Relationship Between Sleep and Arthritis in a Middle-aged and Older Chinese Population- the China Health and Retirement Longitudinal Study

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Abstract

Objective. To evaluate the relationship between sleep duration, sleep restless and arthritis in middle-aged and older Chinese population.

Methods. A total of 4957 middle-aged and elderly people aged 45 years and above from The China Health and Retirement Longitudinal Study (CHARLS) wave 3 were included. Multivariable logistic regression was used to calculate adjusted odds ratios (ORs) and 95 % confidence intervals (CIs) for arthritis.

Results. Sleep duration was shown to have a U-shaped association with arthritis after adjusting confounding factors. Compared with <5h sleep duration per night, ORs (95 % CIs) of sleep duration 5-7,7-8 and 8-9 h per night for arthritis were 0.61 (0.52– 0.73, P value <0.001) ,0.47 (0.38-0.58, P value <0.001),0.50 (0.41,0.60, P value <0.001)and 0.50 (0.39–0.64, P value <0.001), respectively. Sleep restless was positively correlated with the prevalence of arthritis. After stratification according to sleep restless status, for those without sleep restless, 8-9 hours duration (OR=0.55, 95 % CI 0.39-0.78,P value=0.001)had the best protective effect on arthritis, while7-8 hours duration (OR=0.45, 95 % CI 0.34-0.60,P value <0.001)was best in people with sleep restless.

Conclusion. In middle aged and old Chinese population, sleep duration is U-shaped associated with arthritis, and sleep restless affect the correlation.

Key Messages

Unhealthy sleep behaviors (short duration and more restless) were linked to higher prevalence of arthritis.

Sleep duration was shown a U-shaped association with arthritis, and the protection effect was best for 7–8 hours.

A change of sleep restless leads to compensatory changes in sleep duration, which affects the correlation with arthritis.

Introduction

Arthritis is a general term for over 100 joint diseases, among which osteoarthritis (OA) and rheumatoid arthritis (RA) are the most common forms, accompanied by pain and high disability, severely affecting quality of life and life expectancy, brings a heavy economic burden with the increasing proportion of health care medical services expenditure [1].

Globally, an increase in age-standardised prevalence, annual incidence rate of OA and RA were observed between 1990 and 2017 [2, 3]. In addition, global age- standardised years lived with disability (YLDs) rate of OA in 2017 was 118.8 (95% UI 59.5 to 236.2), an increase of 9.6% (95% UI 8.3–11.1%) from 1990 [2]. In China, age-standardised prevalence of OA increased from 2.9% (95% UI 2.5–3.3) to 3.1% (2.7–3.4),the

prevalence of YLDs and YLD caused by OA also showed an upward trend between 1990 and 2017[4]. Besides, the China Health and Retirement Longitudinal Study (CHARLS) baseline survey showed the total prevalence of arthritis was 31.4% in the adults over 45 years old, and prevalence increased with age increased with age, higher in females in each age group[5]. As the population and scale of the growth, brings the aggravating trend of aging, increasing demand of life expectancy [1], and more obesity [6], as well as the growing prevalence rate of arthritis.

Sleep is the basic physiological requirement of human beings and is regulated by circadian rhythm, homeostasis and neurohormones[7]. A number of studies have shown that sleep duration and quality are associated with all-cause mortality, a variety of chronic diseases such as coronary heart disease, diabetes and obesity[8–10]. People with arthritis were reported to have a higher proportion of sleep problems[11, 12]. Epidemiological studies had also found correlation between sleep problems and higher risk of arthritis, especially the middle-aged and the elderly[13–16].

Sleep is reported to be associated with several intermediate pathophysiological mechanisms, such as immunity and inflammation[17], oxidative stress[18], metabolism[19], above of which are associated with the risk of arthritis. Studies have shown that both short and long sleep duration have been associated with higher levels of proinflammatory cytokines [20, 21], such as interleukin-6 (IL-6), tumor necrosis factor - α (TNF - α) and C-reactive protein (CRP) [22–24], TNF and IL-6 seem to be the main proinflammatory cytokines involved in the pathophysiology of OA[25]. Sleep time may be associated with resistance to oxidative stress, high metabolic rates leading to high levels of reactive oxygen species (ROS) related to aging, and it will produce wrinkles, arthritis, dementia in mice at two[18].

At present, there are few studies on the relationship between sleep and arthritis. For Asian population, previous studies in Korea only focused on sleep duration and arthritis, ignoring the impact of sleep quality[26–29]. A recent study of the Chinese population only selected the rural elderly with RA in single center, could not represent the prevalence of arthritis in middle-aged and older Chinese[30].The CHARLS is a national survey of middle-aged and elderly people. The purpose of this study is to find out the relationship between sleep duration, sleep restless and arthritis in Chinese middle-aged and elderly population, so as to find the best combination of sleep duration and quality on the prevention of arthritis.

Methods

Participants

The China Longitudinal Study on Health and Retirement (CHARLS) is a nationally representative survey in the middle-aged and older population (≥45 year) , covering 150 county-level units distributed in 28 provinces in mainland China except Tibet. In this study , after excluding individuals younger than 45 years old and losing the necessary information, a total of 4957 participants (2529 males and 2428 females) from CHARLS wave 3 during 2015 to 2016 were included.

