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Hypertension prevalence alteration in 92 815 nurses based on the new standard by 2017 ACC/AHA hypertension guideline: observational cross-sectional study from China

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ABSTRACT

Objectives This study aimed to elucidate the status of hypertension and to analyse the hypertension changes in prevalence, awareness, treatment and control rate among the portion of Chinese nursing staff based on the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) High Blood Pressure Guideline and the 2010 Chinese Guideline for the Management of Hypertension.

Design Cross-sectional study.

Setting 512 medical institutions in 13 cities in Hebei Province.

Participants The candidates of registered nurses from 512 medical institutions in 13 cities in Hebei Province (N=143 772) were invited to participate in the survey, and few of them who refused to participate were excluded from the research group based on the reasons that 93 603 incumbent nurses at the age of 18–65 accepted to the survey and submitted questionnaires online. Undoubtedly, a response rate of 65.11% was achieved. After excluding 788 individuals with incomplete information in the questionnaires, 92 815 participants were included in the final analysis.

Main outcome measures The prevalence, awareness, treatment and control rates of hypertension.

Results 92 815 participants were included in the final analysis, among which consisted of 3677 men (3.96%) and 89 138 women (96.04%). The mean age of the participants was 31.65 (SD=7.47) years.

We demonstrated that 26 875 nursing staff were diagnosed as having hypertension according to the new standard by the 2017 ACC/AHA guideline, more than 20 551 cases compared with the previous threshold on the 2010 Chinese guideline. The prevalence of hypertension among nursing staff was 28.96% in the context of the 2017 ACC/AHA guideline, 3.25 times higher than that (6.81%) evaluated by the criteria of the 2010 Chinese guideline. However, the awareness, treatment and control rate (13.50%, 10.73% and 0.81%) were 3.25, 3.22 and 17.48 times lower than those (57.37%, 45.30% and 14.97%) based on the 2010 Chinese guideline, respectively.

Conclusions This research illustrated that it was crucial to improve the awareness rate, drug treatment rate and control rate of hypertension for nurses. Meanwhile, according to the 2017 ACC/AHA guideline, the prevalence of hypertension in China will increase significantly, which poses a more severe challenge to the management of hypertension in China.

Strengths and limitations of this study

- ► This study described the current status of the hypertension in nurses according to the 2010 Chinese guideline and the 2017 American College of Cardiology/American Heart Association guideline.
- ► This study had a large sample size, covering 13 regions, and described the prevalence and distribution of hypertension in different population groups.
- ► Not all the relationships between hypertension and specific factors identified in this study were investigated.

INTRODUCTION

With the rapid development of society and economy, changes in lifestyle and the ageing of the population, hypertension has become one of the most important public health issues in the world. Its complications are associated with high morbidity and mortality, as well as high rate of consumption of medical resources.[1] The direct economic burden caused by hypertension in China in 2013 amounted to 210.3 billion yuan, accounting for 6.61% of the total expenditure on health in China.[2–4] According to the China Health and Nutrition Survey (CHNS) data from 1991 to 2011, the adjusted prevalence rate of hypertension in Chinese over 18 years old increased from 15.6% to 20.9%, and the

prevalence rate of hypertension increased[5]; however, the awareness, treatment and control rates were still low.[6]

The 2017 American Heart Association (AHA)/American College of Cardiology (ACC) guideline for the prevention, detection, evaluation and management of high blood pressure (BP) in adults has been recently released. A significant transformation in the guideline is the shift in the definition of hypertension, from a systolic blood pressure (SBP) of ≥140 mm Hg or a diastolic blood pressure (DBP) of ≥90 mm Hg to an SBP of ≥130 mm Hg or a DBP of ≥80 mm Hg. According to the 2017 AHA/ACC guideline, the prevalence rate of hypertension increased from 31.9% to 45.6% in the USA.[7]

