Home or ambulatory blood pressure monitoring for the diagnosis of hypertension?

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In 2008, the European Society of Hypertension (ESH) [1] and the American Heart Association/American Society of Hypertension [2] published guidelines for home blood pressure (HBP) monitoring and both recommended this method to be widely applied in clinical practice in both the initial diagnostic phase in patients with elevated blood pressure (BP) and also in the long-term follow-up of treated hypertension. These recommendations are based on the evidence about the prognostic value of HBP, its diagnostic ability, its cost-effectiveness, and its good acceptance by hypertensive patients [1,2].

Several studies have assessed the diagnostic value of HBP monitoring by taking ambulatory blood pressure (ABP) monitoring as reference method [1–4]. These studies, however, were quite heterogeneous with regard to their methodology and/or their objectives. First, 11 studies included untreated patients ($n = 1866$), whereas seven studies included treated hypertensive patients ($n = 1059$) [3,4]. Moreover, these previous studies included individuals on triple therapy, diabetic patients, patients with renal failure, on hemodialysis, or children and adolescents [3,4]. Second, the diagnostic endpoint was either white-coat hypertension, masked hypertension, sustained hypertension, white-coat effect, masked uncontrolled hypertension, resistant hypertension, or a mixture of these. Third, some studies have taken daytime ABP as reference whereas others focused on 24-h ABP as their reference, and different HBP schedules have been used [3,4]. The results of all these studies, although largely varying according to the diagnostic endpoint, tend to agree in indicating a higher specificity and higher negative predictive value with lower sensitivity and lower positive predictive value for the HBP monitoring method as compared with ABP monitoring.

In this issue of the *Journal of Hypertension*, Kang *et al.* [5] provide further evidence in this regard, by reporting on the results of a cross-sectional study including data from 1774 patients in China, aimed at comparing the diagnostic accuracy of HBP with that of 24-h ABP monitoring. The results of this study are largely in line with the findings of the above-mentioned previous articles. Moreover, in these previous studies [3,4], there was moderate-to-substantial diagnostic agreement between the two methods (κ statistic 0.40–0.70) [6], a finding that is confirmed by the data by Kang *et al.* [5] who reported κ-statistic values 0.40–0.66 in untreated and 0.41–0.58 in treated patients when comparing the diagnostic agreement between HBP and ABP monitoring.

Although rather confirmatory of previous papers, the study by Kang *et al.* [5] has several points of strength. First, analyses were performed on a large sample of individuals. Second, both treated and untreated individuals were included. Third, assessments of white-coat, masked and sustained hypertension were included in a single analysis. Fourth, 24 h rather than daytime ABP values were chosen to be taken as reference BP level, which means that night-time ABP was not ignored, in line with recent ESH ABP monitoring guidelines [7,8]. Indeed, the prevalence of masked hypertension was always significantly larger when this condition was assessed by 24-h ABP monitoring, regardless of the antihypertensive treatment status. Fifth, HBP monitoring was implemented according to the recommended schedule by ESH guidelines [1], with 7-day monitoring and duplicate morning and evening measurements. Sixth, assessment of HBP was based on readings exported by the device memory, which thus prevented misreporting; and seventh, implementation and conduction of this study was done in China where there are scarce data comparing HBP with ABP.

Overall, the findings by Kang *et al.* [5] strengthen the importance of current recommendations indicating that presence of masked hypertension should be evaluated by taking into account a whole 24-h monitoring period and not only limiting the assessment to the awake period [7,8]. Somehow surprisingly, however, authors did not find an association between masked hypertension and advanced age, diabetes mellitus, and, more in general, major cardiovascular risk factors, a finding which is in contrast with other population studies [9–11].

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Probably, this is related to the fact that cardiovascular risk level was only low to moderate in this study, and the mean age of the population was younger than in the previous articles. An additional explanation of such finding might be that Chinese hypertensive patients may behave differently from Caucasian individuals, and thus cross comparison of data collected in different ethnic groups worldwide could be useful to identify possible differences.

The findings on the diagnostic agreement between HBP and ABP monitoring data in the study by Kang *et al.* [5] are supported by the results of a similar European study, which found a good agreement between HBP and ABP [12]. In fact, in this article, Nasothimiou *et al.* [12] also separately analyzed untreated and treated patients and focused on the assessment of white-coat, masked, and sustained hypertension, by investigating in a large dataset the diagnostic ability of HBP versus ABP [12]. Comparison of the two studies in Table 1 shows a striking similarity in the results with a high degree of diagnostic agreement between the two methods, ranging from 80 to 90% across all the hypertension phenotypes in both untreated and treated individuals.