Arthritis and other health conditions

Participants were defined as arthritis and other health conditions based on self- report derived from the doctor's diagnosis. New Respondents in the third waves were asked “Have you been diagnosed with [conditions listed below, read one by one] by a doctor? The details are as follows:1.Hypertension;2. Dyslipidemia (elevation of low density lipoprotein, triglycerides (TGs),and total cholesterol, or a low high density lipoprotein level);3.Diabetes or high blood sugar;4.Cancer or malignant tumor (excluding minor skin cancers);5.Chronic lung diseases, such as chronic bronchitis , emphysema (excluding tumors, or cancer);6.Liver disease (except fatty liver, tumors, and cancer);7.Heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems;8.Stroke;9.Kidney disease (except for tumor or cancer);10.Stomach or other digestive disease (except for tumor or cancer);11.Emotional, nervous, or psychiatric problems;12.Memory-related disease;13.Arthritis or rheumatism;14.Asthma.If the answer is "yes", it is considered as patients with the disease diagnosed by the doctor. For remaining respondents since last waves reported that he/she had [conditions listed],asked “Our records from your last interview show that you have had/not had [conditions listed below], is this right?” If the answer of the last visit was correct, then asked the next chronic disease. If it was wrong, asked if they had this chronic disease since last interview. If the interviewees reported that they did not have [load chronic disease] at last visit and confirmed that the answer was correct, then they were asked whether they had this chronic disease since last wave. If the answer in the last interview was wrong, it indicated that the interviewees had suffered from this chronic disease in the last visit, and then asked the accesses (through routine or CHARLS physical examination, or any other?)Finally, based on the results of the above questionnaires, we included a total of 1719 patients (including 740 males and 979 females)with arthritis, including self-report of new and previous respondents with arthritis, and self-reported arthritis since last visit.

As hypertension, diabetes and coronary heart disease are the main risk factors of arthritis, we included these three diseases as covariates.

Exposure

The nighttime sleep duration item was set under the part of lifestyle and health behaviors in a standardized questionnaire. And the hours of actual sleep were considered instead of time in bed. According to the answers, they were divided into five groups (Group A:< 5h, Group B: 5-7h, Group C: 7-8h, Group D:8-9h and Group E: ≥ 9h), and the Group A (< 5h) was set as the reference group.

The sleep restless was evaluated through the self-report question “My sleep was restless” with four options: Rarely or none of the time (< 1 day);Some or a little of the time (1-2 days);Occasionally or a moderate amount of the time (3-4 days); Most or all of the time (5-7 days). According to the answers, they were divided into four groups: I Rarely or none, II Some or a little, III Occasionally and IV Most or all, and the group I (Rarely or none) was set as the reference group.

Participants were asked “Have you started menopause?” and “When did you begin the menopause?” If the respondents answered “yes” or the specific time of menopause, they were considered to be postmenopausal, based on the answer, 2068 postmenopausal women were included.

Other Covariables

The biological age was obtained by asking “What’s your actual date of birth?”. Then, people aged 45-60 years old were defined as middle-aged, and over 60 as old, and the middle-aged was set as the reference group. “The main city zone” was defined as urban, and other residential types, including “Combination zone between urban and rural areas, the town center, Zhenxiang area, special area, township Central, village” were defined as rural, and the urban was set as the reference group. Marital status was divided into three groups: Married with spouse present and Cohabitated; Married but not living with spouse temporarily for reasons such as work; Separated/Divorced/Widowed/Never married. “Married with spouse present and Cohabitated” was set as reference. A subsample of the participants was randomly selected to answer questions regarding physical activity. The questionnaire classified the levels of physical activity intensity as vigorous, moderate and walking, and then asked the duration they spent of each. High-intensity physical exercise is a risk factor for arthritis, and the prevalence increases for people with more than four continuous hours[33]. So only vigorous activity was taken into consideration, which required hard/high-intensity physical effort, such as heavy lifting, digging, ploughing, aerobics and fast bicycling, and cycling with a heavy load. BMI was calculated by dividing weight in kilograms by height in meters squared. BMI status were divided into following groups, normal weight range of 18.5–23.9 kg/m2,thin <18.5 kg/m2, overweight 24.0–27.9 kg/m2, obesity>28.0 kg/m2.The ever and current smoking was defined as smoking, never smoking was defined as non-smoking, the ever and current drinking was defined as drinking, never drinking was defined as non-drinking.

Blood samples were collected from each respondent by trained staff from the Chinese Center for Disease Control and Prevention (CDC), and respondents were asked to fast overnight. More detailed information regarding blood sample storage, transportation, and measurement has been published [31]. The protocol of the blood- based biomarker sample collection study was approved by the ethical review committee (IRB) of Peking University (IRB 00001052-11014). Written informed consent was obtained from all study participants.

Statistics

The frequency and percentage of samples were used to show the characteristics of the participants. T test was used for continuous variables and chi square test for categorical variables. To evaluate the association between sleep duration, restless and arthritis, a multivariate logistic model was fitted to estimate the adjusted odds ratio (OR) and its 95% CI. Model 1 only included sleep duration group (Group A,B,C,D,E) and age. Model 2 adjusted for model 1 and the variable sleep restless. Model 3 included additional adjustments including: residence, marital status, vigorous exercises, drinking status, smoking status, BMI status, hypertension, diabetes, heart problems, blood indexes (including: Total cholesterol, Triglycerides, HDL cholesterol, LDL cholesterol, Glucose). Model 4 adjusted for model 3 and the variable sleep restless. Participants were stratified by sex ,postmenopausal status and sleep restless status. Considering the balance of sample size, the sleep restless stratification was based on participants with

sleep restless (Group II: Some or a little, III Occasionally and IV Most or all) and without sleep restless (Group I: Rarely or none).

We did all statistical analyses using version 14 (Stata Corp LP, College Station, Texas, USA) ,plotted graphs using R version 3.5.3 and Graphpad prism 8. A p-value < 0.05 was defined as statistically significant.