The 2017 ACC/AHA guideline may bring critical effects on the hypertension status in different regions worldwide.[8–11] Recently, more and more researchers focused on the issues about the potential impacts of the updated guideline on the Chinese population. A nationally representative cross-sectional study examined the hypertension prevalence rate according to the new guideline and found an absolute increase of 17.0% among adults aged 45–75 years in China.[12] Additionally, a survey examined the effects of the new guideline in Southwest China and found that the prevalence of hypertension was nearly twice than that in the Chinese hypertension guideline.[13] Findings from previous studies were mainly focused on the increase in the prevalence of hypertension in the Chinese general population under the new guideline, but it was still largely unclear how the new guideline exerted influence on the hypertension status in different social communities in China. Moreover, the BP levels of nursing staff, a special class of professional group whose work was of high intensity, characterised by high stress level and requiring frequent rotating shifts, should be paid more attention to.[14 15] This study is a cross-sectional survey based on a large number of nursing staffs. The purpose was to analyse the alteration of prevalence, awareness, treatment and control rates of hypertension in Chinese nursing staff based on the 2017 ACC/AHA guideline and the 2010 Chinese guideline, as well as the characteristics of the newly diagnosed hypertension population.

METHODS

Participants and data collection

This cross-sectional study was conducted from October 2016 to February 2017 using a general survey design. Candidates of registered nurses from 512 medical institutions in 13 cities in Hebei Province (N=143 772) were invited to participate in the survey, and few of them who refused to participate were excluded from the research group. Based on who accepted the survey and submitted questionnaires online, we collected 93 603 incumbent nurses aged 18–65 years. Undoubtedly, a response rate of 65.11% was achieved. After excluding 788 individuals with incomplete information in the questionnaires, 92 815 participants were included in the final analysis.

Electronic folders were distributed to the Nursing Quality Control Center (NQCC) of each city through the NQCC of Hebei Province. The folder contained three documents: the link to the electronic questionnaire (SO JUMP), a document on BP measurement precautions and an investigation notice. On receiving the folder, the contact person of each NQCC sent it to the nursing department of all medical institutions in the different cities. Then, the nursing department sent it to the head managers of the departments, who organised the nurses to fill in the questionnaire online. A researcher was arranged to report the response rate to the NQCC of each city every day. The questionnaire content mainly involved (1) the demographic characteristic: hospital name, hospital grade, department, name, age, gender, height and weight; (2) the SBP and the DBP; and (3) the risk factors associated with hypertension: monthly night shift frequency, years of hyperlipidaemia, years of diabetes, years of hypertension, educational status, marital status, menstruation condition, reproductive history, history of abortion, whether the participant received hormone replacement therapy, smoking habit, alcohol drinking, physical exercise and family history of hypertension.[16–19]

Participants and public involvement

In this study, self-report was adopted, and all the participants were nurses who understood the effect of BP measurement by themselves. After receiving the notification on the BP survey, all participants filled in and submitted relevant data online, and those who did not accept could refuse to participate. Although the participants or the public were not formally involved in the design and conduct of the study, the questionnaire used for data collection and the specific assessment conduction were developed based on previous experiences in other surveys and expert opinions. The research data was sent to the Municipal Nursing Quality and Control Centre in Hebei Province.

Measurement

BP measurement and data reporting

The nursing staff measured BP by themselves and reported data through the network. Although nurses mastered the BP measurement method generally, the researchers standardised the method of BP measurement and gave relevant attention in order to reduce measurement bias as much as possible. In order to ensure the accuracy of the report and BP data, a series of measures were adopted for quality control. First, our research group established a three-level supervision mechanism that contained the NQCC, nursing departments and head nurses of hospitals at all levels. Each day during the investigations, research group members exported data from the information platform to conduct data analysis, calculated the number of staff who had finished the questionnaire in each hospital, then fed it back it to their municipal quality control centres for controlling researching progress. Additionally, each questionnaire was checked and

verified by professional quality investigators. After that, the results of verified data were sent to the municipal quality control centres for complementing the missing items and correcting mistakes. What is more, we also attached important cautions while releasing announcement of taking BP measurements.

BP measurements

Choose a regular calibration of the mercury sphygmomanometer or validated electronic sphygmomanometer. Use the standard specification cuff with air bag, which is 22 cm in length and 12 cm in width. Obese individuals or individuals with large arm circumferences used a large sized balloon cuff, and the upper arm was wrapped up at least 80% by the air bag. Each participant was asked to take a rest at least for 5 min; any vigorous activity was avoided; cigarettes and beverages containing caffeine, such as tea and coffee, were forbidden within 30 min; and the participants were instructed to empty their bladder before the BP measurement. BP was measured in a sitting position; the right upper arm should be exposed and the cuff should be kept at the same level as the heart. Each participant was measured three times with an interval time of 1 min, and the average of the last two readings was used for analysis.

