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Extended afternoon naps are associated with hypertension in women but not in men

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Abstract

Background: The impact of afternoon napping duration on the risk of hypertension has not been well established, particularly with regards to sex and age differences.

Objective: To examine the association between afternoon napping duration and hypertension stratified by sex and age among Chinese adults over 45 years of age.

Methods: The 2011–2012 survey of the China Health and Retirement Longitudinal Study (CHARLS) was used, including 7,980 participants. We conducted logistic regression models in the overall sample, and then stratified by sex and age groups.

Results: Middle-aged and older women who napped over 90 min were 39% and 54% more likely to have hypertension, respectively; however, the associations were not significant in middle-aged and older men.

Conclusion: Extended afternoon napping (≥ 90 min) was associated with hypertension in both the middle-aged women and older women but not in men. Future studies are needed to further examine the association and possible mechanisms.

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Declaration of Competing Interest

None.

Keywords

Hypertension; Afternoon napping; Age; Sex

Introduction

Hypertension, affecting 31.1% of the adult population worldwide, contributes considerably to the global burden of health problems.¹ It increases the risk of heart disease, stroke, and kidney failure.² In China, the prevalence of hypertension is high and varied significantly by sex and age. It is estimated that the prevalence of hypertension in China was 35.7% in adults aged 45–59 and 58.9% in those aged over 60 in 2012 and women reported a higher rate of hypertension than men (57.6% vs. 42.4%).^{3,4} Hypertension accounts for approximately 9.4 million deaths every year in the world.⁵ Thus, identifying modifiable risk factors has important clinical implications for reducing the morbidity and mortality of hypertension. Researchers have identified aging, overweight or obesity, anxiety and other lifestyle factors, such as high-sodium diet, excessive drinking as risk factors in the development of hypertension in Chinese adults.^{6,10} Sleep characteristics, such as disturbed nocturnal sleep and excessive daytime napping, have also been linked to the development of hypertension.^{11,14}

Afternoon napping (habitual nap after lunch), is a common practice in many Latin America, Asia, and Africa countries where the temperature considerably increases due to the heat of the sun in the afternoon.¹⁵ Afternoon napping is culturally regarded as a part of healthy lifestyle in China. Over two-thirds of Chinese older adults reported afternoon napping, and men were more likely to nap than women among older adults.¹⁶

Emerging research has investigated the health consequences of napping but yielded inconsistent findings. While, some studies reported that naps could reduce sleepiness and improve cognitive performance,^{17,18} others found that some naps were associated with increased risks of cognitive decline,¹⁹ diabetes,²⁰ hypertension,^{13,21} and all-cause mortality, particularly cardiovascular mortality.^{22,23} The impacts of naps on health outcomes depend on the features of naps, such as the circadian timing, frequency, and duration of daytime napping.¹⁷ Current literature suggest that people have the greatest tendency to take a nap during the post-lunch circadian dip period (13:00–16:00) in the daytime and post-lunch naps are most restorative and may provide favorable health effects.^{17,24} A recent meta-analysis found a significant association between daytime napping (nap vs. no-nap) and an increased risk of hypertension. However, the majority of studies included in the meta-analysis neither adjusted for nighttime sleep nor specified the duration or the circadian timing of napping.²⁵

Sex and age differences in the relationship between nighttime sleep duration and hypertension were noted in previous studies, which suggested that these associations were stronger in women and people under 65 years.¹¹ In addition, evidence suggest that risk for cardiovascular diseases differs between men and women. For example, women after menopause have higher risk for hypertension than men due to menopausal related symptoms, including the decline in estrogen levels, vasomotor symptoms, depression, insomnia, anxiety, and panic attacks.^{26,27}

Although previous studies found that afternoon napping duration (e.g., over 30 min) was associated with hypertension,^{13,21} little is known about the sex and age differences in the association between afternoon napping duration and hypertension. In this study, we used the China Health and Retirement Longitudinal Study (CHARLS) data collected in 2011–2012, to examine the association between afternoon napping duration and hypertension among Chinese adults over 45 years of age and within specific sex and age groups (men vs. women; aged 45–59 vs. aged 60 and above). The findings from this study will extend the current knowledge on the role of daytime napping duration in the risk of hypertension and inform future preventions and interventions for cardiovascular health, especially in a Chinese context.