Results

Baseline general features

Of all participants included, the mean age were 60.5 ± 9.1years, males and females were 60.8 ± 9.47 and 60.1 ± 8.8 respectively. The mean sleep durations were 6.37 ± 1.88 h per night in general, 6.50 ± 1.71h ,6.23 ± 2.03h in males and females, respectively. Participants were more likely to report short sleep duration(< 5h per night) than long sleep(≥ 9 h per night) in both sex. 55.23% women had sleep restless which was significantly higher compared with 39.38% in men (P value < 0.001). Of the studied women, 85.17 % had postmenopausal status, and 56.38% postmenopausal women with sleep restless. Descriptive statistics for the characteristics of participants were presented in general and by gender in Table 1. Men and women who had arthritis were older, had lower sleep duration and worse sleep restless status. In addition, participants who lived in rural and married not living with spouse, had more vigorous exercises, comorbidity with obesity, hypertension and heart problems, had more risk on arthritis.

Table 1
Baseline characteristics and sleep duration/restless for the risk of arthritis according to gender

Characteristics	Males(Col%)			Female(Col%)		
	No Arthritis	Arthritis	P value	No Arthritis	Arthritis	P value
Sample size, N (%)	1789 (70.74)	740 (29.26)		1449 (59.68)	979 (40.32)	
Age (years)	60.4 ± 9.7	61.8 ± 8.9	0.0009	59.3 ± 8.9	61.4 ± 8.5	< 0.001
Age (years)			0.001			< 0.001
45 ≤ R < 60	855 (73.9)	302 (26.1)		780 (64.73)	425 (35.27)	
R ≥ 60	934 (68.08)	438 (31.92)		669 (54.7)	554 (45.3)	
Sleep duration (h)	6.59 ± 1.64	6.28 ± 1.85	< 0.001	6.51 ± 1.89	5.83 ± 2.18	< 0.001
Sleep duration (h)			< 0.001			< 0.001
< 5	194 (59.69)	131 (40.31)		209 (43.45)	272 (56.55)	
5 ~ 7	675 (70.68)	280 (29.32)		508 (59.42)	347 (40.58)	
7 ~ 8	368 (74.34)	127 (25.66)		274 (68.33)	127 (31.67)	
8 ~ 9	417 (73.8)	148 (26.19)		303 (66.59)	152 (33.41)	
≥ 9	135 (71.43)	54 (28.57)		155 (65.68)	81 (34.32)	
Sleep restless			< 0.001			< 0.001
Rarely or None	1148 (74.89)	385 (25.11)		729 (67.07)	358 (33.21)	
Some or A Little	243 (67.88)	115 (32.12)		214 (59.44)	146 (40.56)	
Occasionally	193 (66.32)	98 (33.68)		234 (56.25)	182 (43.75)	
Most or All	205 (59.08)	142 (40.92)		272 (48.14)	293 (51.86)	

Characteristics	Males(Col%)			Female(Col%)		
	No Arthritis	Arthritis	P value	No Arthritis	Arthritis	P value
Marital status			0.089			0.002
Married with spouse present/cohabitated	1597 (71.45)	638 (28.55)		1217 (61.34)	767 (38.66)	
Married not living with spouse	48 (64)	27 (36)		56 (51.85)	52 (48.15)	
Separated/divorced/ widowed/never	144 (65.75)	75 (34.25)		176 (52.38)	160 (47.62)	
Residence			0.001			0.058
Urban	228 (79.44)	59 (20.56)		178 (64.96)	96 (35.04)	
Rural	1561 (69.62)	681 (30.37)		1271 (59.01)	883 (40.99)	
Drinking status			0.833			0.378
No	486 (71.05)	198 (28.95)		1135 (60.15)	752 (39.85)	
Yes	1303 (70.62)	542 (29.38)		314 (58.04)	227 (41.96)	
Smoking status			0.069			0.691
No	340 (74.24)	118 (25.76)		1327 (59.56)	901 (40.44)	
Yes	1449 (69.97)	622 (30.03)		122 (61)	78 (39)	
BMI Status			0.18			0.001
Thin	98 (74.81)	33 (25.19)		84 (62.69)	50 (37.31)	
Normal	927 (69.8)	401 (30.2)		604 (60.83)	389 (39.17)	
Overweight	579 (72.83)	216 (27.17)		567 (61.83)	350 (38.17)	
Obesity	185 (67.27)	90 (32.73)		194 (50.52)	190 (49.48)	
Hypertension No	148 (70.14)	63 (29.86)	< 0.001	136 (55.06)	111 (44.94)	< 0.001

Characteristics	Males(Col%)			Female(Col%)		
	No Arthritis	Arthritis	P value	No Arthritis	Arthritis	P value
Yes	483 (64.66)	264 (35.34)		413 (51.45)	390 (48.57)	
Diabetes			0.842			0.119
No	1641 (70.79)	677 (29.21)		1313 (60.2)	868 (39.8)	
Yes	148 (70.14)	63 (29.86)		136 (55.06)	111 (44.94)	
Heart problems			< 0.001			< 0.001
No	1590 (72.67)	598 (27.33)		1230 (62.15)	749 (37.85)	
Yes	199 (58.36)	142 (41.64)		219 (48.78)	230 (51.22)	
Vigorous exercises			0.001			0.009
No	1049 (73.3)	382 (26.7)		1024 (61.43)	643 (38.57)	
Yes	740 (67.4)	358 (32.6)		425 (55.85)	336 (44.15)	
Total cholesterol (mmol/L)	4.59 ± 0.89	4.66 ± 0.94	0.0647	4.94 ± 0.93	4.95 ± 0.90	0.7289
Triglycerides (mmol/L)	1.59 ± 1.08	1.61 ± 1.11	0.5816	1.68 ± 1.02	1.70 ± 1.00	0.6295
HDL cholesterol (mmol/L)	1.30 ± 0.31	1.32 ± 0.35	0.1498	1.36 ± 0.27	1.37 ± 0.30	0.8472
LDL cholesterol (mmol/L)	2.55 ± 0.71	2.59 ± 0.73	0.1833	2.76 ± 0.77	2.76 ± 0.74	0.8422
Glucose (mmol/L)	5.75 ± 1.89	5.65 ± 1.78	0.2277	5.78 ± 2.20	5.69 ± 1.53	0.2326

