant hypertension according to OBP measurements.

Nearly half of the sample (44%) were newly diagnosed hypertensive cases (93 cases), more than half of them were grade I (54%), their systolic between 135-149 mmHg and diastolic between 85 and 94 mmHg. Grade II was found in 36 cases (40%) with average ABPM during daytime was



150/95mmHg or higher. Severe hypertension was found in five cases with blood pressure of 180/120 and above. Masked hypertension was found in one case, where his office blood pressure was less than 140/90, while his average day time ABPM was more than 135/85mmHg. Isolated nocturnal hypertension was found in one case. Figure 1

Figure 1: Stages of hypertension in newly diagnosed cases.

In the 69 known hypertensive patients on regular treatment, only half of them 37 patients (53%) were treated normalized hypertensive patients, thirty patients (43.4%) were uncontrolled, and two patients (2.9%) were over-treated. Figure 2:

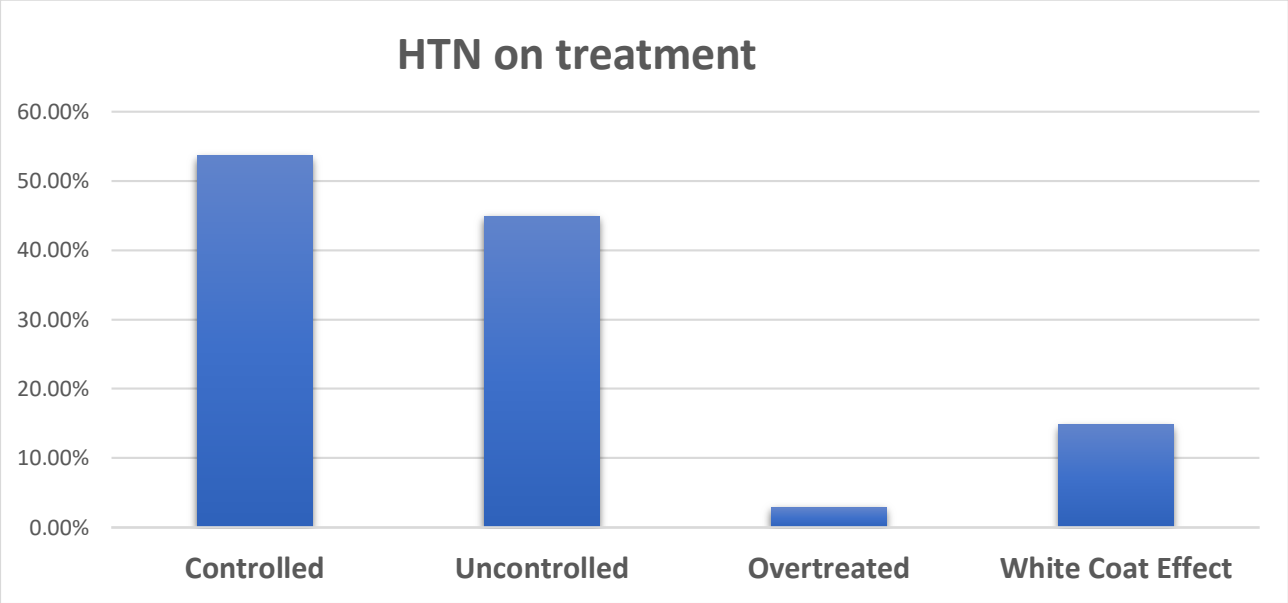


Figure 2: Hypertensive patients on treatment

In the 162 hypertensive patients (known 69 cases on treatment, and 93 newly diagnosed cases), the pattern of nocturnal blood pressure was recorded and detected (non-dipping, reverse dipping, extreme dipping, and morning surge). These are cardiovascular diseases risk factors. There were 75 (46.2%) hypertensive patients with non-dipping patterns, also seventeen patients (10.49) were reverse dippers, and two patients (1.2%) with extreme dipping. Morning surge was reported in 21 hypertensive patients (12.9%). Figure 3

compared with daytime blood pressure values) is an alteration of circadian blood pressure rhythm. It is frequently documented in hypertension, type 2 diabetes mellitus, chronic kidney disease, and sleep apnea