The occurrence of some degree of diagnostic disagreement between HBP and ABP is not an unexpected finding, and should be interpreted by taking into account a few important factors. First, the reproducibility of both HBP and ABP, although being clearly superior to that of office BP, is still imperfect, which means that some level of diagnostic disagreement would be expected even when the same BP monitoring method (HBP or ABP) is applied twice [13]. Thus, on such a background, the level of agreement between the two methods observed in the study by Kang *et al.* [5] as well as in the previous studies [3,4] might be regarded as excellent. Second, any diagnostic disagreement between HBP and ABP does not necessarily mean that ABP is the correct method and HBP is wrong. In fact, a level of disagreement should be expected because, although the two methods have important similarities (given that they both provide multiple measurements in the usual environment of each individual), they also have important differences. ABP is usually monitored only once, although over 24 h and in fully ambulatory conditions, at work, at home, and during sleep, whereas HBP is monitored over several days, weeks, or months, but always in the same environment and posture (seated after a few minutes of rest, at home). Third, because of the above-mentioned methodological differences, HBP and ABP monitoring appear to have a complementary rather than a competitive role in the evaluation of hypertension and provide similar but also different information about the BP profile and behavior. These data are supported by a study in 2051 patients assessed with HBP and ABP monitoring in Italy, which compared white-coat hypertensive patients who had normal HBP and ABP values with those who showed normal values only with one of these out-office BP monitoring methods, and showed that the latter group had higher risk of cardiovascular event and death [14].

An additional and important difference between data obtained in the study by Kang *et al.* [5] and data obtained in the previous studies is that in both untreated and treated patients of the study by Kang *et al.* [5], average diastolic HBP was at similar levels with average 24-h diastolic ABP, whereas systolic HBP was by 4–5 mmHg higher than 24-h systolic ABP.

The study by Kang *et al.* [5] represents one of the first large studies assessing the respective diagnostic values of HBP versus ABP in the detection of white-coat and masked hypertension, in either untreated or treated hypertensive patients. This observational study, based on data collected in a large sample of Chinese hypertensive patients referring to hypertension clinics, yields several relevant new pieces of information on the features of white-coat and masked hypertension as assessed by these BP measuring methods. The low sensitivity and high specificity of home BP suggest that this technique may be useful to exclude a diagnosis of masked or white-coat hypertension but not to confirm its presence. This means that, in terms of hypertension management, ABP monitoring stands as the ideal tool to assess BP control, whereas HBP appears to be a complementary technique [1]. As a matter of fact, although ABP allows repeated measurements to be obtained both during awake activities and night sleep, this is not usually the case for HBP. On the contrary, at variance from 24-h ABP monitoring, self-BP measurements at home are collected over successive days, weeks, or months, which makes HBP monitoring a useful approach to BP assessment during long-term follow-up. With HBP monitoring, however, measurements are usually taken only during waking hours, without any possibility to have information also on night-time BP levels. Thus, on the background of the growing awareness on the importance of night-time BP, in the future, the power of HBP for detecting masked or white-coat hypertension should be tested by considering the inclusion of sleep readings. This possibility is currently provided by new devices for HBP monitoring that allow a number of night-time automated HBP measurements to be obtained. Use of these novel diagnostic tools may thus

TABLE 1. Diagnostic agreement between home and ambulatory blood pressure monitoring in two studies that assessed all hypertension phenotypes separately in untreated and treated patients

		Nasothimiou *et al.* [12]			Kang *et al.* [5]		
Hypertension phenotype	Drug treatment	*N*	Agreement (%)	Kappa statistic	*N*	Agreement (%)	Kappa statistic
White coat	No	252	88	44*	573	83	40*
White coat	Yes	361	92	69*	1201	82	41*
Masked	No	252	94	40*	573	85	46*
Masked	Yes	361	79	69*	1201	84	45*
Sustained	No	252	88	73*	573	83	66*
Sustained	Yes	361	92	80*	1201	82	58*

*$P < 0.001$.

allow to more precisely check the predictive value of HBP *vis-à-vis* that of ABP, under more similar settings.

In conclusion, the study by Kang *et al.* [5], together with the previous studies assessing the diagnostic ability of HBP monitoring, support the position of the ESH [1] that recommended the wide application of the method as a reliable alternative to ABP monitoring for the detection of the white-coat and masked hypertension phenomena and the confirmation of sustained hypertension both in the initial evaluation of untreated hypertension and also in the long-term follow-up, when assessing the occurrence of an effective BP control.

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Conflicts of interest

There are no conflicts of interest.

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