Prevalence of arthritis

The overall arthritis prevalence rate was 34.68%, higher than the baseline prevalence of 31.4%. [5]The prevalence of arthritis in women was significantly higher than men,40.32% and 29.26% respectively. The trends of prevalence by sleep duration and sleep restless for men and women, postmenopausal women are shown in Fig. 1A and Fig. 1B. Short sleepers with higher prevalence rate of arthritis than longer

sleepers, and an apparently U-shape trend on prevalence of arthritis according to sleep duration was suggested in all participants, regardless sex and menopause status .In addition, increasing trend was found between sleep restless frequency and arthritis in all participants. The highest arthritis prevalence was found among the people who had the most sleep restless in a week, and the prevalence in females was higher than that in males. Menopause expanded the harmful dose-response effect in women. Figure S1 showed the association between sleep duration and sleep restless. The prevalence of arthritis with sleep restless increased significantly in all participants compared to those without sleep restless.

The associations of sleep duration and restless with arthritis

Figure 2–5 showed the results of multivariable models examining the associations of sleep duration and restless with arthritis. Overall, compared with those who sleep less than 5 h per night, the protective effects for arthritis were elevated in longer sleep duration and peaked at 7–8 h duration per night as shown in model 1 (OR = 0.47 ,95 % CI 0.38–0.58, P value < 0.001), whereas the protective effects attenuated after adjustment for sleep restless (model 2).Compared with model 3,the protective effects in 7–8 h duration association remained significant after adjustment for potential confounders, and still attenuated after adjustment for additional sleep restless status (model 4).In females, the ORs (95% CIs) of arthritis showed an apparently U-shape trend according to sleep duration, and the protective effects was best in 7–8 h duration (OR = 0.38 ,95 % CI 0.28–0.50, P value < 0.001), so was the postmenopausal women. Nevertheless, this dose-response relationship was not obvious in men.

Figure S2 shows the age-adjusted ORs of arthritis according to sleep duration on stratification of sleep restless status. Overall, in participants without sleep restless, the adjusted model showed 8-9h sleep duration per night with highest protective effect on arthritis (OR = 0.55,95 % CI 0.39–0.78, P value = 0.001). For participants with sleep restless, the best protective effect on arthritis was shifted to 7-8h sleep duration per night (OR = 0.45,95% CI 0.34–0.60,P value < 0.001). Neither short nor long sleep duration was associated with arthritis in men without sleep restless(FIGURE S3). For men with sleep restless, the relationship between sleep duration and arthritis became apparent(FIGURE S3).Compared with females without sleep restless, the protective effect of sleep duration on arthritis decreased in those suffered from sleep restless(FIGURE S4),so were the postmenopausal women(FIGURE S5).

Discussion

Arthritis is a major public health challenge. Despite the obvious international differences in prevalence, incidence rate and arthritis induced YLDs, the burden on most countries is increasing [1]. With the increase of life expectancy and the aging of population, the prevention and management of arthritis became an urgent public health problem to be solved. China is making every effort to promote the implementation of the strategy of healthy China, shifted the focus from treat to prevent[32].

Previous studies have demonstrated that demographic characteristics, such as age and gender, are associated with the development of arthritis, unhealthy life habits such as vigorous exercise is another contributing factor to arthritis, menopause, obesity, hypertension and heart problems bring additional

risks[5, 33]. In our study, the result was similar with the above-mentioned studies, but optimal sleep duration varies slightly by race, age group, and other confounders[34, 35].

To our knowledge, this is the first study to record the relationship between sleep duration, sleep restless and arthritis in Chinese people aged 45 and above. Consistent with other studies, our study presents a new finding that sleep duration has a significant U-shaped relationship with prevalence of arthritis in men, women and postmenopausal women. In our study, compared with short sleep, 7–8 hours of sleep showed the best protective effect on arthritis, while sleep restless weakened this protective effect.

The exact mechanism of the association between sleep and arthritis is uncertain, but there are sharing mechanisms served as potential explanations. Arthritis is common in middle-aged and elderly people and may be caused by driving inflammation and oxidative stress. In most inflammatory diseases, women are at higher risk than men and are more likely to have sleep discomfort, high levels of systemic inflammation[36]. Experimental sleep loss leads to greater and / or more sustained increases in nuclear factor kappa B signaling and toll like receptor 4 stimulated IL-6 and tumor necrosis factor monocytes in women[37]. In this study, women were associated with a higher prevalence of arthritis and more sleep restless problems, suggesting that they were more likely to have elevated inflammation associated with sleep disorders.

Also, it has been confirmed that sleep disorders are associated with the incidence and mortality of age-related diseases[36]. The risk of arthritis was higher in people over 60 years old than in middle aged between 45 and 60 years old. Pro-inflammatory and pro-oxidative pathways may accelerate the process of telomere shortening, thus promoting the aging process[37, 38]. Partial sleep deprivation enhanced senescence- associated secretory phenotype (SASP) and increased the accumulation of DNA damage, thus initiating cell cycle arrest and promoting cell senescence[39, 40]. Sleep disorders are associated with another biological marker of cell aging, the reduction of telomere length[41, 42], and DNA epigenetic methylation (known as epigenetic age) in women [43].

Menopause brings changes in metabolism, weight and skeletal muscle, accelerates the aging process. 40–60% postmenopausal women had severe sleep disorders[44], the prevalence of arthritis in postmenopausal women increased significantly, and the correlation remained strong after adjusting for confounding factors. It was reported that the inflammatory factors of IL-1, IL-6 and TNF - α in serum and synovial fluid of postmenopausal women can promote and aggravate the occurrence of arthritis[45].