Methods

Study population

CHARLS is a nationally representative study; the sample was of community residents over 45 years of age and their spouses from 28 provinces in China. CHARLS adopted multistage probability sampling and followed up every two years for the purpose of evaluating the economic, social and health status of community residents. Data collection was completed by personal interviews assisted with face-to-face computers. The design, methods, and other details of the CHARLS have been reported elsewhere.²⁸ A total of 11,847 participants provided blood samples between June 2011 and March 2012 from CHARLS 2011–2012 survey. We applied the following exclusion criteria when identifying eligible participants: (1) age less than 45 years ($n = 223$); (2) taking antidepressants, tranquilizers or sleeping pills, or receiving psychiatric or psychological treatment for current emotional, nervous, or psychiatric problems ($n = 92$); (3) missing or abnormal values of any variables used in the data analysis ($n = 3552$). Finally, 7980 participants were included in our study. No statistical differences in terms of sex and age were found between participants included and those excluded in our analysis.

Measurement

Hypertension: In CHARLS, participants' systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by trained medical staff and repeated three times at 45-s intervals. We used the average of the three measured results as the final blood pressure. Hypertension in this study was determined based on the final blood pressure (SBP ≥ 140 mmHg, DBP ≥ 90 mmHg), a self-reported diagnosis hypertension, or self-reported use of antihypertensive medications at data collection. This is based on standards in the seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.²⁹

Afternoon napping and nighttime sleep were assessed in the face-to-face interviews. Afternoon napping duration was evaluated by asking the question: "During the past month, how long did you take a nap after lunch in general?" We classified afternoon napping into five groups based on the length of naps: 0 min (min), <30 min, 30–59 min, 60–89 min, ≥ 90 min.¹³ Nighttime sleep duration was evaluated by asking, "During the past month, how many hours of actual sleep did you get at night (average hours for one night)? (This may be

shorter than the number of hours you spend in bed.)” The nighttime sleep duration was also categorized into five groups: <6 h/night, 6–7 h/night, 7–8 h/night, 8–9 h/night, 9 h/night.¹²

Demographic characteristics were collected using a questionnaire that included age, sex, education, marital status, and residential region. Consistent with prior studies in China, participants were categorized into middle-aged (<45 years and <60 years) adults and older adults (>60 years) groups.³⁰ We classified the level of education into illiterate, primary (can read or write/sishu school/elementary school), junior/senior/secondary vocational school, and college or above. Marital status was categorized into single (widowed, unmarried, divorced) and married or cohabiting. Region was grouped as an urban or rural area.

Clinical and behavioral variables: a set of clinical and behavioral measures were included as covariates for risk adjustment, including body mass index (BMI, calculated as weight in kilograms divided by height in meters squared), waist circumference, smoking status, alcohol drinking, and chronic diseases.

According to the overweight and obesity guidelines for Chinese adults,³¹ participants were grouped into four categories based upon their BMI: (1) under-weight (<18.5 kg/m²), (2) normal-weight (18.5–23.9 kg/m²), (3) over-weight (24–27.9 kg/m²) and (4) obese (>28 kg/m²). Waist circumference was measured by trained medical staff placing a tape around the belly button of the participants and reading at the end of exhalation. Smoking was categorized as (1) non-smoker, (2) former smoker (history of smoking), and (3) current smoker. Alcohol drinking was categorized into (1) never, (2) drinking less than once per month, and (3) drinking more than once per month during the past year.¹²

Chronic diseases including diabetes, dyslipidemia, high C-reactive protein (CRP), and depression were included as covariates. These variables were defined based on clinical diagnosis, questionnaires, and plasma biomarker assessments of the participants. Blood samples were collected by trained medical staff and stored at the Chinese Center for Disease Control and Prevention (China CDC). The biomarkers included high CRP, a lipid panel (total, high-density lipoprotein cholesterol [HDL-C], low-density lipoprotein cholesterol [LDL-C], and triglycerides) and fasting glucose, which were analyzed at the Youanmen Center for Clinical Laboratory of Capital Medical University.³² Diabetes was defined as fasting glucose level of ≥ 126 mg/dL (7.0 mmol/L), self-reported use of diabetes medication, or self-reported diagnosis of diabetes. Dyslipidemia was defined using decreased HDL-C concentration (men <40 mg/dL, women <50 mg/dL), elevated LDL-C concentration of >130 mg/dL, triglyceride concentration of ≥ 150 mg/dL, or a self-reported diagnosis of dyslipidemia. Those with a CRP concentration of ≥ 3 mg/dL were considered as high CRP. Depression was measured by the 10-item Center for Epidemiologic Studies Depression Scale (CES-D) short form; a score of 10 or more was defined as depression.³³