Definitions

Hypertension was defined as an SBP of ≥140 mm Hg or a DBP of ≥90 mm Hg, and/or a self-report of having an existing diagnosis of hypertension in accordance with the 2010 Chinese guideline. The new classification designates SBP≥130 mm Hg or DBP≥80 mm Hg and/or self-report of having an existing diagnosis of hypertension as hypertension according to the 2017 ACC/AHA guideline.

The ratio of hypertension to the total population was the prevalence of hypertension. Awareness of hypertension was defined as any self-reported previous diagnosis of hypertension by a healthcare professional physician; treatment was self-reported use of a prescription medication for hypertension management within the 2 weeks at the time of the interview; control referred to pharmacological treatment of hypertension associated with SBP<140 mm Hg and DBP<90 mm Hg during the past 2 weeks.

In addition, the study also estimated the prevalence (SBP≥130 mm Hg or DBP≥80 mm Hg) and control rate (SBP<130 mm Hg and DBP <80 mm Hg) of hypertension according to the 2017 ACC/AHA guideline.

Response rate was defined as the number of nurses responding to the questionnaire online divided by the total number of registered nurses in Hebei Province.

Statistical analysis

All variables were statistically described, the normality of the continuous variables was assessed, variables with a normal distribution were presented as mean±SD, variables with a skewed distribution were reported with medians and IQRs, and categorical data were presented by the percentage description. The prevalence of hypertension, as well as awareness, treatment and control rates of hypertension among hypertensive participants, was calculated according to the two guidelines. In addition, we reported the prevalence for each of the background characteristics of the study. Then we calculated the distribution of the population across five groups, including those who did not have an existing diagnosis of hypertension with SBP/DBP<120/<80 mm Hg, 120–129/<80 mm Hg, 130–139/80–89 mm Hg and ≥140/90 mm Hg, and those who had an existing diagnosis of hypertension. To investigate the factors associated with newly diagnosed hypertension, the possible risk factors (gender, age, body mass index (BMI), years of hyperlipidaemia, years of diabetes, smoking, alcohol drinking and family history of hypertension) were incorporated into a multiple logistic regression analysis. Analyses were performed by using SPSS V.21.0 software. A two-sided p value of <0.05 was considered statistically significant.

RESULTS

Demographic characteristics

A total of 93 603 participants from 512 medical institutions in 13 cities were enrolled in this study, accounting for 65.11% of the total number of registered nurses in Hebei Province. The main reason for non-response might be that some invited nurses had retired but had not logged out of the registration system; being on leave, including maternity leave, study leave and other reasons during the period of data collection; or refusing to participate.

After excluding 788 individuals with incomplete questionnaires, information in the 92 815 participants was included in the final analysis, among which consisted of 3677 men (3.96%) and 89 138 women (96.04%). The median age of participants was 30 (IQR 26–35) years (age range: 18–65 years). Our sample contained more people aged 35 years and younger (76.59%, table 1). Hypertension levels in different groups are shown in table 1. With increases in BMI, years of diabetes and years of hyperlipidaemia, the BP presented an increasing trend.

Prevalence, awareness, treatment and control rate of hypertension in Chinese nurses according to the two editions of the guidelines

According to the 2017 ACC/AHA guideline, the prevalence of hypertension increased from 6.81% to 28.96%, and the prevalence rate was 3.25 times higher than that defined in the 2010 Chinese guideline. The awareness rate, drug treatment rate and control rate of hypertension according to the two guidelines are shown in table 2.

Multidimensional comparative analysis of hypertension prevalence among nursing staff

According to the 2017 ACC/AHA guideline, the number of people with high BP in nursing staff rose from 6324 to 26 875, with a total increase of 20 551. The times of increase of hypertension prevalence in different groups according to the new guideline are shown in table 3.