Compared with those who slept 7 hours per day, short sleepers had an increased risk of significant weight gain and central obesity[46]. After experimental acute sleep loss, tissue-specific metabolic disorder occurs in peripheral tissues (such as skeletal muscle and adipose tissue),and gain of fat mass occurring concomitantly with loss of lean mass[47]. On the other hand, short sleep duration may lead to weight gain and obesity by changing the time and amount of food intake, disrupting energy balance, interfering with glucose metabolism and insulin sensitivity[48].

In this study, the prevalence of arthritis without sleep restless was 28.36% (n = 743), with sleep restless was 42.58% (n = 976). Sleep restless can be regarded as a disturbance of biological rhythms, disrupting the established nocturnal circadian clock. The circadian-controlled Melatonin and its derivatives are broad-spectrum antioxidants and free radical scavengers, which regulate multiple molecular pathways, inflammation, proliferation, apoptosis and metastasis under different pathophysiological conditions, and may protect from arthritis [49].

With the increasing awareness of arthritis, more risk factors have been identified, and primary prevention through lifestyle change is considered to be the most promising way to prevent arthritis. Sleep is a modifiable behavior by cognitive behavioral therapy, physical exercise, psychological intervention and so on[50].

Although our data is based on a large sample size and are powered to have robust results when adjusting various covariates, there are a few limitations to consider. Firstly, our data come from CHARLS wave 3,a nationally representative survey in the middle-aged and older population. Its cross-sectional nature precludes the ability to examine causal associations between sleep duration, restless and arthritis. Secondly, we relied on self-reported sleep duration and sleep restless which was not objectively measured. Thirdly, due to the limitation of sample size, the frequency of sleep restless is not divided in detail. And there is a smaller number of people in Group E of sleep duration(≥ 9h per night), which may lead to inaccurate prevalence in this group. Finally, as 85.17% of women are postmenopausal in this study, we only investigate the relationship between sleep and arthritis of postmenopausal women.

Conclusion

In conclusion, the present study demonstrated the U-shaped association between sleep duration and arthritis, and sleep restless affect the correlation in middle aged and older people. Sleep was regarded as an adjustable behavior to explore the best sleep prevention combination to prevent arthritis

Declarations

Ethical Approval and Consent to participate

The Medical Ethics Board Committee of Peking University granted the study an exemption from review.

Consent for publication

Not applicable.

Availability of supporting data

The datasets used and analyzed during the current study are available from the corresponding author on reasonable use.

Competing interests

We declare no conflict of interest.

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Author contribution

Study concept and design, obtained funding and Critical revision of the manuscript for important intellectual content: Shang shaomei

Analysis and interpretation of data, statistical analysis and drafting of the manuscript: Li Chunnan

We declare no conflict of interest.

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Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable use.

