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CORRESPONDENCE

Stroke risk due to partial white-coat or masked hypertension based on the ACC/AHA guideline's blood pressure threshold: the Ohasama study

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Introduction

The American College of Cardiology/American Heart Association (ACC/AHA) guideline for the prevention, detection, evaluation and management of high blood pressure (BP) in adults lowered the diagnostic threshold for hypertension of office systolic/diastolic BP from ≥140/≥90 mmHg to ≥130/≥80 mmHg [1] and that of out-of-office BPs, i.e., home BP to ≥130/≥80 mmHg and 24-h ambulatory BP to ≥125/≥75 mmHg. However, the thresholds of out-of-office BPs are not evidence based [1].

Based on a general population in Ohasama, Japan, we recently investigated [2] the prognostic significance of hypertension defined by the conventional guidelines (≥140/≥90 mmHg for office BP, ≥135/≥85 mmHg for home BP, and ≥130/≥80 mmHg for 24-h ambulatory BP) and reported that residents experiencing either home hypertension or 24-h ambulatory hypertension have significantly higher stroke risk than normotensives [2]. However, the generalizability of this result could be limited under clinical practice considering the new thresholds for hypertension proposed by the ACC/AHA. We therefore investigated whether our previous findings based on the criteria of hypertension by conventional guidelines [3–6] are also applicable to the revised thresholds of the ACC/AHA guideline.

Methods

Study population and methodology of the present analysis, except for hypertension definitions, were same as our previous report [2]. Briefly, 1464 participants without history of stroke (31.8% men; mean age, 60.6 years) from the general population of Ohasama, Japan, were included in this analysis. Office BP was measured twice and the mean of the two readings was used [2]. Home BP was measured once in the morning after ≥2 min rest within 1 h after awakening and participants were asked to measure it for 4 weeks (the average number of measurement days: 23.8 days); the mean of all measurements were used in the present study [2]. Twenty-four-hours ambulatory BPs were recorded every 30 min throughout a monitoring day [2]. The Institutional Review Board of Teikyo University, Tohoku Medical and Pharmaceutical University, and Tohoku University approved the study protocol.

We set two definitions of hypertension for in- and out-of-office settings according to the conventional guidelines [3–6] and the ACC/AHA guideline [1] as (1) office BPs ≥140/≥90 mmHg [3–6], home BPs ≥135/≥85 mmHg [3–6], 24-h ambulatory BPs ≥130/≥80 mmHg [3, 4], and (2) office BPs ≥130/≥80 mmHg, home BPs ≥130/≥80 mmHg, 24-h ambulatory BPs ≥125/≥75 mmHg [1], respectively. According to our previous study [2], we defined complete white-coat hypertension (WCHT) as isolated office hypertension, partial WCHT as either home or 24-h ambulatory normotension with office hypertension, complete masked hypertension (MHT) as both home and 24-h ambulatory hypertension with office normotension, partial MHT as

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Table 1 Prevalence of hypertension based on the blood pressure cross-classification according to conventional guidelines and ACC/AHA guideline

Prevalence, %	All, $n = 1464$	Untreated, $n = 1003$	Treated, $n = 461$
All hypertension based on the conventional guidelines (Office hypertension: BP ≥140/≥90 mmHg, Home hypertension: BP ≥135/≥85 mmHg, 24-h hypertension: BP ≥130/≥80 mmHg)			
SNBP	53.0	65.7	25.4
Complete WCHT	9.4	8.2	11.9
Partial WCHT	8.0	5.9	12.6
Complete MHT	6.8	4.1	12.8
Partial MHT	12.3	9.8	17.8
SHT	10.5	6.4	19.5
Only Office hypertension based on the ACC/AHA guideline (Office hypertension: BP ≥130/≥80 mmHg, Home hypertension: BP ≥135/≥85 mmHg, 24-h hypertension: BP ≥130/≥80 mmHg)			
SNBP	37.3	47.7	14.8
Complete WCHT	25.1	26.2	22.6
Partial WCHT	13.7	10.4	20.8
Complete MHT	2.7	1.6	5.2
Partial MHT	6.6	5.3	9.5
SHT	14.6	8.9	27.1
All hypertension based on the ACC/AHA guideline (Office hypertension: BP ≥130/≥80 mmHg, Home hypertension: BP ≥130/≥80 mmHg, 24-h hypertension: BP ≥125/≥75 mmHg)			
SNBP	30.2	39.9	9.1
Complete WCHT	15.6	17.6	11.3
Partial WCHT	15.1	12.3	21.3
Complete MHT	6.1	4.5	9.5
Partial MHT	10.4	10.2	10.9
SHT	22.7	15.7	38.0

Hypertension definitions were shown in parentheses

MHT masked hypertension, *SHT* sustained hypertension, *SNBP* sustained normal blood pressure, *WCHT* white-coat hypertension

either home or 24-h ambulatory hypertension with office normotension. Others were classified into sustained normal BP (SNBP) or sustained hypertension (SHT). Based on previous reports [2, 7], the WCHT and MHT groups included participants with antihypertensive drug medication.