Table 1 Characteristics of study participants (N=92 815)

Variable	N	Percentage (%)	SBP Median (IQR)/mean±SD	DBP Median (IQR)
Overall	92 815	100	110 (102–120)	70 (64–80)
Gender				
Female	89 138	96.04	110 (101–120)	70 (63–80)
Male	3677	3.96	123 (120–130)	80 (75–85)
Age (years)*				
18–25	17 289	18.63	110 (102–120)	70 (63–78)
26–35	53 799	57.96	110 (100–120)	70 (62–78)
36–45	14 989	16.15	110 (105–120)	70 (65–80)
46–55	6376	6.87	120 (110–130)	80 (70–85)
56–65	250	0.27	130 (120–135)	80 (75–86)
Missing data	112	0.12	–	–
BMI (kg/m^2)*†				
Underweight	7037	7.58	106 (99–110)	68 (60–70)
Normal	57 077	61.50	110 (100–120)	70 (61–77)
Overweight	22 235	23.96	118 (110–123)	72 (70–80)
Obese	6253	6.74	120 (110–130)	79 (70–80)
Missing data	213	0.23	–	–
Years of hyperlipidaemia*				
0	86 900	93.63	110 (101–120)	70 (63–80)
~5	4837	5.21	120 (110–130)	80 (70–85)
~10	636	0.69	125 (110–140)	80 (70–90)
>10	127	0.14	128 (120–140)	82 (76–90)
Missing data	315	0.34	–	–
Years of diabetes*				
0	91 886	99.00	110 (102–120)	70 (64–80)
~5	625	0.67	123 (110–138)	80 (70–90)
~10	164	0.18	120 (110–130)	80 (70–90)
>10	56	0.06	130±18	80 (75–90)
Missing data	84	0.09	–	–
Smoking				
Never	91 020	98.07	110 (102-120)	70 (64-80)
<10 cigarettes/day	1280	1.38	110 (105–120)	70 (66–80)
10–20 cigarettes/day	419	0.45	110 (105–120)	70 (68–80)
>20 cigarettes/day	96	0.10	110 (103–120)	70 (70–80)
Alcohol drinking				
Never	45 984	49.54	110 (102–120)	70 (64–80)
Occasionally	46 263	49.84	110 (102–120)	70 (64–80)
Often	568	0.61	110 (102–120)	70 (69–80)
Family history of hypertension				
Yes	44 451	47.89	110 (102–120)	70 (64–80)
No	48 364	52.11	110 (102–120)	70 (64–80)

*With the missing data.
†BMI was used to classify participants into categories of underweight (<18.5), normal weight (18.5 to <24), overweight (24 to <28) and obese (≥28).
BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure.

Table 2 Prevalence, awareness, treatment and control rate of hypertension

Participants	Diagnostic criteria for hypertension	Prevalence (95% CI)	Awareness (95% CI)	Treatment (95% CI)	Control (95% CI)
Overall (N=92 815)	≥140/90*	6.81 (6.65 to 6.97)	57.37 (57.05 to 57.69)	45.30 (44.98 to 45.62)	14.97 (14.74 to 15.20)
	≥130/80†	28.96 (28.67 to 29.25)	13.50 (13.28 to 13.72)	10.73 (10.53 to 10.93)	0.81 (0.75 to 0.87)
Female (n=89 138)	≥140/90*	6.28 (6.12 to 6.44)	58.52 (58.20 to 58.84)	46.74 (46.41 to 47.07)	16.10 (15.86 to 16.34)
	≥130/80†	27.41 (27.12 to 27.70)	13.40 (13.18 to 13.62)	10.77 (10.57 to 10.97)	0.87 (0.81 to 0.93)
Male (n=3677)	≥140/90*	19.83 (18.54 to 21.12)	48.56 (46.94 to 50.18)	34.29 (32.76 to 35.82)	6.31 (5.52 to 7.10)
	≥130/80†	66.41 (64.88 to 67.94)	14.50 (13.36 to 15.64)	10.28 (9.30 to 11.26)	0.25 (0.09 to 0.41)

*According to the diagnostic criteria for hypertension in the 2010 Chinese guideline.
†According to the diagnostic criteria for hypertension in the 2017 edition of the guideline.