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Figures

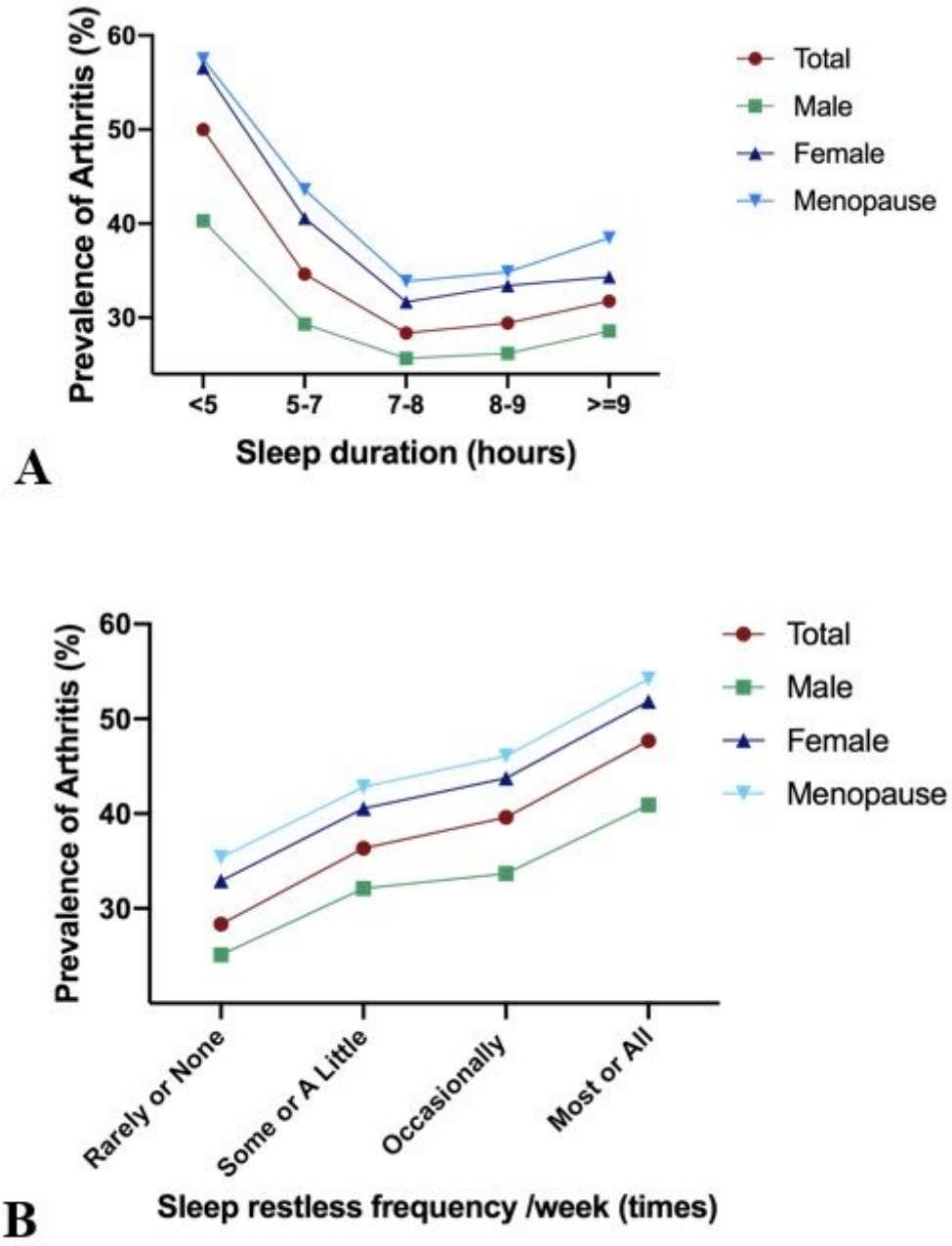

Figure 1

The prevalence of arthritis by sleep duration/restless for total population, men and women, postmenopausal women

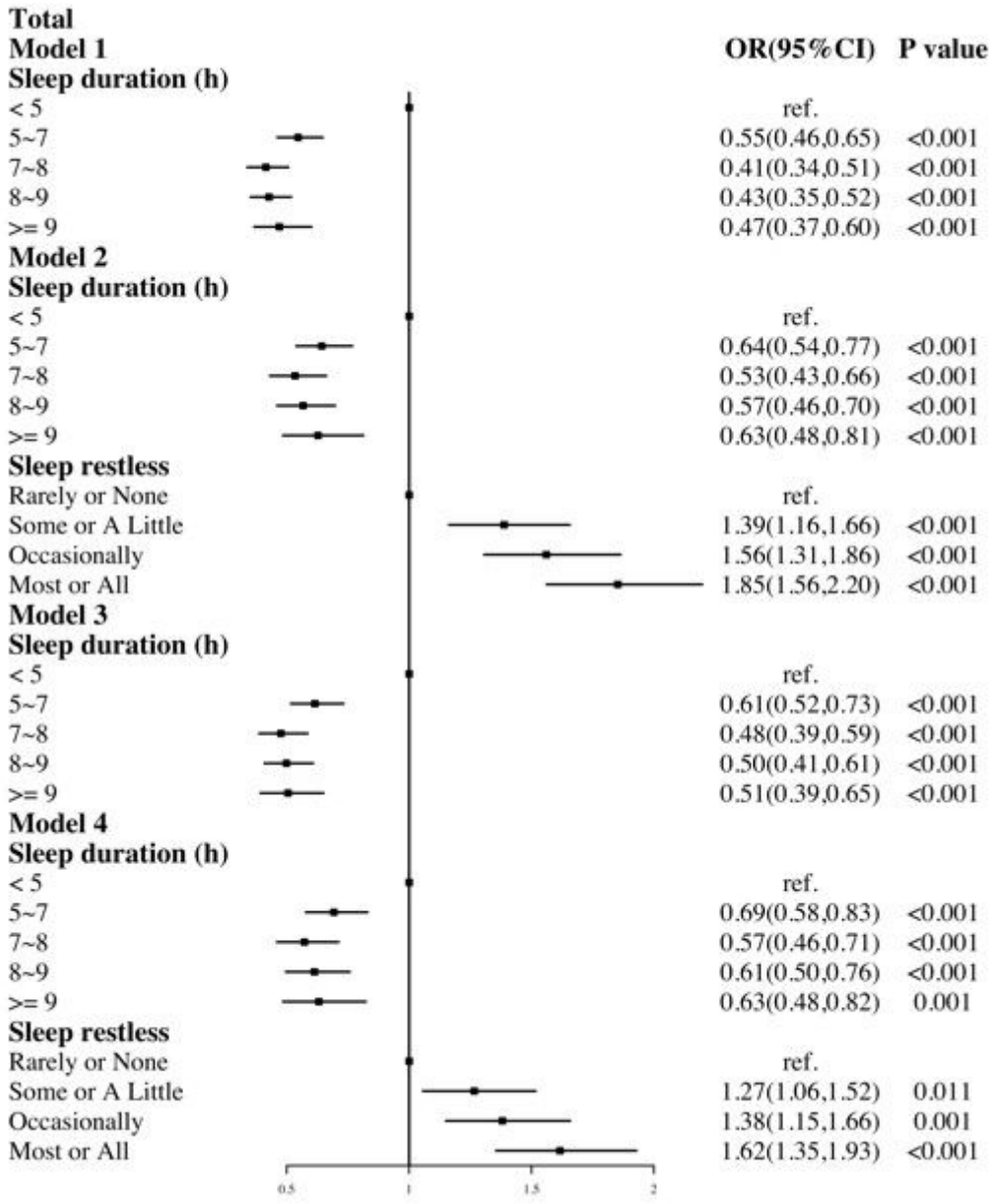

Figure 2

Age-adjusted odds ratios (95 % CIs) for arthritis according to sleep duration and/or sleep restless in total participants