Statistical analysis

Characteristics of the participants, including demographics and clinical and behavioral characteristics, were first described using standard descriptive stats. Differences in these characteristics between blood pressure groups (normotension vs. hypertension) were examined using the student's *t*-test for continuous variables and the Chi-square test for

categorical variables. Differences in age, sex and nighttime sleep duration by afternoon napping duration were examined using Analysis of Variance or Chi-square test. The association between afternoon napping duration and hypertension was first examined using the Chi-square test. Two logistic regression models were used to further explore the sex- and age-specific association between the afternoon napping duration and hypertension, with Model 1 (partially adjusted model) adjusted for demographic characteristics (age groups, sex, education, marital status, region) and Model 2 (fully adjusted model) adjusted for both demographic characteristics and clinical and behavioral variables (BMI, waist circumference, smoking status, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression). The selection of covariates in the fully adjusted Model 2 was based on literature review and inputs from bivariate analysis (i.e., a variable was included if the association between the variable and hypertension was <0.1). All statistical tests were two-sided, and a p -value <0.05 was considered statistically significant. All data management and analyses were completed using Stata 15.0 (StataCorp LP, College Station, Texas, USA) and SPSS 23.0 (IBM Corp., Armonk, NY, USA).

Results

Sample characteristics

As shown in Table 1, our sample had an average age of 59.15 (SD = 9.16), with 44.8% over 60 years of age. Of the 7980 participants, approximately half (52.4%) were women; the majority lived in rural area (82.2%), were married or cohabiting (88.9%) and illiterate or with primary education (68.8%). About 40% of the sample had hypertension. As for afternoon napping, participants reported no napping (46.8%), napping <30 min (9.6%), 30–59 min (8.3%), 60–89 min (22.1%), and 90 min (13.3%). Older adults had a higher rate of hypertension, compared to middle-aged adults (56.5% vs. 43.5%). Also, hypertension was more prevalent in women (53.6%) than in men (46.4%). Table 1 also shows the comparisons of sample characteristics between normotension and hypertension groups. Compared with the normotension group, a greater proportion of participants in the hypertension group were overweight or obese, had diabetes, dyslipidemia, or high CRP.

We observed differences in age ($p = 0.012$), sex ($p < 0.001$), and nighttime sleep duration ($p < 0.001$) across afternoon napping groups (Table 2). Participants reported no nap (58.79 ± 8.84) were younger than those who reported 60–89 mins (59.49 ± 9.55) and 90min naps (59.57 ± 9.57). Higher proportion of middle-aged adults reported no nap (48.4%) and higher proportion of older adults reported 60–89 min (22.7%) and 90 min naps (14.2%). More proportion of women reported no nap (52.9%) and more proportion of men reported 60–89 min (25.7%) and 90 min naps (15.9%). Participants in the 90 min nap group reported longer nighttime sleep duration than all other nap groups (no nap, 6.20 ± 1.84 ; <30 min, 6.43 ± 1.73 ; 30–59 min, 6.15 ± 1.72 ; 60–89 min, 6.51 ± 1.65).

Prevalence of hypertension by afternoon napping duration groups

The prevalence of hypertension in different sex or age groups within afternoon napping duration categories are presented in Fig. 1. The prevalence of hypertension among overall adults in the five nap groups was 37.7%, 43.0%, 41.5%, 41.5%, 44.0%, respectively.

Statistically, hypertension was more common in those who napped more than 90 min versus non-nappers in the overall sample ($p = 0.015$), the stratified women's group ($p = 0.001$) and either age group (middle-aged, $p = 0.036$; older adults, $p = 0.028$).