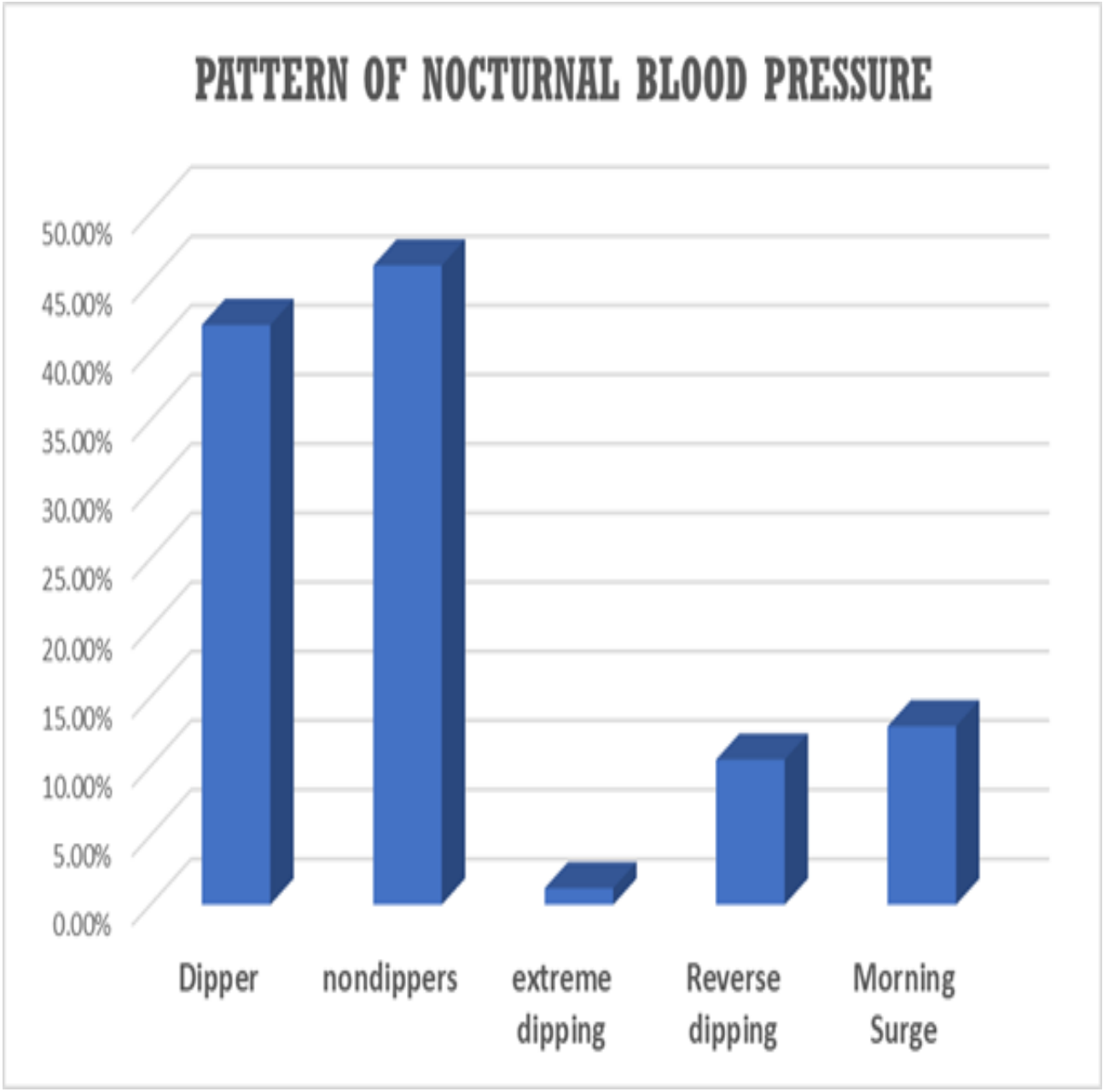


Figure 3: Pattern of nocturnal blood pressure

IV) Discussion:

In this study, we investigated the use of ambulatory monitoring (ABPM) to estimate the mean level of blood pressure over prolonged periods. For decades the risks of hypertension and the benefits of treating it were based on the traditional method of taking a small number of readings with the auscultatory technique in a medical setting.

Pierdomenico stated that office blood pressure measurements (OBPM) provide a poor estimate of risk in an individual patient for reasons such as poor technique of the observer, the "white coat" effect and the inherent variability of blood pressure. (*Pierdomenico et al., 2011).*

Pickering recorded that ambulatory blood-pressure monitoring (ABPM) is currently used only in the minority of patients with hypertension. Ambulatory monitoring can be regarded as the gold standard for the prediction of risk related to blood pressure, since prognostic studies have shown that it

predicts clinical outcome better than conventional blood-pressure measurements. *(Pickering,Shimbo,Haas, 2006).*

Ogedegbe, argued that the combination of out-of-office blood pressure measurements (via ambulatory and home blood pressure monitoring) with office blood pressure measurements allows clinicians to identify four types of blood pressure status: normotension, white-coat hypertension, masked hypertension, and sustained hypertension *(Ogedegbe , Agyemang and Ravenell , 2010).*

In the current study, we investigated the value of monitoring high blood pressure using ABPM for diagnosis and management of high blood pressure. We found significant evidence that through a continuous record of BP during 24 -hour period we can diagnose and differentiate different grades of hypertensive state (Grade I, II, severe HTN), and detect hypertensive cases of under-treatment and overtreatment.