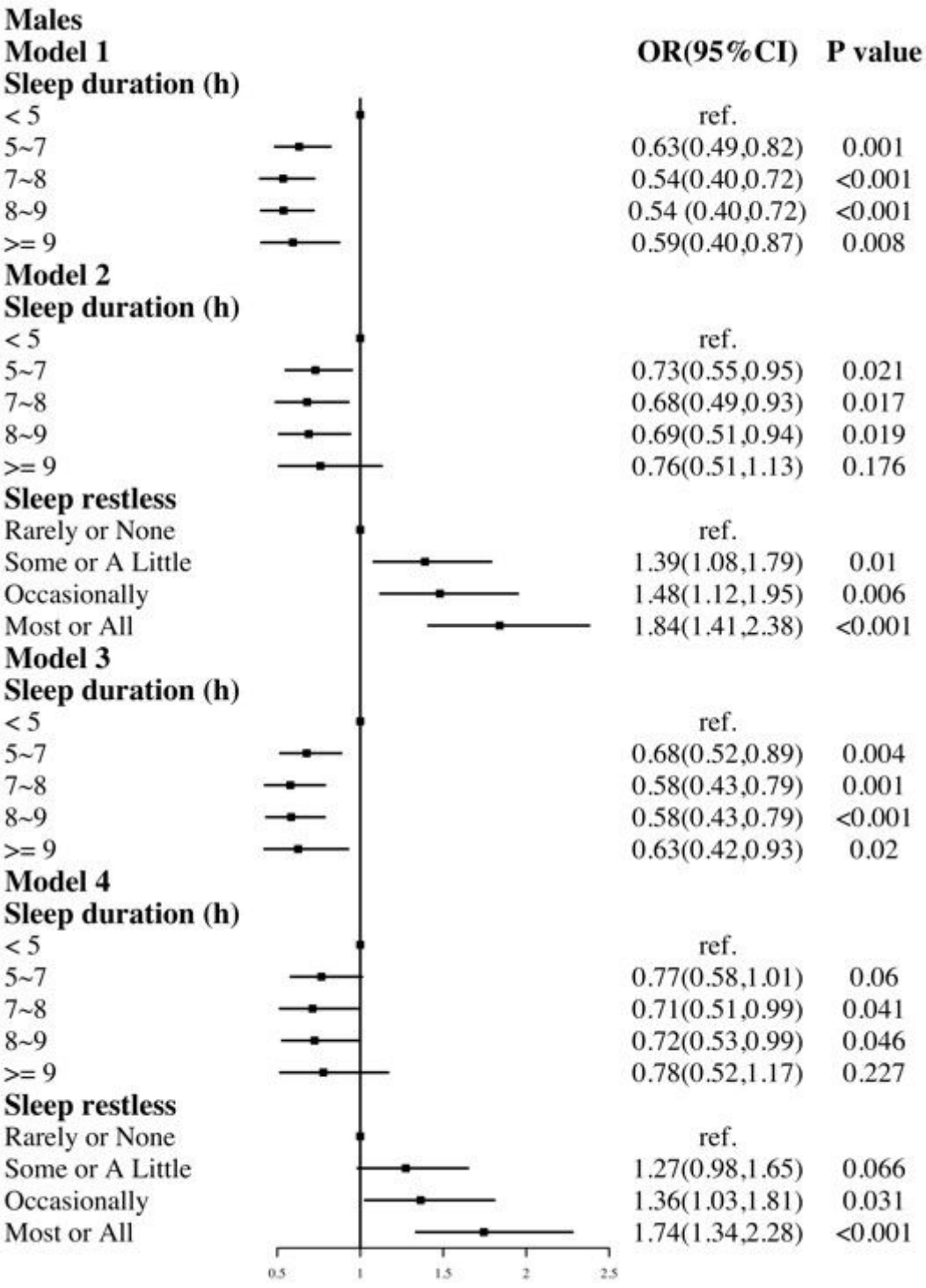

Figure 3

Age-adjusted odds ratios (95 % CIs) for arthritis according to sleep duration and/or sleep restless in males