Associations between afternoon napping duration and hypertension

Overall association: Table 3 shows the relationships between afternoon napping duration and hypertension in the overall sample. After controlling for all studied covariates (Model 2), participants in 90 min nap group had increased odds of having hypertension compared to those in the no nap group (OR, 1.16; 95% CI, 1.01 – 1.35). Older adults (OR, 2.20; 95% CI, 1.98–2.44) were more likely to have hypertension than middle-aged adults. There are no differences in the odds of having hypertension between men and women in the overall sample.

Sex and age-specific associations

When stratified by sex and age, estimates from the fully adjusted model indicates that among women who napped more than 90 min were more likely (OR, 1.44; 95% CI, 1.15–1.80) to have hypertension than those did not nap. No significant differences were observed when comparing other nap groups to no nap group among women. Among older adults, who napped 90 min were 26% more likely to have hypertension (OR, 1.26; 95% CI, 1.02–1.56), compare to those did not nap. However, no significant associations between afternoon napping duration and hypertension were detected in men or middle-aged groups (Table 4).

To further understand the sex and age-specific associations between afternoon napping duration and hypertension, we further categorized the participants into four groups: middle-aged men, middle-aged women, older men, and older women, and conducted analyses for each group. Compared with participants in the no napping group, those who reported napping over 90 min were more likely to have hypertension among both middle-aged women (OR, 1.39; 95% CI, 1.03–1.86) and older women groups (OR, 1.54; 95% CI, 1.09–2.16). No significant associations were found between afternoon napping duration and hypertension in middle-aged men or older men groups (Table 4 and Fig. 2).

Discussion

Using the national 2011–2012 data from the CHARLS, we examined sex and age variations in the association between afternoon napping duration and hypertension among adults over 45 years of age in China. Our findings suggest that there are, indeed, significant associations between afternoon napping duration and hypertension, and the associations varied by sex and age. Extended afternoon napping (> 90 min) was associated with hypertension, especially in women and older adults. Specifically, among women, extended afternoon napping (> 90 min) was associated with higher risk of having hypertension and this association was more obvious among older women. To the best of our knowledge, this is the first study to study the sex and age-specific association between afternoon napping duration and hypertension in the Chinese population.

In our study, we found that participants with habitual afternoon napping were 53.2%. A survey from America reported that one third of the adults (34%) take a nap, and nap had

distinctive racial patterns. Half of the black adults reported they napped in the past 24 h, compared with only one third of whites and Hispanics.³⁴ Thus, there may be cultural differences in napping. In the last decade, researchers have paid increased attention to the impact of napping on health in Chinese people and identified that some napping characteristics were associated with the risks of adverse health consequences, including diabetes,³⁵ metabolic syndrome,³⁶ cardiovascular disease and all-cause mortality.¹⁶

Our findings of the relationship between afternoon napping duration and hypertension provides unique insight in to the relationship between napping and hypertension. To date, only a few studies on this topic have been conducted; however, in the most of those studies, hypertension was not the main outcome and thus the finding was not further discussed.^{21,37,38} Cao's et al. study was the only study that examined the association between nap duration and the risk of hypertension and suggested that longer afternoon napping (>60 min) was associated with hypertension.¹³ Similar associations were identified in our analysis, though we only found that extended napping 90 min was associated with hypertension.

Further, we took into account the possible sex and age differences in the afternoon nap duration-hypertension relationship. We found that higher proportion of women reported no nap and more men took longer naps than women. Perhaps it is because women are more involved in housework in China and they are less likely to take afternoon nap. In addition, in our sample there was a high prevalence of smoking in men than women. Previous research has indicated an association between smoking and longer nap duration.³⁹ We also found that the association between extended afternoon nap (90 min) and hypertension existed in women but not in men. It is unclear whether the women-specific association between afternoon napping duration and hypertension was attributable to hormone changes around menopause in middle-aged and older women. Researchers have shown that menopausal women often experienced vasomotor symptoms, mood disturbances and obstructive sleep apnea syndrome, due to fluctuated physiologic changes.^{26,40} Evidence suggests a relationship between obstructive sleep apnea syndrome and hypertension and that napping might be as a symptom of sleep apnea, which may partially explain hypertension observed in female extended nappers.^{14,37}

