



# Time of the day and season should be considered for automated office blood pressure-based assessment of control status in hypertension clinic

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Despite the limitation of office blood pressure (BP) measurement such as masked and white-coat effects, this method remains the standard in the hypertension management in the clinical setting [1]. Recently, automated office BP (AOBP) has been adopted in the clinical trials, such as SPRINT, and clinical practice as reflected in Canadian guidelines [2, 3]. Its main advantage lies in avoiding the white-coat effect or BP reactivity caused by healthcare personnel, especially when the measurement is unattended [4].

In this regard, the article by J Wang et al. evaluated the control rate of clinic BP measurement using AOBP at the various time point of the day and different seasons in real clinical practice [5]. They demonstrated that pulled AOBP readings at the individual patient level peaked at 7 AM and dipped at 12 PM (noon), with exaggeration and attenuation of the peak in the winter and summer, respectively. Consequently, the control rates were 42.1% in the winter morning and 86.8% in the summer noon with overall difference of 23.9% between measurements at 7 AM and noon.

The intrinsic circadian rhythm driven by endogenous clock is reported to peak at 9 PM [6]. However, there are many environmental factors, such as temperature, humidity, noise, light, behavior, emotional stress, posture, and physical activity, can affect the circadian rhythm of BP. According to the best mathematical modeling of the circadian rhythm in normal young subjects includes 24-hour, 12-hour and 6-hour components [7]. Typical ambulatory BP monitoring (ABPM) displays small pre-awakening BP increase, striking rise upon awakening, two daytime peaks (2–3 h after awakening and

during mid or late activity), small midday nadir, and the decline during sleep [8]. It is uncertain whether the midday component demonstrated in Wang's study is due to the intrinsic rhythm of BP under the steady BP-lowering effect of antihypertensive medication (AHM) or the direct effect of certain AHMs causing changes in the rhythm.

For treated hypertension, the precise peaking and dipping times could be differed based on when antihypertensive medication (AHM) was taken, the time of peak efficacy of the drug, and the drug's half-life, although this information were not available in this study [9]. It is noteworthy that there is relatively low chance of white-coat uncontrolled hypertension (WUCH) when using AOBP. In terms of BP reactivity, while reactivity to diurnal or seasonal stress (except reactivity to healthcare personnel) could be still measured by AOBP, it is important to consider this factor.

When diagnosing BP control status in the clinic in the early afternoon, masked uncontrolled hypertension (MUCH) could be further classified by masked uncontrolled morning hypertension (MUCMH) with reference to the clinic BP or AOBP measured in the morning. According to the diurnal rhythm of BP measured by ABPM, BP in the afternoon could dip for a couple of hours, suggesting that BP measured in the afternoon might be subject to larger masked effect or a higher chance of MUCH compared to measurement taken at other times of the day. This phenomenon is exacerbated in the summer. In the context of intensive BP-lowering therapy, there could be an increased chance of MUCH when using AOBP, potentially leading to an overestimation of the overall control rate [10].

It is unknown which component of seasonal changes or the diurnal changes is responsible for this phenomenon. Theoretically, transient postprandial low BP response might be exaggerated in the summer due to high temperature causing volume depletion and attenuated in the winter due to low temperature causing vasoconstriction. Seasonal

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changes in overall sodium balance might be related. The clustering of summer and women with a higher chance of MUCMH versus the clustering of winter, diabetes and octogenarian with a lower chance of MUCMH is consistent with theoretical considerations. Arterial stiffness might be related to increased reactivity in the winter.

In clinical context, it is recommended that, when evaluating BP control status, appointments should be scheduled in the morning to avoid MUCMH, especially in the summer. BP measurement taken after noon in the summer should not be used to evaluate the achievement of target BP goal. Instead, they might indicate potential patient safety concerns related to excessively low BP. European hypertension guidelines recommend that BP should not lowered below 120 mmHg, but they do not specify the hour of BP measurement [1]. Considering the evidence behind the recommendation, where BP measurement in clinical trials are typically conducted in the morning, and provided the patient shows no symptoms or sign of hypotension, it is reasonable to disregard the BP measurements taken in the afternoon for guiding down-titration of AHM even if they are below 120 mmHg.

## Compliance with ethical standards

**Conflict of interest** The author declares no competing interests.

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