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Can office blood pressure readings predict masked hypertension?

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Abstract

Background—Studies in children with chronic kidney disease indicate a high prevalence of masked hypertension detected by ambulatory blood pressure) monitoring (ABPM). However, it is not well-known if the frequency of masked hypertension is related to the level of normal casual BP.

Methods/Results—We hypothesized that lower levels of normal casual BP are associated with a lower prevalence of masked hypertension. Data from the CKiD cohort were analyzed cross-sectionally across multiple visits. The majority of children with normal casual BP had also normal wake and sleep ABP (60%), even at the highest percentiles of casual BP. The frequency of masked hypertension was lower in children with casual BP ≤25th percentile versus those with casual BP in 26–50th percentile and casual BP in 51–90th percentile during both wake and sleep periods. In children with the lowest normal casual BP levels (≤25th percentile), the frequency of abnormal mean wake or sleep ABP was 2–7%, and of abnormal BP load was 6–16%.

Conclusion—These data suggest that masked hypertension is unlikely if the casual BP is found to be in the low normal range.

Keywords

chronic kidney disease; hypertension; ambulatory blood pressure monitoring; children

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Introduction

Over the last two decades, ambulatory blood pressure monitoring (ABPM) has been used with greater frequency to evaluate blood pressure (BP) in children. While in the general population ABPM is frequently used to diagnose white coat hypertension, in children with chronic medical conditions, ABPM has become a useful tool to detect masked hypertension, a condition characterized by normal office BP but elevated BP outside of a medical setting [1]. Masked hypertension can be found in 25–40% of children with chronic kidney disease (CKD), with especially high rates of nocturnal hypertension [2]. The presence of masked hypertension is independently associated with adverse outcomes, including progression of CKD and cardiovascular disease (CVD) in adults [3] and development of left ventricular hypertrophy (LVH) in children with CKD [4]. In view of the high frequency of masked hypertension and its association with adverse outcomes, many advocate for routine use of ABPM to detect masked hypertension in children with CKD. However, ABPM equipment is expensive, may not be readily available, and is recommended to be performed by only personnel with specific training in the application of the device and interpretation of ABPM data in pediatric patients [1].

Recognizing these limitations, we conducted an analysis to determine if the outcome of ambulatory blood pressure (BP) monitoring studies is predicted by clinic (casual) BP level. Specifically, we analyzed the prevalence of masked hypertension according to casual BP percentiles and hypothesized that lower levels of casual BP were associated with a lower prevalence of masked hypertension.

Methods

ABPM and office BP data were collected from participants enrolled in the Chronic Kidney Disease in Children (CKiD) study, a multicenter prospective observational cohort study being conducted in the United States and Canada. Inclusion criteria were age between 1 and 16 years and estimated glomerular filtration rate (GFR) of 30 to 90 ml/min/1.73m^2 as estimated by the Schwartz equation [5]. Details of the CKiD study design and methodology of casual BP and ABPM measurements have been previously published [2,5,6]. ABPM was offered to all children older than 5 years of age at bi-annual visits beginning with the first follow-up visit. Data were analyzed cross-sectionally across multiple CKiD visits (V2, V4, V6, and V8). Normal casual BP was defined as systolic and diastolic BP<90th percentile for age, gender and height [7]. Masked hypertension was defined according to American Heart Association (AHA) criteria [1] as normal systolic and/or diastolic casual BP and wake and/or sleep systolic/diastolic mean ambulatory BP≥95th. Given the lower threshold for treatment of hypertension in children with CKD, we also included systolic or diastolic BP load ≥25% in the presence of mean ambulatory BP<95th percentile and normal casual BP as criteria for masked hypertension.[2] This group of patients would be unclassified based on AHA classification.[1] To evaluate for the prevalence of masked hypertension according to casual BP percentiles, subjects with normal casual BP measurements – systolic and diastolic independently - were divided into 3 groups: ≤25th percentile, 26–50th percentiles and 51–90th percentiles.

Results

Among 710 visits from 451 children with ABPM studies, there were 204 studies with elevated casual BP and 506 with normal casual BP. The remainder of the analysis presented here is restricted to this latter group. Median (interquartile range) age was 14 (11, 16) years; 41% were females, 14% were African-Americans and 14% were of Hispanic ethnicity. 19% had glomerular disease as a cause of their CKD. Of 506 children with normal casual BP, only 71% were taking antihypertensive medications; 64% were being treated with ACEI/ARBs. The majority of children with normal casual BP also had normal wake and sleep systolic and diastolic ambulatory BP (60%), even those with casual BP between the 51st and 90th percentiles. Overall prevalence of masked hypertension in the cohort was 40%; 6% had isolated wake, 15% had isolated sleep, and 18% had combined wake and sleep masked hypertension.