Table 4 shows that 60.68%, 10.36%, 22.14% and 2.90% of nurses not having an existing diagnosis of hypertension had SBP/DBP levels of <120/80 mm Hg, 120–129/<80 mm Hg, 130–139/80–89 mm Hg and ≥140/90 mm Hg, respectively. Additionally, 3.91% of the nurses had an existing diagnosis of hypertension. Among the nurses who did not have an existing diagnosis of hypertension, nurses with higher BP were older and were more likely to be men, overweight or obese, and tended to have hyperlipidaemia for less than 10 years or diabetes for less than 5 years.

Table 5 shows that gender (OR 0.647, 95% CI 0.585 to 0.716, p<0.001), age (OR 0.538, 95% CI 0.520 to 0.557, p<0.001), BMI (OR 0.760, 95% CI 0.729 to 0.791, p<0.001), years of hyperlipidaemia (OR 0.426, 95% CI 0.397 to 0.458, p<0.001) and years of diabetes (OR 0.597, 95% CI 0.517 to 0.690, p<0.001) were factors significantly associated with newly diagnosed hypertension. Women were more likely to be newly diagnosed with hypertension than men according to the 2017 ACC/AHA guideline. Besides, participants with no hyperlipidaemia, no diabetes, with lower age and with lower BMI value were more likely to be newly diagnosed with hypertension.

DISCUSSION

At present, there were few studies on the current status of hypertension among nurses. This study was a cross-sectional survey based on a large sample of nursing staff. The final analysis included 92 815 participants from 512 medical institutions in 13 cities in Hebei Province. According to the 2010 Chinese guideline, the prevalence rate of hypertension was 6.81% in this study. Li *et al*[20] investigated 4032 cardiovascular physicians from 386 hospitals in China and found that the prevalence of hypertension among them was 13.1%. Liu *et al*[21] analysed the prevalence of hypertension among 1369 medical staff in a tertiary academic hospital in Zhengzhou, and the prevalence of hypertension was 18.33%. The prevalence of hypertension in this survey was lower than the above results, which may be related to the lower age and the greater proportion of women in the nursing staff. The report of China Health and Family Planning Commission indicated that the awareness rate of hypertension among people over 18 years old in China was 46.5%, the drug treatment rate was 41.1%, and the control rate was 13.8% in 2012.[22] In addition, a survey[23] of 174 621 people aged 18 years or older in 31 provinces in China from 2013 to 2014 showed that the awareness, treatment and control rate were 31.9%, 26.4% and 9.7%, respectively. Lu *et al*[24] organised a population-based screening hypertension project enrolling around 1.7 million adults aged 35–75 years from all 31 provinces in Mainland China. The rates of hypertension prevalence, awareness, treatment and control were 37.2%, 36.0%, 22.9% and 5.7%, respectively. In this survey, the awareness rate of hypertension in nursing staff was 57.37%, the rate of treatment was 45.30%, and the control rate was 14.97%, which were all higher than the above results. However, the control rate of hypertension among female nurses was 16.10%, and that among male nursing staff was only 6.31%. For medical workers, the awareness rate and the drug treatment rate of hypertension should have been higher. There is still a large space for improvement in the awareness rate of hypertension.

In this study, we sought to assess the potential impact of the new hypertension guideline on the status of BP in clinical nurses. According to the 2017 ACC/AHA guideline, the hypertension prevalence rate of nursing personnel in the survey increased to 28.96%, which increased 4.15 times among nurses aged under 45 years and 1.04 times among nurses aged 45 years or older. The prevalence rate of the population with no hyperlipidaemia, no diabetes, with lower age and with lower BMI value increased, suggesting that a more low-risk population would be diagnosed with hypertension. Meanwhile, the awareness rate, drug treatment rate and control rate of hypertension among Chinese nurses decreased from 57.37%, 45.30% and 14.97% to 13.50%, 10.73% and 0.81%, respectively.