Results

When the threshold of office hypertension was changed to that based on the ACC/AHA guideline, participants with office BP of 130–139/80–89 mmHg moved from sustained normal BP to complete WCHT group, resulting in 2.5 times increase in the prevalence of complete WCHT (Table 1). After further changing the remaining out-of-office BP thresholds to those of the ACC/AHA guideline, the proportion of participants with sustained normal BP decreased from 53.0% to 30.2%, whereas the prevalence of those with sustained hypertension increased from 10.5% to 22.7%. These were confirmed when we limited participants without antihypertensive drug treatment (Table 1).

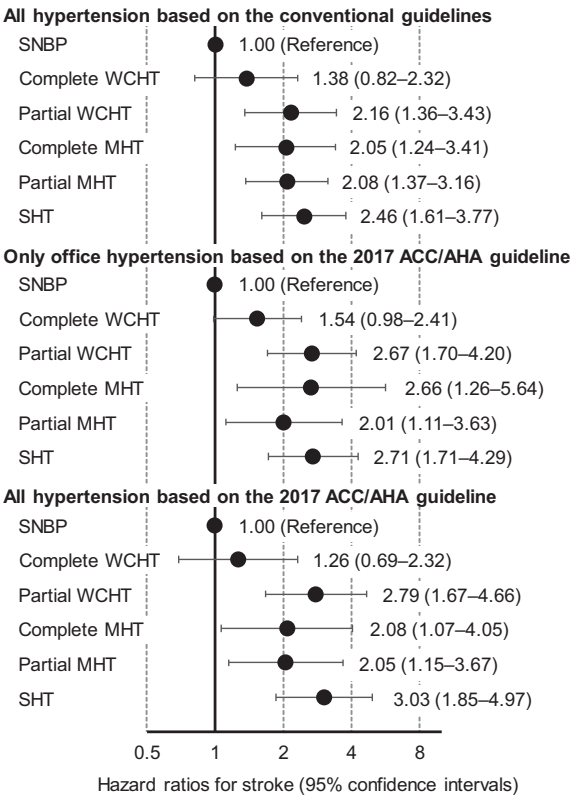

Fig. 1 Hazard ratios for stroke among hypertension based on the blood pressure cross-classification. MHT masked hypertension; SHT sustained hypertension; SNBP sustained normal blood pressure; WCHT, white-coat hypertension

During a median follow-up period of 17.1 years, a first stroke occurred in 212 participants. Regardless of the thresholds, participants with hypertension, except for complete WCHT, had a significantly higher stroke risk when those with sustained normal BP were set as a reference (Fig. 1). The adjusted hazard ratios for complete WCHT were not >1.54, whereas these were ≥2.01 for other hypertension categories (Fig. 1).

Discussion

Lowering the BP thresholds from conventional to ACC/AHA guidelines, did not critically alter the stroke risk estimation in the present study. Changing only the threshold of office BP did not also affect the predictive powers of hypertension categories, implying the predictive power of office BP is not high. Since the association of BP with

stroke risk is linear [8], the relative stroke risks of hypertension may have been similar even if the out-of-office BP thresholds were changed.

We found that our previous report [2] can be applicable in general settings even if the threshold BP values for hypertension are changed. The prevalence of hypertension differs according to the definitions of hypertension (Table 1). Thus, the change in BP cutoff points can affect an absolute risk and also a population attributable risk. However, it should be noted that, according to the ACC/AHA guideline, the number of adults who are recommended to be treated by antihypertensive drugs do not increase because cardiovascular risk factors should also be considered under condition of moderate hypertension [1]. The prevalence of hypertension in adults in the United States increased by 13.7% after changing the office hypertension threshold from ≥140/≥90 mmHg to ≥130/≥80 mmHg [9]. However, the ACC/AHA guideline resulted in only 1.9% increase in the percentage of US adults recommended for antihypertensive medication [9] when cardiovascular risk factors were considered in individuals with BPs of 130–139/80–89 mmHg [1].

From our previous [2] and present findings, measuring both home BP and ambulatory BP may enable us to evaluate appropriate stroke risk stratification irrespective of hypertension definitions. Previous evidence regarding relative cardiovascular risk of WCHT or MHT is still applicable for general population under hypertension definitions of the ACC/AHA guideline. if the threshold of BP values are changed.

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Compliance with ethical standards

Conflict of interest K.A., H.M., Y.I. and T.O. concurrently hold directorship in the Tohoku Institute for Management of Blood Pressure, which is supported by Omron Healthcare Co. Ltd.

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