The prevalence of masked systolic hypertension according to normal casual systolic BP percentiles is shown in Figure 1A; data for diastolic BP are shown in Figure 1B. The frequency of masked hypertension - both systolic and diastolic - was lower in children with casual BP in ≤25th percentile versus those with casual BP in 26–50th percentiles and casual BP in 51–90th percentiles during both wake and sleep periods. In children with the lowest normal casual BP levels (≤25th percentile), the frequency of an abnormal mean wake or sleep ambulatory BP - systolic or diastolic - was 2–7%, and the frequency of an abnormal BP load was 6–16%. For both diastolic and systolic measurements, masked hypertension was highest in subjects in the 51–90th percentile range for casual BP, reaching 29–36% while asleep when BP load was used to define masked hypertension.

Discussion

ABPM is the only reliable method to evaluate sleep BP and diagnose nocturnal hypertension. Our data using a large dataset of ABPM in children with CKD confirm a relatively high prevalence of masked, particularly nocturnal hypertension in children with CKD. These results confirm previously published data from the CKiD study. While previous reports have focused on detailed analysis of factors associated with abnormal ABPM [2,4], the aim of current report was to investigate if degree of casual BP control can predict ABPM results, specifically the presence of masked hypertension. It is important to note, that while masked hypertension was relatively frequent finding, the majority of our subjects with normal casual BP also had a normal ambulatory BP. Masked hypertension, even during sleep, was especially uncommon in subjects with low normal casual BP (≤25th percentile). Our data, in turn, suggest that at least in clinical settings with limited access to ABPM, an estimation of BP outside the medical office could be made based on a BP obtained during a clinic visit; if the casual BP is found to be in the low normal range, ABPM could be omitted from the patient's evaluation. This analysis is limited to children with mild-to-moderate CKD. It would be important to reproduce these results in the general pediatric population and in other populations at high risk for masked hypertension (e.g. diabetes) prior to omitting ABPM from any subset of patients.

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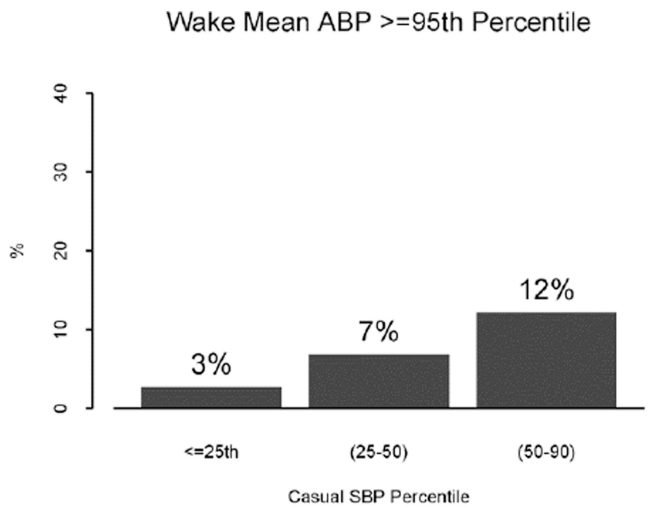