Given the well-documented associations between nighttime sleep duration and hypertension, nighttime sleep duration was included as a covariate in our analysis. Disturbed nocturnal sleep may lead to the development or aggravation of hypertension. For example, Guo et al.⁴¹ found a U-shaped association between sleep duration and hypertension: that either short or long nighttime sleep durations were associated with an increased prevalence of hypertension. Sex and age-specific associations between sleep and hypertension were suggested in prior studies. Grandner et al.⁴² found that both short and long sleep duration were associated with increased risk of hypertension in a U.S sample of over 700,000 adults. The associations with short sleep were stronger in women and younger adults. Some studies have found that napping is associated with less nighttime sleep, poor sleep efficiency, and insomnia,^{38,43} which could lead to hypertension. Campbell et al.⁴⁴, however, found that napping had little effect on nighttime sleep duration or quality. In our study, no significant differences in nighttime sleep duration were found among afternoon napping groups, except people who napped 90 min reported more nighttime sleep than all other groups. One

potential explanation for these findings is that nighttime sleep was fragmented and the sleep efficiency was low in those who slept longer at night (e.g. people with sleep apnea). They took longer afternoon naps to compensate sleep loss at night. However, we do not have data on that. To avoid the possible confounding effect of nighttime sleep, we controlled nighttime sleep duration in our statistical model and found increased risk of hypertension in women who napped ≥ 90 min.

The mechanism underlying the relationship between afternoon napping and hypertension remains unclear. Previous research suggested that sleep deprivation might activate the sympathetic system.^{45,46} The activated sympathetic system could stimulate the renin-angiotensin-aldosterone system and increase the synthesis of central catecholamines,⁴⁷ which might lead to constrict blood vessel and raise blood pressure. Afternoon napping with appropriate duration may compensate for the nighttime sleep deprivation and then help maintain normal blood pressure. However, extended naps may increase the risk of hypertension. Literature suggested that rapid-eye-movement sleep (REM) may increase the sympathetic nervous activity.⁴⁸ REM usually occurs in long naps (e.g. naps over 90 min) and thus may increase the blood pressure due to increased sympathetic nervous activities.⁴⁹ Future research is warranted to explore the mechanisms underlying the association between afternoon napping and hypertension.

The strengths of our study lie in using a nationally representative sample of middle-aged and older Chinese, adjusting for multiple possible covariates, and examining the association in sex- and age-specific groups. There are also several limitations in our study. First, it was a cross-sectional study; therefore, we cannot conclude a causal relationship between afternoon napping duration and hypertension. The use of self-reported afternoon napping duration may introduce recall bias. Finally, although we controlled nighttime sleep duration, other sleep-related factors (e.g. sleep disordered breathing and insomnia) were not included due to limitation in the data we used. There is no other information about sleep, besides nighttime sleep duration in the 2011–2012 CHARLS survey.

Conclusion

In a large nationally representative sample of middle-aged and older Chinese, extended afternoon napping (≥ 90 min) was associated with hypertension in both the middle-aged women and older women and this association was more obvious in the older women group. As a changeable lifestyle, afternoon napping habits may be adjusted to prevent hypertension. Special attention needs to be paid to napping behavior in middle-aged and older women. Extended napping such as ≥ 90 min may not be good practice for the prevention and management of hypertension, especially in women. However, future longitudinal studies are needed to confirm the association. Interdisciplinary collaboration between researchers, cardiovascular, and sleep specialists are needed to further explore the relationship between afternoon napping and hypertension and the possible mechanisms behind the association.

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Fig. 1. Prevalence of hypertension by afternoon napping duration category. According to (A) sex (men/women) and (B) age (middle-aged/older adults).

Fig. 2.

Odds ratios (95% CI) for hypertension in afternoon napping duration categories. According to (a) sex (men/women), (b) age (middle-aged/older adults) and (c) sex and age (middle-aged men/older men/middle-aged women/older women). The adjusted covariates included: (a) age groups, education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression; (b) sex, education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression; (c) education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression.