A study from South Korea showed that the prevalence of hypertension was 49.2% based on the 2017 ACC/AHA guideline, while the number was 30.4% based on the previous guideline; the control rate decreased from 59.5% to 16.1%.[25] Additionally, a study from Nepal found that if the ACC/AHA guideline was applied, the overall prevalence of hypertension in Nepal would be approximately double (from 21.2% to 44.2%).[26] According to the standards of the new guideline, the prevalence rate of

Table 3 Comparison of hypertension prevalence among nursing staff

Variable	N	≥140/90*		≥130/80†		Times of increase
		Hypertension	Prevalence (95% CI)	Hypertension	Prevalence (95% CI)	
Gender						
Female	89 138	5595	6.28 (6.12 to 6.44)	24 433	27.41 (27.12 to 27.70)	3.36
Male	3677	729	19.83 (18.54 to 21.12)	2442	66.41 (64.88 to 67.94)	2.35
Age (years)‡						
18–25	17 289	448	2.59 (2.35 to 2.83)	4303	24.89 (24.25 to 25.53)	8.61
26–35	53 799	2263	4.21 (4.04 to 4.38)	13 532	25.15 (24.78 to 25.52)	4.97
36–45	14 989	1784	11.90 (11.38 to 12.42)	5284	35.25 (34.49 to 36.01)	1.96
46–55	6376	1726	27.07 (25.98 to 28.16)	3524	55.27 (54.05 to 56.49)	1.04
56–65	250	91	36.40 (30.44 to 42.36)	185	74.00 (68.56 to 79.44)	1.03
BMI (kg/m^2)§‡						
Underweight	7037	153	2.17 (1.83 to 2.51)	1028	14.61 (13.78 to 15.44)	5.73
Normal	57 077	2501	4.38 (4.21 to 4.55)	13 552	23.74 (23.39 to 24.09)	4.42
Overweight	22 235	2527	11.36 (10.94 to 11.78)	8941	40.21 (39.57 to 40.85)	2.54
Obese	6253	1120	17.91 (16.96 to 18.86)	3280	52.45 (51.21 to 53.69)	1.93
Years of hyperlipidaemia‡						
0	86 900	4473	5.15 (5.00 to 5.30)	23 495	27.04 (26.74 to 27.34)	4.25
~5	4837	1431	29.58 (28.29 to 30.87)	2712	56.07 (54.67 to 57.47)	0.90
~10	636	292	45.91 (42.04 to 49.78)	417	65.57 (61.88 to 69.26)	0.43
>10	127	61	48.03 (39.34 to 56.72)	95	74.80 (67.25 to 82.35)	0.56
Years of diabetes‡						
0	91 886	5951	6.48 (6.32 to 6.64)	26 285	28.61 (28.32 to 28.90)	3.42
~5	625	270	43.20 (39.32 to 47.08)	413	66.08 (62.37 to 69.79)	0.53
~10	164	64	39.02 (31.55 to 46.49)	99	60.37 (52.88 to 67.86)	0.55
>10	56	30	53.57 (40.51 to 66.63)	45	80.36 (69.95 to 90.77)	0.50
Smoking						
Never	91 020	6200	6.81 (6.65 to 6.97)	26 290	28.88 (28.59 to 29.17)	3.24
<10 cigarettes/day	1280	87	6.80 (5.42 to 8.18)	415	32.42 (29.86 to 34.98)	3.77
10–20 cigarettes/day	419	32	7.64 (5.10 to 10.18)	139	33.17 (28.66 to 37.68)	3.34
>20 cigarettes/day	96	5	5.21 (0.76 to 9.66)	31	32.29 (22.94 to 41.64)	5.20
Alcohol drinking						
Never	45 984	3085	6.71 (6.48 to 6.94)	13 226	28.76 (28.35 to 29.17)	3.29
Occasionally	46 263	3194	6.90 (6.67 to 7.13)	13 463	29.10 (28.69 to 29.51)	3.22
Often	568	45	7.92 (5.70 to 10.14)	186	32.75 (28.89 to 36.61)	3.14
Family history of hypertension						
Yes	44 451	2967	6.67 (6.44 to 6.90)	12 743	28.67 (28.25 to 29.09)	3.30
No	48 364	3357	6.94 (6.71 to 7.17)	14 132	29.22 (28.81 to 29.63)	3.21

*According to the diagnostic criteria for hypertension in 2010 Chinese guideline.
†According to the diagnostic criteria for hypertension in the 2017 edition of the guideline.
‡With the missing data.
§Body mass index was classified into underweight (<18.5), normal weight (18.5 to <24), overweight (24 to <28) and obese (≥28).