In the present study, patients with white coat effect and hypertension were identified and managed accordingly. Our results were online with those previously reported by other author (Cuspidi), who stated that white-coat hypertension (WCH) does not appear to benefit from anti-hypertensive treatment. Cardiovascular morbidity seems low in WCH. It is obvious that the lower the BP regarded as the limit of normality, the less likely the occurrence of secondary effects of metabolism, or end-organ effects or complications in those classified as hypertensive. It does not seem that WCH predicts cardiovascular morbidity or mortality *(Cuspidi et al., 2017).*

In our study we found cases of reverse or inverted dipping (i.e., the phenomenon characterized by higher nighttime

syndrome, and generally regarded as a harmful condition. Also, many patients who were found to be non-dipper hypertensive cases have associations with obstructive sleep apnea syndrome. These cases cannot be detected through one-time office reading and are considered risk factors for cardiovascular complications.

Cuspidi stated that those who had Isolated Nocturnal Hypertension (INH) and those who were non-dipper are at more risk to cardiovascular events and stroke than daytime BP and this can be detected only by use of ABPM so it can be targeted with treatment. The same can be applied to the subjects with Morning surge. *(Cuspidi, et al., 2017,Hower,2018).*

We found some patients with risk factors who were even undertreated, and as Muntner stated that the presence of cardiovascular disease risk factors, clinical cardiovascular disease, diabetes mellitus and target organ damage significantly increase the absolute risk of cardiovascular disease associated with high blood pressure. *(Muntner, He, , Roccella, and Whelton 2002).*

One of our objectives was the diagnosis of masked hypertension and to identify patients who have persistently elevated out-of-office blood pressure and thus are not receiving treatment or are treated inadequately. Ogedegbe declared that ideally, the “gold standard” for identifying patients with masked hypertension is ABPM. *(Ogedegbe, Agyemang, Ravenell 2010).*

Perloff conducted a pivotal study with a mean of eight years' follow-up reported a progressive rise in risk of cardiovascular morbidity and mortality. There is a stronger relationship between left ventricular hypertrophy (LVH) and 24-hour ambulatory systolic blood pressure (ABPM) than office or casual systolic blood pressure measurement (OBPM). There is also a relation between increasing levels of ABPM and the occurrence of angina, peripheral arterial disease, stroke, or myocardial infarct. Many prognostic studies have shown that ABPM predict clinical outcomes better than conventional blood-pressure measurements. (*Perloff, et al.1989*, *Muntner,2002, Fujiwara,2020*).

V) Conclusions:

The present study demonstrated convincing evidence regarding the usefulness of ABPM as the gold standard for the diagnosis of new cases of hypertension in Libya. Using ABPM may prevent misdiagnosis in approximately one-third of all treated and untreated subjects. This could reduce unnecessary treatment because of WCH and lead to improved treatment for those with masked hypertension, isolated nocturnal hypertension, and pseudo-resistant cases. The diagnosis of white coat hypertension by means of ABPM can lead to reduction of health care costs. Night-time blood pressure pattern (Non-dipping, Reverse dipping and Morning surge) is an important cardiovascular risk predictor which if detected in time can reduce morbidity and mortality of hypertensive patients and it can only be detected by ABPM.

VI) Recommendations:

- we recommend the use of ABPM technique in all newly diagnosed hypertensive patients by means of office blood-pressure measurements (OBPM).

- ABPM is recommended to assess all types of blood pressure patterns and to reduce the cost of overtreatment.

- Masked hypertension is a recognized cardiovascular risk factor and should be treated with antihypertensive medications, like patients with sustained hypertension.

- In cases of non-dippers, it is recommended that an appropriate antihypertensive chronotherapeutic approach should be followed because of the high cardiovascular risk associated with this condition.

- We should change our practice in diagnosis and management of hypertension and use ABPM and not Office BP measurement exclusively.

VII) References:

1- Beaney T, et al.; (2020): An analysis of blood pressure screening in Libya. Eur Heart J Suppl. (Suppl H):H77-H79.
doi: 10.1093/eurheartj. /suaa011. PMID: 32884477; PMCID: PMC7456182.

2- Boggia J, Luzardo L, Lujambio I, Sottolano M, Robaina S, Thijs L, et al. (2016): The diurnal profile of central hemodynamics in a general Uruguayan population. Am J Hypertension.; 29; p: 737–46.
doi: 10.1093/ajh/hpv169.