Table 1

Sample characteristics^a (N = 7980)

Characteristics	Overall	Normotension (n = 4771)	Hypertension (n = 3209)	p value
Age				.000 ^b
Age, mean ± SD	59.15 ± 9.16	57.49 ± 8.73	61.62 ± 9.22	
45 and <60	4405(55.2)	3009(63.1)	1396(43.5)	
60	3575(44.8)	1762(36.9)	1813(56.5)	
Sex				.064 ^b
Men	3801(47.6)	2313(48.5)	1488(46.4)	
Women	4179(52.4)	2458(51.5)	1721(53.6)	
Education				.000 ^b
Illiterate	2167(27.2)	1195(25.0)	972(30.3)	
Primary	3322(41.6)	1983(41.6)	1339(41.7)	
Junior/senior/secondary vocation school	2372(29.7)	1525(32.0)	847(26.4)	
College or above	119(1.5)	68(1.4)	51(1.6)	
Marital status				.000 ^b
Single	884(11.1)	419(8.8)	465(14.5)	
Married or cohabiting	7096(88.9)	4352(91.2)	2744(85.5)	
Region				.000 ^b
Rural	6557(82.2)	4007(84.0)	2550(79.5)	
Urban	1423(17.8)	764(16.0)	659(20.5)	
BMI				.000 ^b
BMI, mean ± SD	23.49 ± 3.41	22.87 ± 3.15	24.40 ± 3.58	
Under-weight	459(5.8)	321(6.7)	138(4.3)	
Normal-weight	4215(52.8)	2833(59.4)	1382(43.1)	
Over-weight	2457(30.8)	1301(27.3)	1156(36.0)	
Obese	849(10.6)	316(6.6)	533(16.6)	
Waist circumference, mean ± SD	84.85 ± 10.64	82.94 ± 9.99	87.70 ± 10.94	.000 ^c
Smoking				.001 ^b

Characteristics	Overall	Normotension (<i>n</i> = 4771)	Hypertension(<i>n</i> = 3209)	<i>p</i> value
No-smoker	4792(60.1)	2842(59.6)	1950(60.8)	
Former smoker	731(9.2)	399(8.4)	332(10.3)	
Current smoker	2457(30.8)	1530(32.1)	927(28.9)	
Drinking				.001 ^b
Never	5352(67.1)	3124(65.5)	2228(69.4)	
< 1 per-month	622(7.8)	394(8.3)	228(7.1)	
1 drink per-month	2006(25.1)	1253(26.3)	753(23.5)	.075 ^b
Depression	2975(37.3)	1741(36.5)	1234(38.5)	
Diabetes	1288(16.1)	596(12.5)	692(21.6)	.000 ^b
Dyslipidemia	5232(65.6)	2905(60.9)	2327(72.5)	.000 ^b
High CRP	1402(17.6)	721(15.1)	681(21.2)	.000 ^b
Nighttime sleep duration				.001 ^b
<6 h	2329(29.2)	1341(28.1)	988(30.8)	
6–7 h	1701(21.3)	1003(21.0)	698(21.8)	
7–8 h	1580(19.8)	1009(21.1)	571(17.8)	
8–9 h	1778(22.3)	1077(22.6)	701(21.8)	
9 h	592(7.4)	341(7.1)	251(7.8)	
Afternoon napping duration				.000 ^b
0 min	3731(46.8)	2323(48.7)	1408(43.9)	
< 30 min	763(9.6)	435(9.1)	328(10.2)	
30–59 min	665(8.3)	389(8.2)	276(8.6)	
60–89 min	1763(22.1)	1032(21.6)	731(22.8)	
90 min	1058(13.3)	592(12.4)	466(14.5)	

Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CRP, C-reactive protein; SD, standard deviation; h, hour; min, minute.

^aData are presented as number (percentage) of participants unless otherwise indicated.

^bChi-square test for categorical variables.

^cStudent's *t* test for continuous variables.

