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## Association of Sleep Duration on the Prevalence of H-type Hypertension in Female Population

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# Association of Sleep Duration on the Prevalence of H-type Hypertension in Female Population

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**【Abstract】** **Background** Sleep duration is strongly associated with hypertension, but its effect on H-type hypertension in female population is not well characterized. **Objective** The examine the effect of sleep duration on the prevalence of H-type hypertension in female population. **Methods** A cross-sectional study design was used. One thousand seven hundred and nine female hypertensive inpatients were selected from Department of General Medicine and Geriatric Department of Hunan Provincial People's Hospital from July 2018 to December 2020, among whom those who with serum Hcy  $\geq 10 \mu\text{mol/L}$  and the others were assigned into H-type hypertension and non-H-type hypertension groups, respectively. Binary Logistic regression was used to assess the correlation of between sleep duration and H-type hypertension across three groups with different self-reported mean daily sleep durations in the past month ( $<7$  h,  $7-8$  h, and  $>8$  h), and to further assess the correlation between the two across by age ( $\leq 60$  and  $>60$ ). **Results** The distribution of age, education level and marital status differed across three groups with different daily sleep durations ( $P<0.05$ ). 901 (52.72%) with daily sleep duration of  $<7$  h, 697 (40.78%) with daily sleep duration of  $7-8$  h, and 111 (6.50%) with daily sleep duration of  $>8$  h. The distribution of age, education level, living area (urban or rural), marital status, BMI, exercise status, and daily sleep duration, as well as prevalence of drinking between H-type hypertension group (973 (56.93%)) and non-H-type hypertension group (736 (43.07%)) ( $P<0.05$ ). The risk of H-type hypertension in those with  $<7$  h of daily sleep duration was 1.291 times higher than that in those with  $7-8$  h of daily sleep duration (95%CI (1.032, 1.615),  $P<0.05$ ) after adjusting for confounding factors such as age, education level, living area, marital status, BMI and exercise status. Further analysis revealed that  $<7$  h of daily sleep duration was associated with increased risk of H-type hypertension only in those aged greater than 60 years (OR (95%CI)=1.421 (1.021, 1.978),  $P<0.05$ ). **Conclusion** Less than 7 h of daily sleep duration was a risk factor for H-type hypertension in female over 60 years old. In view of this, it is suggested to put more attention to sleep health to improve blood pressure in this group.

**【Key words】** H-type hypertension; Daily sleep duration; Female health; Age; Root cause analysis

H-type hypertension is primary hypertension combined with homocysteine (Hcy). The proportion of H-type hypertension among hypertensive patients in China is as high as 80.3%<sup>[1-2]</sup>. The proportion of H-type hypertension among hypertensive patients in China is as high as 80.3%<sup>[1-2]</sup>. Several studies have found that sleep deprivation is closely related to hypertension and is one of the important risk factors for the development of hypertension. The risk of hypertension can be increased by either too much or too little sleep<sup>[3-4]</sup>. However, the current domestic and international studies mainly focus on the correlation between sleep duration and hypertension<sup>[5-6]</sup>. However, domestic and international studies have focused on the correlation between sleep duration and hypertension<sup>[5-6]</sup>, and there are relatively few reports on H-type hypertension. In addition, the female population is a potential risk group for H-type hypertension<sup>[7]</sup>, and sleep disorders are more common in women than in men<sup>[8-9]</sup>. Elucidation of the effect of sleep duration on the prevalence of H hypertension in women and exploration of the influencing factors is important to improve the sleep pattern of women to prevent H hypertension. In this study, the effect of sleep duration on the prevalence of H hypertension in women. In this study, the female population was used as the study population to investigate the effect of sleep duration on the prevalence of H-type hypertension in women, in order to provide a scientific basis for the prevention and treatment of H-type hypertension in women.

## 1 Subjects and methods

### 1.1 Study subjects

Female patients admitted to the general practice and geriatric departments of Hunan Provincial People's Hospital from December 2018 to December 2020 were selected as the study subjects. Inclusion criteria: (1) age > 18 years; (2) diagnosed with hypertension according to the Guidelines for the Prevention and Treatment of Hypertension in China (2018)<sup>[10]</sup>. Exclusion criteria: (1) patients with diabetes, other cardiovascular diseases, severe heart/liver/kidney function diseases, malignant tumors or serious infection; (2) patients with language disorder, mental illness, unable to reflect their own conditions or unable to cooperate with the questionnaire survey; (3) women during pregnancy and lactation; (4) missing clinical data. Finally, 1 709 subjects were included in the study. According to the diagnostic criteria for H hypertension<sup>[11]</sup>, the study subjects were divided into H hypertension group (hypertension and Hcy 10 μ mol/L) and non-H hypertension group. This study was reviewed and approved by the Medical Ethics Committee of Hunan Normal University (2017034), all study subjects signed informed consent before participating in this study.

