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Letter to the Editor

Blood pressure components and stroke in Inner Mongolians — A prospective cohort study

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Stroke is the leading cause of disability and the second-leading cause of death in the world [1]. It is becoming an ever-increasing public health burden in China [2]. There is a strong association between both systolic blood pressure (SBP) and diastolic blood pressure (DBP) and stroke, but even in cases of normal BP stroke can still occur [3]. This indicates that other risk factors and BP components other than SBP or DBP may play a role in the development of stroke. In addition to SBP and DBP, BP is also characterized by pulse pressure (PP) and mean arterial pressure (MAP). It is notable that the effect of BP components on stroke is controversial and studies are limited in Inner Mongolians. As a result, we sought to analyze the relationship between BP components and stroke in a cohort of Inner Mongolians.

This prospective cohort study was conducted from June 2002 to July 2012 in Inner Mongolia, China. After obtaining approval from the Soochow University Ethics Committee, informed, written consent was received from 2589 participants. At baseline examination, participants underwent a physical examination, anthropometry, BP determination, and phlebotomy for vascular risk factors. Up to 2012, 2583 individuals (99.8%) were successfully contacted and who provided comprehensive health information. Additional details on the methods of study participant recruitment and baseline data collection have been detailed elsewhere [4].

For our analysis, stroke incidence during the follow-up period is the primary study outcome. Stroke was defined as the sudden onset of neurological symptoms lasting ≥24 h or by using a cranial computed tomography or magnetic resonance imaging examination [5]. Participants who did not have a stroke, died from other causes, or were lost to follow-up were defined as censored. Trained staff interviewed either the participants or their relatives every two years to find new stroke cases. When a new case was found during follow-up, the staff reviewed the hospital records and completed a standard event form. The questionnaires were sent to a professional review board to determine the participants' stroke diagnosis.

In our cohort, there was a total follow-up time of 23,292 person–years; 124 (76 ischemic stroke, 46 hemorrhagic stroke and 2 unknown subtype stroke) individuals developed stroke. Notably, participants who developed stroke had higher BP levels for all components compared to those who did not develop stroke.

As shown in Table 1, SBP, DBP, PP and MAP were all significantly associated with an increased risk for stroke, as well as ischemic and hemorrhagic stroke. As shown in Fig. 1, SBP was significantly better than DBP ($P = 0.038$) and PP ($P = 0.005$) at predicting stroke. There was no significant difference in the area under the ROC curves between SBP and MAP ($P = 0.817$). Similarly, SBP and MAP were also the best predictors for ischemic stroke and hemorrhagic stroke.

The effect of BP components on stroke is controversial. According to a recent study done in a population of Chinese Han women, MAP and DBP may be slightly more informative in predicting stroke mortality [6]. Some other studies found that PP was a major determinant of stroke [7]. In our cohort of Inner Mongolians, SBP was the best predictor of stroke, which is consistent with previous researches [8,9]. MAP was also a strong predictor of stroke in our study, which confirms research conducted in a cohort of middle aged and older Asians [10]. When examining the various BP components, MAP is the steady pressure gradient that transports blood from the heart toward other peripheral tissues. Individuals with hypertension typically have higher SBP and DBP levels, so MAP is generally higher in these individuals as well. In Mongolians, increased MAP is also associated with stroke, though SBP is a slightly better predictor. These results suggest that in addition to SBP, MAP also needs to be monitored in clinical practice and in self-management of hypertension at home.

Conflict of interests

None declared.

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Table 1
Multivariate adjusted relative risk of stroke, ischemic stroke, and hemorrhagic stroke associated with each blood pressure component.

Component	Stroke[a]		Ischemic stroke[b]		Hemorrhagic stroke[c]	
	Events/n	RR (95% CI)	Events/n	RR (95% CI)	Events/n	RR (95% CI)
SBP	124/2589	1.02 (1.02–1.03)	76/2543	1.02 (1.01–1.03)	46/2513	1.04 (1.03–1.04)
DBP	124/2589	1.06 (1.05–1.07)	76/2543	1.05 (1.03–1.06)	46/2513	1.08 (1.06–1.10)
PP	124/2589	1.02 (1.02–1.03)	76/2543	1.02 (1.01–1.03)	46/2513	1.04 (1.03–1.05)
MAP	124/2589	1.05 (1.04–1.06)	76/2543	1.04 (1.02–1.05)	46/2513	1.06 (1.05–1.08)

In the multivariate models, age, gender, smoking, drinking, family history of CVD, TC, TG, HDL-C, BMI, and FPG were adjusted for.
[a] Including 76 ischemic stroke, 46 hemorrhagic stroke, and 2 unknown subtype stroke.
[b] Participants who develop hemorrhagic stroke and unknown subtype stroke were excluded.
[c] Participants who develop ischemic stroke and unknown subtype stroke were excluded.