hypertension among nurses in China was lower than that of the above two studies, which might be related to the fact that most of the nurses were female, were lower in age level, and had more medical knowledge and resources. In addition, the difference could be due to several factors, including Nepal's predominantly rural population and low income. However, it is worth noting that the hypertension control rate among nurses according to the new standard is very low, only 0.81%. It had been reported that treatment of hypertension could reduce the risk of stroke and myocardial infarction by 30%–43% and 15%, respectively, along with reducing the risk of a number of

Table 4 Characteristics of study participants by blood pressure levels (N=92 815)

Variable	Nurses not having an existing diagnosis of hypertension				Nurses having an existing diagnosis of hypertension, n (%) (n=3628)
	<120/80, n (%) (n=56 320)	120–129/<80, n (%) (n=9620)	130–139/80–89, n (%) (n=20 551)	≥140/90, n (%) (n=2696)	
Percentage of study participants	60.68 (60.28–61.08)	10.36 (9.75–10.97)	22.14 (21.57–22.71)	2.90 (2.27–3.53)	3.91 (3.28–4.54)
Gender					
Female	55 669 (98.84)	9036 (93.93)	18 838 (91.66)	2321 (86.09)	3274 (90.24)
Male	651 (1.16)	584 (6.07)	1713 (8.34)	375 (13.91)	354 (9.76)
Age (years)*	29 (26–34)	30 (27–35)	30 (26–36)	31 (27–40)	43 (35–49)
BMI*†					
Underweight	5587 (9.92)	422 (4.39)	875 (4.26)	109 (4.04)	44 (1.21)
Normal	38 076 (67.61)	5449 (56.64)	11 051 (53.77)	1220 (45.25)	1281 (35.31)
Overweight	10 363 (18.40)	2931 (30.47)	6414 (31.21)	926 (34.35)	1601 (44.13)
Obese	2176 (3.86)	797 (8.28)	2160 (10.51)	428 (15.88)	692 (19.07)
Missing data	118 (0.21)	21 (0.22)	51 (0.25)	13 (0.48)	10 (0.28)
Years of hyperlipidaemia*					
0	54 352 (96.51)	9053 (94.11)	19 022 (92.56)	2373 (88.02)	2100 (57.88)
~5	1652 (2.93)	473 (4.92)	1281 (6.23)	251 (9.31)	1180 (32.52)
~10	167 (0.30)	52 (0.54)	125 (0.61)	39 (1.45)	253 (6.97)
>10	26 (0.05)	6 (0.06)	34 (0.17)	1 (0.04)	60 (1.65)
Missing data	123 (0.22)	36 (0.37)	89 (0.43)	32 (1.19)	35 (0.96)
Years of diabetes*					
0	56 053 (99.53)	9548 (99.25)	20 334 (98.94)	2649 (98.26)	3302 (91.01)
~5	167 (0.30)	45 (0.47)	143 (0.70)	31 (1.15)	239 (6.59)
~10	47 (0.08)	18 (0.19)	35 (0.17)	10 (0.37)	54 (1.49)
>10	10 (0.02)	1 (0.01)	15 (0.07)	1 (0.04)	29 (0.80)
Missing data	43 (0.08)	8 (0.08)	24 (0.12)	5 (0.19)	4 (0.11)
Smoking					
Never	55 276 (98.15)	9454 (98.27)	20 090 (97.76)	2644 (98.07)	3556 (98.02)
<10 cigarettes/day	740 (1.31)	125 (1.30)	328 (1.60)	37 (1.37)	50 (1.38)
10–20 cigarettes/day	251 (0.45)	29 (0.30)	107 (0.52)	12 (0.45)	20 (0.55)
>20 cigarettes/day	53 (0.09)	12 (0.12)	26 (0.13)	3 (0.11)	2 (0.06)
Alcohol drinking					
Never	27 936 (49.60)	4822 (50.12)	10 141 (49.35)	1280 (47.48)	1805 (49.75)
Occasionally	28 056 (49.82)	4744 (49.31)	10 269 (49.97)	1402 (52.00)	1792 (49.39)
Often	328 (0.58)	54 (0.56)	141 (0.69)	14 (0.52)	31 (0.85)
Family history of hypertension					
Yes	27 017 (47.97)	4691 (48.76)	9776 (47.57)	1259 (46.70)	1708 (47.08)
No	29 303 (52.03)	4929 (51.24)	10 775 (52.43)	1437 (53.30)	1920 (52.92)
SBP median (IQR) (mm Hg)	108 (100–110)	120 (120–123)	120 (120–125)	130 (120–140)	140 (130–145)
DBP median (IQR) (mm Hg)	68 (60–70)	70 (70–75)	80 (80–80)	90 (90–90)	90 (85–95)