Table 2

Age, sex and nighttime sleep duration according to afternoon napping group^a (*N* = 7980)

Characteristics	Overall	0	<30	30–59	60–89	90	<i>P</i>
Afternoon napping (min)							
Age							.012^b
45 and <60	4405(55.2)	2131(48.4)	424(9.6)	348(7.9)	950(21.6)	552(12.5)	
60	3575(44.8)	1600(44.8)	339(9.5)	317(8.9)	813(22.7)	506(14.2)	
Age, mean ± SD	59.15±9.16	58.79±8.84	59.12±8.87	59.61 ±9.43	59.49±9.55	59.57±9.57	.017^d
Sex							.000^b
Men	3801(47.6)	1522(40.0)	395(10.4)	301(7.9)	978(25.7)	605(15.9)	
Women	4179(52.4)	2209(52.9)	368(8.8)	364(8.7)	785(18.8)	453(10.8)	
Nighttime sleep duration							.000^b
<6 h	2329(29.2)	1258(54.0)	196(8.4)	205(8.8)	444(19.1)	226(9.7)	
6–7 h	1701(21.3)	751(44.2)	185(10.9)	171(10.1)	387(22.8)	207(12.2)	
7–8 h	1580(19.8)	691(43.7)	153(9.7)	139(8.8)	383(24.2)	214(13.5)	
8–9 h	1778(22.3)	769(43.3)	172(9.7)	113(6.4)	425(23.9)	299(16.8)	
9 h	592(7.4)	262(44.3)	57(9.6)	37(6.3)	124(20.9)	112(18.9)	
Nighttime sleep duration	6.36 ± 1.78	6.20 ± 1.84	6.43 ± 1.73	6.15 ± 1.72	6.51 ± 1.65	6.77 ± 1.75	.000^d
Mean ± SD							

Abbreviation: min, minute; h, hour.

^aData are presented as number (percentage) of participants unless otherwise indicated.

^bChi-square test for categorical variables.

^dAnalysis of Variance for continuous variables.

Table 3

Associations between afternoon napping duration and hypertension (N = 7980)

		n (%)	Model 1			Model 2		
			OR	95%CI	P	OR	95%CI	P
Age	45 and <60	4405(55.2)	Reference	Reference				
	60	3575(44.8)	2.08	(1.89–2.19)	.000	2.20	(1.98–2.44)	.000
Sex	Men	3801(47.6)	Reference	Reference				
	Women	4179(52.4)	1.10	(0.99–1.22)	.053	.053	(0.82–1.10)	.507
Afternoon napping duration	0 min	3731(46.8)	Reference	Reference				
	<30 min	763(9.6)	.507	(1.08–1.49)	.005	1.13	(0.95–1.34)	.164
	30–59 min	665(8.3)	1.11	(0.93–1.32)	.241	1.05	(0.88–1.26)	.577
	60–89 min	1763(22.1)	1.17	(1.04–1.32)	.011	1.09	(0.96–1.23)	.193
	19 min	1058(13.3)	1.31	(1.14–1.51)	.000	1.16	(1.01–1.35)	.047

Abbreviation: min, minute; OR, odds ratio; CI, confidence interval; BMI, body mass index; CRP, C-reactive protein.

Model 1 adjusted age groups, sex, education, marital, region.

Model 2 adjusted age groups, sex, education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression.

Associations between afternoon napping duration and hypertension by sex and age ($N = 7980$)