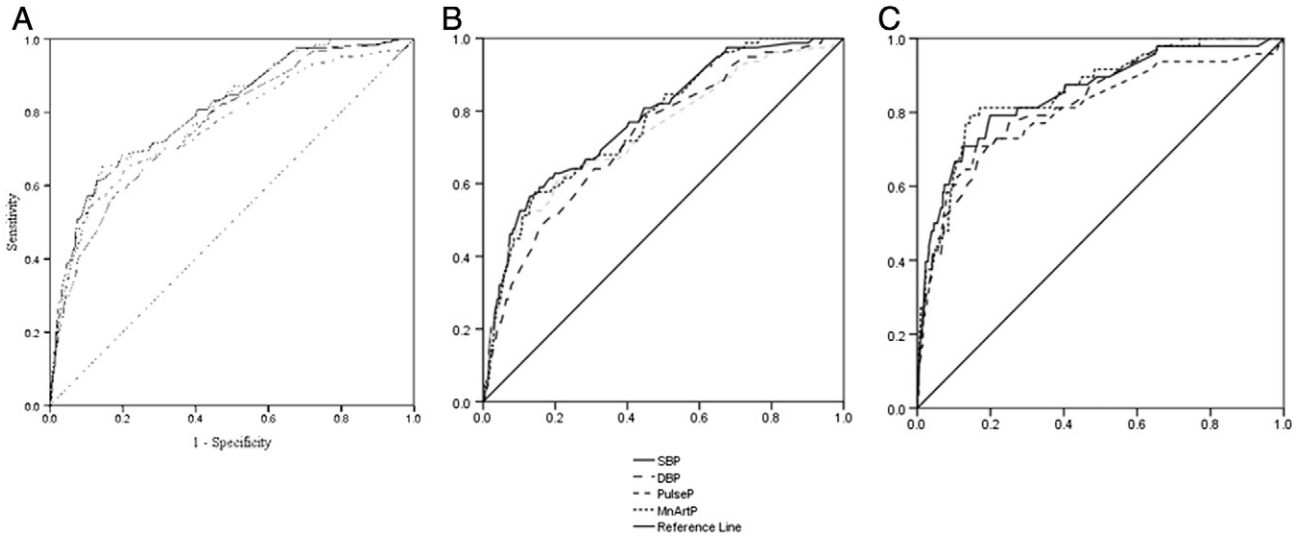


Fig. 1. Receiver operating characteristic curves between each blood pressure component and stroke (A), ischemic stroke (B), and hemorrhagic stroke (C). Panel A shows the discriminatory value of the four blood pressure components for predicting stroke. The areas under the ROC curves for each blood pressure component are as follows: 0.803 for SBP; 0.801 for MAP; 0.766 for DBP; and 0.762 for PP. The *P* values for comparisons in the areas under the ROC curves are as follows: 0.817 for SBP vs. MAP; 0.038 for SBP vs. DBP; 0.005 for SBP vs. PP; <0.001 for MAP vs. DBP; 0.008 for MAP vs. PP; and 0.892 for DBP vs. PP. Panel B shows the discriminatory value of the four blood pressure components for predicting ischemic stroke. The areas under the ROC curves for each blood pressure component are as follows: 0.779 for SBP; 0.770 for MAP; 0.742 for PP; and 0.729 for DBP. The *P* values for comparisons in the areas under the ROC curves are as follows: 0.498 for SBP vs. MAP; 0.051 for SBP vs. PP; 0.035 for SBP vs. DBP; 0.333 for MAP vs. PP; 0.001 for MAP vs. DBP; and 0.742 for PP vs. DBP. Panel C shows the discriminatory value of the four blood pressure components for predicting hemorrhagic stroke. The areas under the ROC curves for each blood pressure component are as follows: 0.857 for MAP; 0.849 for SBP; 0.829 for DBP; and 0.804 for PP. The *P* values for comparisons in the areas under the ROC curves are as follows: 0.598 for MAP vs. SBP; 0.068 for MAP vs. DBP; 0.112 for MAP vs. PP; 0.441 for SBP vs. DBP; 0.047 for SBP vs. PP; and 0.567 for DBP vs. PP.

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