### 1.2 Study Methods

#### 1.2.1 Questionnaire survey

The self-made questionnaire was conducted "face to face" for all respondents. The contents of the survey

included general demographic characteristics (age, educational level, area of residence, marital status), living habits (exercise, smoking, alcohol consumption, sleep time), past medical history (history of hypertension, history of antihypertensive drugs) and other information. In this study, unmarried, divorced or widowed patients were defined as single; according to the number of exercises a week, 0 time was defined as basically no exercise, 1 to 3 times were defined as irregular exercise, > 3 times were defined as regular exercise; continuous or cumulative 6 months smoking > 1 / d was defined as smoking, and drinking twice a week was defined as drinking; the subjects' sleep times were obtained by asking patients about "your average sleep hours per day in the past 1 month", the subjects were divided into <7, 7 to 8 and > 8 h according to the sleep time<sup>[12]</sup>.

### 1.2.2 Physical examination and laboratory tests

The physical examination was performed by professionally trained nurses, including height, body mass, waist circumference, and blood pressure. When the height and body mass were measured, the study subjects were barefoot and wearing light clothes, which were measured twice on the electronic height body mass meter, and the average of the two measurements was taken as the final data. Physical mass index (body mass index, BMI) = body mass/height<sup>2</sup>, patients were divided into BMI <24.0 kg/m<sup>2</sup> and 24.0 kg/m<sup>2</sup> according related guideline<sup>[13]</sup>. The waist circumference was measured when the study subject was standing. The soft ruler was placed at the midpoint of the upper edge of the hip bone and the lower edge of the rib, and the horizontal circumference around the abdomen was measured at the normal end-expiration. According to the waist circumference of 80cm, obesity was divided into central obesity and non-central obesity. Blood pressure measurement: The blood pressure in the brachial artery of the right upper arm was measured three times at the quiet state of the study subjects, with an interval of 2 min, and the average of three consecutive blood pressure measurements was used as the final data. Laboratory testing: 5 ml of fasting venous blood was collected from the study subjects at 6 am using an anticoagulation tube. The serum Hcy level was measured at the Department of Laboratory of Hunan Provincial People's Hospital.

### 1.3 Statistical methods

Questionnaire data were collected by EpiDate 3.0, entered and checked by two researchers. Statistical analysis of the data was performed using the SPSS 22.0 software. Categorical variables were expressed using frequency and percentage, and comparisons between groups were performed using the  $\chi^2$  test. Dichotomous Logistic regression was used to analyze the effect of sleep duration on the prevalence of H hypertension in the female population, with the test level of  $\alpha = 0.05$ .

## 2 Results

### 2.1 Basic information

Of the 1,709 study subjects, 823 (48.16%) were aged  $\leq 60$  years and 886 were  $> 60$  years old (51.84%). The education level of 450 cases (26.33%) were elementary school and below, 578 cases (33.82%) were middle school, 451 cases (26.39%) were high school/junior high school, 230 cases (13.46%) were college and above; The residence area of 230 cases (13.46%) were urban; 1,470 cases (86.02%) were married; BMI of 1,002 cases (58.63%) were lower than  $24.0 \text{ kg/m}^2$ , 1,002 (58.63%) cases were non-centric obesity 466 cases (27.27%), 736 cases (43.07%) had basic non-exercise, 1,662 cases (97.25%) were non-smokers, 1,652 cases (96.66%) did not consume alcohol.

## 2.2 Basic situation comparison of women with different sleep duration

Of the 1,709 study subjects, the daily sleep time of 901 (52.72%) were  $< 7$  h, 697 (40.78%) cases were 7-8 h and 111 (6.50%) cases were  $> 8$  h. There were significant differences in sleep among women with different age, education level and marital status, as shown in table 1.

## 2.3 Basic situation comparison of H hypertension patients and non-H hypertension patients

Among the 1 709 study subjects, 973 (56.93%) had H hypertension and 736 (43.07%) had non-H hypertension. There were significant differences in age, educational level, area of residence, marital status, BMI, exercise, alcohol consumption and sleep time between H hypertension patients and non-H hypertension patients ( $P < 0.05$ ), as shown in Table 2.

## 2.4 Dichotomous Logistic regression analysis of the effect of sleep time on the prevalence of H hypertension in the female population

In model 1, Logistic regression was performed with H hypertension as the dependent variable (assigned: H hypertension = 1, non-H hypertension = 0) and sleep time as the independent variable. The results showed that daily sleep time  $< 7$  h could increase the risk of H hypertension in women ( $OR (95\%CI) = 1.696 (1.387, 2.074)$ ,  $P < 0.001$ ).