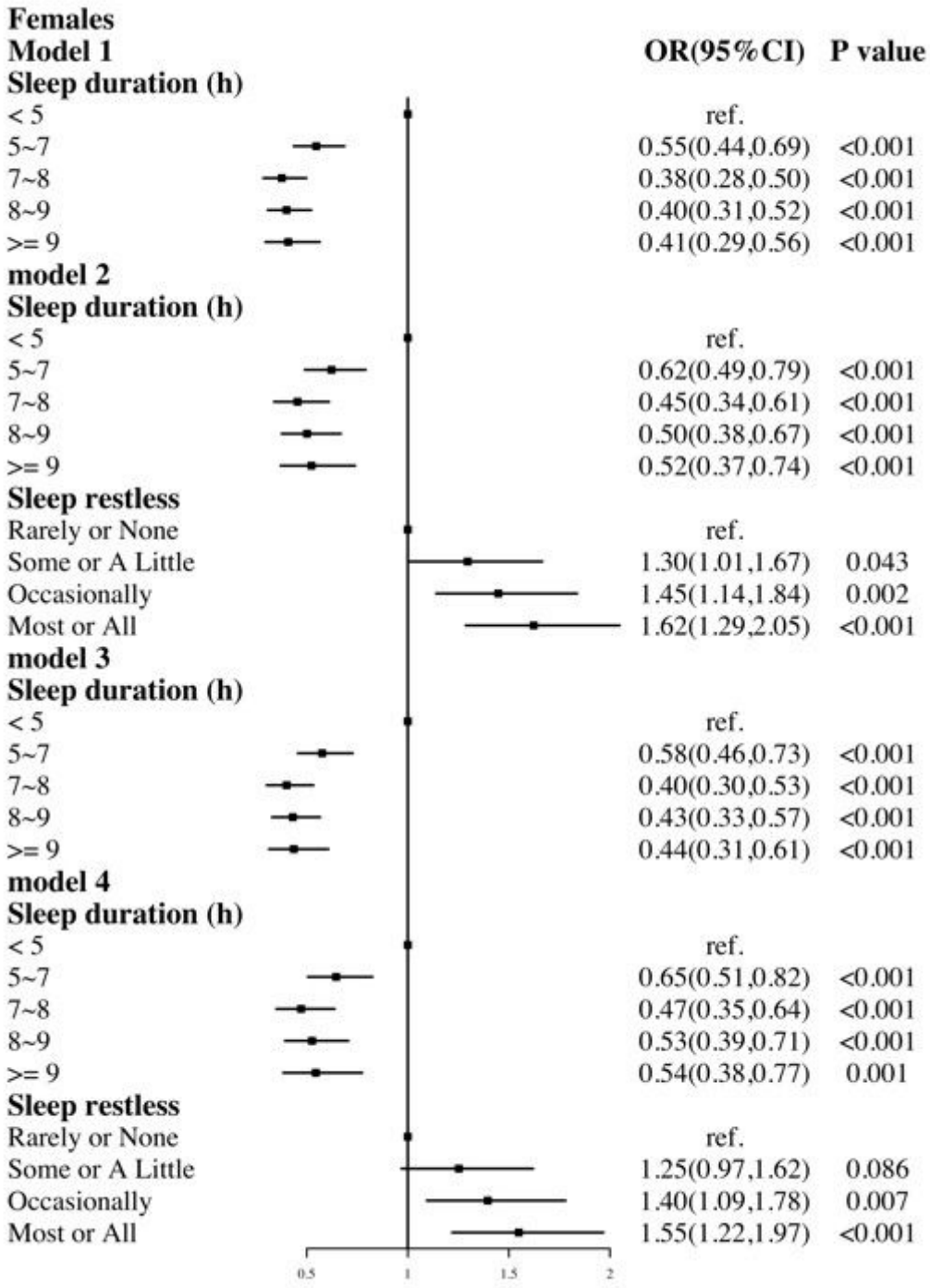

Figure 4

Age-adjusted odds ratios (95 % CIs) for arthritis according to sleep duration and/or sleep restless in females

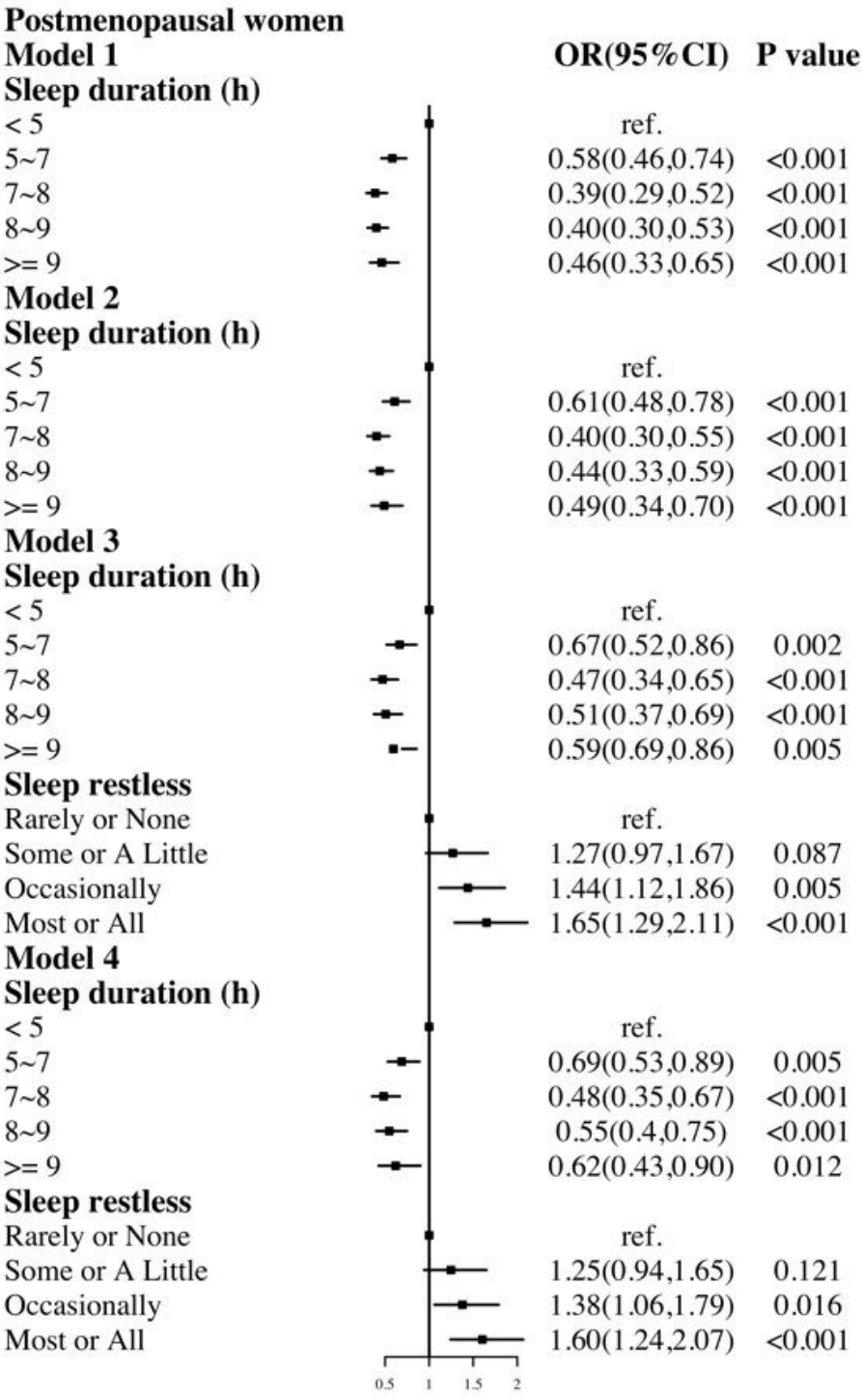

Figure 5

Age-adjusted odds ratios (95 % CIs) for arthritis according to sleep duration and/or sleep restless in postmenopausal women

Supplementary Files

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