Table 4

Models	Afternoon napping (min)															
	<30				30–59				60–89				90			
	0	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P
Sex																
Men	<i>n</i> = 1522		<i>n</i> = 395		<i>n</i> = 301		<i>n</i> = 978								<i>n</i> = 605	
Model 1 ^a	Reference	1.28	(1.02–1.61)	.032	1.08	(0.83–1.40)	.568	1.13	(0.95–1.33)	.168	1.12	(0.92–1.37)	.251			
Model 2 ^b	Reference	1.19	(0.94–1.51)	.156	1.05	(0.80–1.38)	.726	1.04	(0.87–1.24)	.677	0.98	(0.80–1.21)	.871			
Women	<i>n</i> = 2209				<i>n</i> = 364		<i>n</i> = 785				<i>n</i> = 453					
Model 1 ^a	Reference	1.24	(0.98–1.56)	.068	1.12	(0.89–1.42)	.324	1.21	(1.02–1.44)	.028	1.60	(1.29–1.97)	.000			
Model 2 ^b	Reference	1.07	(0.84–1.36)	.581	1.08	(0.84–1.37)	.555	1.15	(0.96–1.37)	.134	1.44	(1.15–1.80)	.001			
Age																
Middle-aged	<i>n</i> = 2131		<i>n</i> = 424		<i>n</i> = 348		<i>n</i> = 950				<i>n</i> = 552					
Model 1 ^c	Reference	1.37	(1.10–1.71)	.005	0.99	(0.77–1.27)	.950	1.09	(0.92–1.28)	.327	1.24	(1.01–1.51)	.036			
Model 2 ^d	Reference	1.23	(0.97–1.55)	.084	0.96	(0.74–1.25)	.762	1.02	(0.86–1.22)	.815	1.08	(0.88–1.34)	.462			
Older adults	<i>n</i> = 1600		<i>n</i> = 339		<i>n</i> = 317		<i>n</i> = 813				<i>n</i> = 506					
Model 1 ^c	Reference	1.15	(0.91–1.46)	.247	1.23	(0.97–1.58)	.094	1.27	(1.07–1.51)	.007	1.40	(1.14–1.72)	.001			
Model 2 ^d	Reference	1.02	(0.80–1.31)	.857	1.15	(0.89–1.49)	.277	1.17	(0.98–1.40)	.083	1.26	(1.02–1.56)	.032			
Middle-aged men	<i>n</i> = 832		<i>n</i> = 201		<i>n</i> = 153		<i>n</i> = 491				<i>n</i> = 289					
Model 1 ^e	Reference	1.39	(1.01–1.92)	.045	1.10	(0.76–1.60)	.613	1.03	(0.81–1.32)	.789	0.98	(0.73–1.31)	.885			
Model 2 ^f	Reference	1.23	(0.88–1.74)	.230	1.01	(0.68–1.50)	.961	0.92	(0.71–1.19)	.528	0.83	(0.61–1.14)	.253			
Older men	<i>n</i> = 690		<i>n</i> = 194		<i>n</i> = 148		<i>n</i> = 487				<i>n</i> = 316					
Model 1 ^e	Reference	1.17	(0.85–1.61)	.350	1.06	(0.74–1.52)	.756	1.23	(0.97–1.55)	.085	1.25	(0.96–1.64)	.098			
Model 2 ^f	Reference	1.10	(0.78–1.53)	.601	1.05	(0.72–1.52)	.816	1.16	(0.90–1.48)	.249	1.10	(0.83–1.46)	.516			
Middle-aged women	<i>n</i> = 1299		<i>n</i> = 223		<i>n</i> = 195		<i>n</i> = 459				<i>n</i> = 263					
Model 1 ^e	Reference	1.33	(0.99–1.80)	.060	0.90	(0.65–1.27)	.552	1.15	(0.91–1.45)	.237	1.55	(1.18–2.05)	.002			

Models	Afternoon napping (min)											
	0	OR	95%CI	P	OR	95%CI	P	OR	95%CI	P	OR	95%CI
Model 2 ^f	Reference	1.19	(0.87–1.64)	.279	0.92	(0.65–1.31)	.654	1.14	(0.90–1.45)	.285	1.39	(1.03–1.86)
Older women	<i>n</i> = 910	<i>n</i> = 145			<i>n</i> = 169			<i>n</i> = 326			<i>n</i> = 190	
Model 1 ^e	Reference	1.10	(0.77–1.57)	.609	1.40	(1.00–1.96)	.053	1.29	(1.00–1.67)	.052	1.63	(1.18–2.25)
Model 2 ^f	Reference	0.91	(0.63–1.32)	.611	1.28	(0.90–1.81)	.177	1.15	(0.88–1.51)	.311	1.54	(1.09–2.16)

Abbreviation: min, minute; OR, odds ratio; CI, confidence interval; BMI, body mass index; CRP, C-reactive protein.

^aModel 1 adjusted age groups, education, marital, region.

^bModel 2 adjusted age groups, education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression.

^cModel 1 adjusted sex, education, marital, region.

^dModel 2 adjusted sex, education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression.

^eModel 1 adjusted education, marital, region.

^fModel 2 adjusted education, marital, region, BMI, waist circumference, smoking, alcohol drinking, nighttime sleep duration, diabetes status, dyslipidemia, high CRP and depression.