3- Cuspidi C, Sala C, Tadic M, Gherbesi E, De Giorgi A, Guido G, et al., (2017): Clinical and prognostic significance of a reverse dipping pattern on ambulatory monitoring: An updated review. J Clin Hypertens; 19; p:713–21.
Wiley Periodicals, LLC DOI: 10.1111/jch.13023

4- Hermida C, Ayala E, Mojón A, Fernández R. (2011): Decreasing sleep-time blood pressure determined by ambulatory monitoring reduces cardiovascular risk. J Am Coll Cardiol.; 58; p:1165–73
[PubMed] [Google Scholar].

5- Hower M, Harper A, Buford W. (2018). Circadian rhythms, exercise, and cardiovascular health. J Circadian Rhythms.p;16:7. https://doi.org/10.5334/jcr.164.

6- Huang Q, Yang W, Asayama K , Zhang Z , Thijs L, Yan L , O'Brien E , and Staessen A. (2023). Ambulatory Blood Pressure Monitoring to Diagnose and Manage Hypertension. Hypertension Jr;77; p:254–64.
Downloaded from http://ahajournals.org. doi:10.1161/hypertensionaha

7- Kario K, Yano Y, Matsuo T, Hoshide S, Eguchi K, Shimada K. (2011): Additional impact of morning haemostatic risk factors and morning blood pressure surge on stroke risk in older Japanese hypertensive patients. Eur. Heart J; 32; p:574–80.
[PubMed] [Google Scholar].

8- Fujiwara T, Hoshide S, Kanegae H, Kario K. (2020: Cardiovascular Event Risks Associated with Masked Nocturnal Hypertension Defined by Home Blood Pressure Monitoring in the J-HOP Nocturnal Blood Pressure Study. Hypertension; 76; p:259-66. doi: 10.1161/hypertensionaha.120.14790
9- O'Brien E, Parati G, Stergiou G, et al.; (2013): on behalf of the European Society of Hypertension Working Group on Blood Pressure Monitoring. European Society of Hypertension position paper on ambulatory blood pressure monitoring. J Hypertens. 2; (31); p:1731–67. Crossref. PubMed
10- Ogedegbe G, Agyemang C, Ravenell J. (2010): Masked hypertension: evidence of the need to treat. Curr Hypertens. Rep. 12(5); p:349-55. doi: 10.1007/s11906-010-0140-4. PMID: 20694858; PMCID: PMC3021509.
11- Mancia G, Bombelli M, Cuspidi C, Facchetti R, Grassi G. (2017): Cardiovascular risk associated with white-coat hypertension: pro side of the argument. Hypertension;70; p: 668–75.
12- Mills T, Bundy D, Kelly T, Reed E, Kearney M, Reynolds K, et al.; (2016): Global disparities of hypertension prevalence and control: a systematic analysis of population- based studies from 90 countries. Circulation of.134; p:441-50.
13- Muntner P, He J, Roccella E, Whelton P. (2002): The Impact of JNC-VI Guidelines on Treatment Recommendations in the US Population. Hypertension 39, (4); p: 897-902
14- Myers G, Godwin M, Dawes M, Kiss A, Tobe W, Kaczorowski J. (2010): Measurement of blood pressure in the office: recognizing the problem and proposing the solution. Hypertens. (Dallas, Tex: 1979);55; p:195–200. https://doi.org/10 1161/01.HYP.0000013862.13962.1D
15- Perloff D, Sokolow M, Cowan R, et al. (1989): Prognostic value of ambulatory blood pressure measurements: further analysis. J Hypertens; l 7;p: S3-S10.
16- Pickering G, Shimbo D, Donald, Haas D. (2006): Ambulatory Blood-Pressure Monitoring: current concepts, The New Engl J Med.; p: 354. www.nejm.org
17- Pierdomenico D, Cuccurullo F. (2011): Prognostic value of white coat and masked hypertension diagnosed by ambulatory monitoring in initially untreated subjects: an updated meta-analysis. AM j Hypertension ,24; p:52-8[PubMed].
18- Seventh Report of the Joint National Committee on Prevention, Detection, and Treatment of High Blood Pressure (2004) (JNC-VI): National High Blood Pressure Education Program. U.S. department of health and human services national institutes of health National Heart, Lung, and Blood Institute. NIH Publication No. 04-5230
19- The task force for the management of arterial hypertension of the European Society of Cardiology (ESC) and European Society of Hypertension (ESH). (2019): Guidelines for the management of arterial hypertension. European Heart Journal, 40(4); p:475. http://doi.org/10.1093/eurheartj/ehy686
20- Yang Y, Melgarejo D, Thijs L, Zhang Y, Boggia J, Wei F, et al; (2019). International Database on Ambulatory Blood Pressure in Relation to Cardiovascular Outcomes (IDACO) Investigators. Association of office and ambulatory blood pressure with mortality and cardiovascular outcomes. JAMA; p:409–20. doi:10.1001/jama.2019.9811.