Participants were grouped into the higher category of SBP and DBP. For example, if a person had an SBP of 142 mm Hg and a DBP of 88 mm Hg, she/he was grouped into the ≥140/90 mm Hg category.
*With the missing data.
†BMI was used to classify participants into categories of underweight (<18.5), normal weight (18.5 to <24), overweight (24 to <28) and obese (≥28).
BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure.

other chronic conditions.[27–29] Consequently, the nursing staff should pay more attention to the management of BP. Improving lifestyle and monitoring the BP regularly were suggested to control the BP in a reasonable range.

According to the 2017 ACC/AHA guideline, for patients with clinical cardiovascular disease (CVD), antihypertensive medications should be used if the average SBP is ≥130 mm Hg or the average DBP is ≥80 mm Hg.

Table 5 Multiple logistic regression of factors associated with newly diagnosed hypertension

Variables	OR	95% CI	P value
Gender	0.647	0.585 to 0.716	<0.001
Age (years)	0.538	0.520 to 0.557	<0.001
BMI (kg/m^2)	0.760	0.729 to 0.791	<0.001
Years of hyperlipidaemia	0.426	0.397 to 0.458	<0.001
Years of diabetes	0.597	0.517 to 0.690	<0.001
Smoking	1.070	0.921 to 1.243	0.379
Alcohol drinking	0.962	0.906 to 1.022	0.210
Family history of hypertension	0.946	0.890 to 1.006	0.077

BMI, body mass index.

For adults without CVD who have a 10-year predictive risk factor for atherosclerotic CVD of ≥10%, antihypertensive medications should be used if the average SBP is ≥130 mm Hg or the average DBP is ≥80 mm Hg.[7] Despite the fact that the number of nursing staff who need the medication treatment is speculated to increase according to the new guideline, they should take both their own conditions and medical history into consideration to make a reasonable judgement on whether it is necessary and proper for them to take the medicine.

Meanwhile, the ACC/AHA guideline would require expansion of the necessary public health infrastructure to manage the substantial increase in the public health burden of hypertension in China. Different countries have different epidemiological characteristics, genetic background, disease control and economic levels. More facts founded on evidence-based medicine are needed to confirm whether the new guideline is applicable to China, how to determine the boundary value of hypertension and whether lowering the hypertension diagnosis standard to 130/80 mm Hg can improve the prognosis. The number of patients with hypertension in China is huge, and the medical resources are relatively insufficient. The report of the Chinese Center for Disease Control and Prevention in 2013 pointed out that the number of hypertension in China had risen to 330 million in 2010, and the direct economic burden caused by hypertension reached 210.3 billion yuan in 2013, accounting for 6.61% of the total health cost in China. The number of people with high BP in China will rise by a large margin according to the new guidelines, which poses more severe challenges to medical and health resources.

LIMITATIONS

Some limitations should be considered when interpreting our data. First of all, this survey used the average BP measured two times on the same day, which might have led to false-positive diagnoses, resulting in overestimation of the prevalence rate. Second, the BP was measured by nurses themselves rather than the staff trained unifiedly, but all nurses had received professional knowledge of BP measurement. In addition, a unified description of the measurement methods and matters of attention were carried out in the study, which could ensure the reliability of the measurement results. Third, the different BP measuring instruments used might have had some effect on the data, but the sphygmomanometer had been tested and corrected. The BP measurement in the survey was carried out according to international measurement and quality control regulations, which could guarantee the reliability of the measurement results. Furthermore, the small proportion of men and nurses over 55 years old in this study might have had some influence on the study results. Finally, the generalisability of our results might have been restricted because the participants being recruited were from only one province in China. Future studies should be carried out to recruit participants from other cities in China.

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