Model 2 was adjusted for age, educational level, and marital status based on model 1, model 3 was adjusted for age, educational level, area of residence, marital status, BMI status, exercise, and alcohol consumption based on model 1. The results showed that daily sleep time  $< 7$  h still increased the risk of H hypertension in the female population ( $OR (95\%CI) = 1.399 (1.123, 1.743)$ 、 $1.291 (1.032, 1.615)$ ,  $P < 0.05$ ), as shown in Table 3. The results showed the increase in sleep time reduces the risk of developing H hypertension ( $OR (95\% CI) = 0.831 (0.783, 0.881)$ ,  $P < 0.05$ ). After adjusting for confounders, the results were unchanged ( $OR (95\% CI) = 0.878 (0.823, 0.935)$ ,  $0.904 (0.847, 0.964)$ ,  $P < 0.05$ ).

## 2.5 Dichotomous Logistic regression analysis of the effect of sleep time on prevalence of H hypertension in women

of different ages

Considering that age differences affect the relationship between sleep time and H hypertension in women, this study stratifies the age of the included female population to further explore the effect of sleep time on the prevalence of H hypertension in women among different age groups. The dependent variables, independent variables (sleep time is included as categorical variables) and control variables in models 1 to 3 are the same as 2.4. The results showed that in women aged >60 years, daily sleep time <7 h was a risk factor for H hypertension ( $P<0.05$ ); in women aged > 60 years, sleep time did not increase the risk of H hypertension ( $P>0.05$ ), as shown in Table 4.

**Table 1** Basic characteristics in the female population by self-reported daily sleep duration

Basic information	Sleep time <7 h	Sleep time was 7-8 h	Sleep time was >8 h	$\chi^2$ value	P value
Age (year)				59.624	<0.001
≤60	356 (39.51)	395 (56.67)	72 (64.86)		
>60	545 (60.49)	302 (43.33)	39 (35.14)		
Education level				24.098	<0.001
Primary school and below	276 (30.63)	144 (20.66)	30 (27.03)		
Junior high school	284 (31.52)	255 (36.59)	39 (35.14)		
High school / technical secondary school	235 (26.08)	193 (27.69)	23 (20.72)		
College or above	106 (11.76)	105 (15.06)	19 (17.12)		
Living area				5.973	0.050
City area	549 (60.93)	396 (56.81)	56 (50.45)		
Rural area	352 (39.07)	301 (43.19)	55 (49.55)		
Marital Status				15.306	<0.001
Single	154 (17.09)	73 (10.47)	12 (10.81)		
Married	747 (82.91)	624 (89.53)	99 (89.19)		
BMI (kg/m <sup>2</sup> )				5.004	0.082
<24.0	538 (59.71)	410 (58.82)	54 (48.65)		
≥24.0	363 (40.29)	287 (41.18)	57 (51.35)		
Obesity				3.976	0.137
Non-central obesity	264 (29.30)	174 (24.96)	28 (25.23)		
Central obesity	637 (70.70)	523 (75.04)	83 (74.77)		
Exercise situation				9.418	0.051
Basically no exercise	416 (46.17)	278 (39.89)	42 (37.84)		
Irregular exercise	249 (27.64)	232 (33.29)	39 (35.14)		
Regular exercise	236 (26.19)	187 (26.83)	30 (27.03)		
Smoking situation				1.410	0.494
Non-smoking	878 (97.45)	678 (97.27)	106 (95.50)		
Smoking	23 (2.55)	19 (2.73)	5 (4.50)		

Alcohol consumption				1.573	0.456
No alcohol consumption	868 (96.34)	678 (97.27)	106 (95.50)		
Alcohol consumption	33 (3.66)	19 (2.73)	5 (4.50)		

**Table 2** Comparison of basic conditions between female inpatients with and without H-type hypertension

Basic information	Non-H-type hypertension (n=736)	H-type hypertension (n=973)	$\chi^2$ value	P value
Age (year)			243.378	<0.001
≤ 60	514 (69.84)	309 (31.76)		
>60	222 (30.16)	664 (68.24)		
Education level			45.576	<0.001
Primary school and below	133 (18.07)	317 (32.58)		
Junior high school	278 (37.77)	300 (30.83)		
High school / technical secondary school	217 (29.48)	234 (24.05)		
College or above	108 (14.67)	122 (12.54)		
Living area			22.746	<0.001
City area	383 (52.04)	618 (63.51)		
Rural area	353 (47.96)	355 (36.49)		
Marital Status			59.856	<0.001
Single	48 (6.52)	191 (19.63)		
Married	688 (93.48)	782 (80.37)		
BMI (kg/m <sup>2</sup> )			17.753	<0.001
<24.0	474 (64.40)	528 (54.27)		
≥24.0	262 (35.60)	445 (45.73)		
Obesity			0.538	0.463
Non-central obesity	194 (26.36)	272 (27.95)		
Central obesity	542 (73.64)	701 (72.05)		
Exercise situation			41.784	<0.001
Basically no exercise	271 (36.82)	465 (47.79)		
Irregular exercise	284 (38.59)	236 (24.25)		
Regular exercise	181 (24.59)	272 (27.95)		
Smoking situation			3.476	0.062
Non-smoking	722 (98.10)	940 (96.61)		
Smoking	14 (1.90)	33 (3.39)		
Alcohol consumption			6.748	0.009
No alcohol consumption	721 (97.96)	931 (95.68)		
Alcohol consumption	15 (2.04)	42 (4.32)		
Sleep duration			33.399	<0.001
<7	330 (44.84)	571 (58.68)		
7~8	345 (46.88)	352 (36.18)		
>8	61 (8.29)	50 (5.14)		