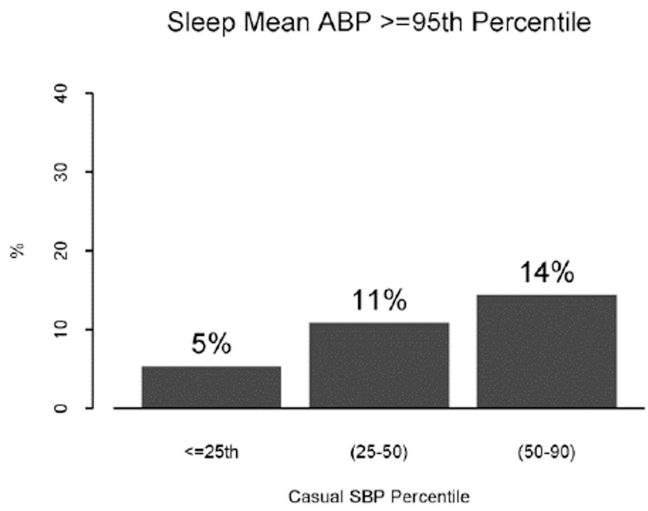

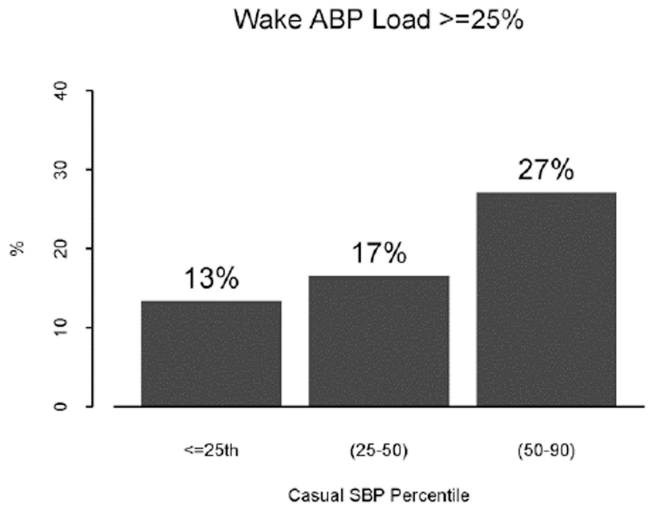

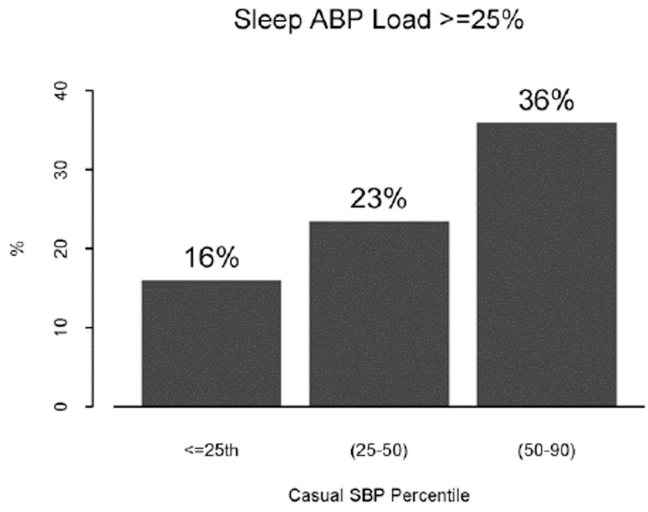

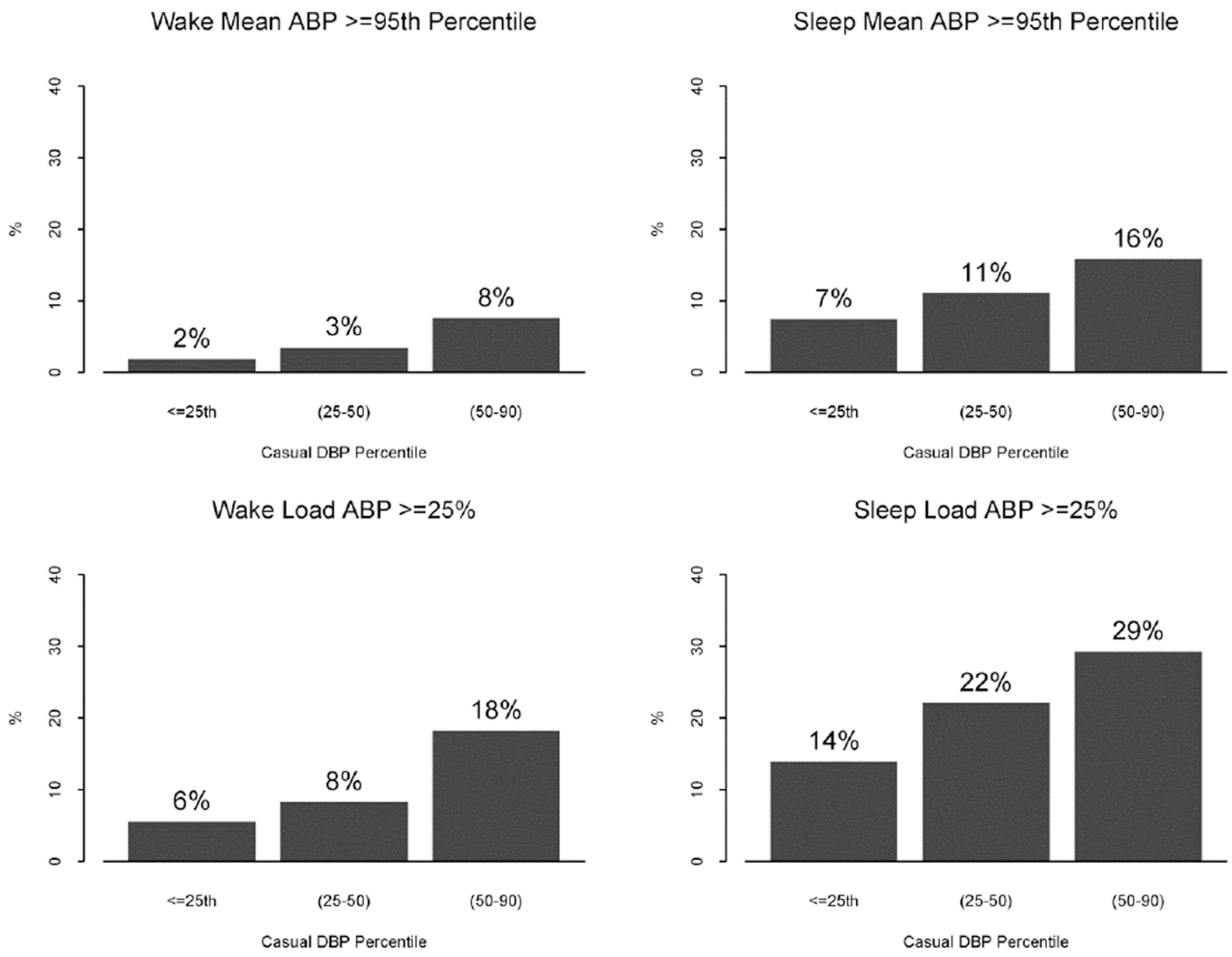

Figure 1.

Prevalence of systolic (A) and diastolic (B) masked hypertension by office blood pressure percentile