**Table 3** Binary Logistic regression analysis of daily sleep duration and H-type hypertension in female inpatients

Independent variables	Model 1		Model 2		Model 3	
	OR (95%CI)	P value	OR (95%CI)	P value	OR (95%CI)	P value
Sleep duration (h, reference 7~8)						
<7	1.696 (1.387, 2.074)	<0.001	1.399 (1.123, 1.743)	0.003	1.291 (1.032, 1.615)	0.025
>8	0.803 (0.537, 1.201)	0.286	0.802 (0.517, 1.244)	0.324	0.813 (0.526, 1.256)	0.351

### 3 Discussion

In recent years, the prevalence of H-type hypertension in China is increasing, and high Hcy level and hypertension can cause dual damage to cardiovascular and cerebrovascular diseases [14]. At present, due to the change of social role and the increasing work pressure, the incidence of insomnia in Chinese adults has been as high as 38.2%, among which 35%~60% of women have sleep problems [15-16]. Several previous epidemiological studies have reported an association between sleep duration and abnormal blood pressure in women [17-18], and sleep deprivation has been shown to be one of the influencing factors of H-type hypertension in women [19]. Similar to the above studies, the results of the cross-sectional study showed that the prevalence of H-type hypertension in the female population was 56.93%; Daily sleep duration <7 h increases the risk of H-type hypertension in women (OR(95%CI)=1.696(1.387, 2.074) ); after adjustment for confounding factors, the association still exists. Compared with the daily sleep duration of 7 to 8 h, daily sleep duration <7 h still increases the risk of H-type hypertension in the female population, suggesting that women have short sleep duration and increased risk of developing type-H hypertension. Previous studies have proved that short sleep time can directly affect blood pressure: sleep time shortage will activate angiotensin-aldosterone system and sympathetic-adrenal medulla system, affect vascular endothelial tension, leading to water and sodium retention in the body [20]; sleep shortage can promote the release of inflammatory factors, damage, vascular endothelial function and hypertension [21]; long-term sleep disorder will also lead to the generation of bad mood, cerebral cortex dysfunction, and sympathetic nerve activity enhancement, then leading to blood pressure [22]. In addition, some studies have found that reduced sleep duration time can improve the level of Hcy, and high Hcy level is an independent risk factor for hypertension [23-24], suggesting that sleep deprivation may lead to the occurrence of hypertension by increasing Hcy level, but the specific mechanism of action still needs to be explored by more experimental studies.

This study also found age differences in the relationship between sleep duration and H-type hypertension in women. The risk of developing H-type hypertension was 1.421 times higher in women with sleep duration time <7 h than women with sleep duration time of 7 to 8 h, but this association was not found in women > 60 years, suggesting

that elderly women with short daily sleep duration time have a greater risk of developing H-type hypertension. Zhu Lingyuan et al.<sup>[25]</sup> also found that the sleep duration time <6 h was associated with the increased risk of cardiovascular and cerebrovascular diseases in postmenopausal women. However, some studies did not find this association in older women with<sup>[26]</sup>, possibly because this study ignored the role of these confounding factors such as increasing age, social role change, and cognitive emotion regulation, these confounding factors were all important causes of reduced sleep duration time of elderly women<sup>[27-29]</sup>.

In conclusion, this study found that sleep duration time<7 h was a risk factor for the development of H-type hypertension in a female population of> 60 years. It is suggested that for elderly women> 60 years old, prolonging sleep duration time, paying attention to sleep health and ensuring daily sleep duration time of 7 h may be effective preventive measures to reduce the risk of H-type hypertension and prevent cardiovascular and cerebrovascular diseases.

This study has some limitations: (1) It is a cross-sectional study, which cannot prove the causal relationship between sleep duration time and H-type hypertension in women, and there may be recall bias; (2) This study did not adjust for relevant confounding factors due to the lack of data on depression and cognitive impairment in women; (3) Hypertension is related to sleep quality and sleep apnea syndrome<sup>[30]</sup>. However, this study did not deeply explore the relationship between the above factors and H-type hypertension in women. Further factors such as sleep quality and sleep apnea syndrome should be considered for further research.

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