Nighttime Sleep, Chinese Afternoon Nap, and Mortality in the Elderly

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Study Objectives: Although many epidemiologic studies have shown that both short and long nighttime sleep durations are associated with increased mortality in the general population, limited data have been reported for older persons, especially those taking afternoon nap. Data from a prospective cohort study of the elderly in Taiwan were used to examine the relationship among nighttime sleep, Chinese afternoon nap, and mortality.

Design: Prospective cohort study

Setting: General population

Participants: A nationally representative sample of 3079 Taiwanese community residents aged 64 and over was studied, using reported sleep related information collected in 1993 and subsequent 10-year mortality data.

Interventions: None

Measurements and Results: Cox proportional hazards models, separated by sex, were computed to estimate mortality hazard ratios in relation to nighttime sleep duration and afternoon nap duration, adjusting for potential confounders. Compared to older adults sleeping 7~7.9 hours at night, those with longer sleeping time (≥ 10 hours in males and ≥ 8 hours in females) had a significantly higher risk of total mortality. Afternoon nap alone was not associated with total mortality. When nighttime sleep duration and afternoon nap duration were considered together by adding the interaction term in the model or stratifying sleep hours and nap duration, the effect of afternoon nap on mortality risk remained insignificant.

Conclusions: Longer nighttime sleep duration increases mortality risk in older adults. Chinese afternoon nap is not an independent predictor of mortality. There is no significant benefit or harm of practicing afternoon nap in addition to the regular night sleep on elderly mortality.

Keywords: Afternoon nap, elderly, mortality, nighttime sleep

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INTRODUCTION

SLEEP, SIMILAR TO OTHER HEALTH-RELATED BEHAVIORS SUCH AS PHYSICAL ACTIVITY AND DIET, IS AN IMPORTANT COMPONENT OF A HEALTHY LIFE. Epidemiologic researches on sleep and mortality in general indicate that both short and long sleep durations are associated with increased mortality risk.[1] For example, study results of the American Cancer Society based on the sample of over 1.1 million people[2] have shown that nocturnal sleep durations of ≤4 hours or ≥10 hours tend to trigger an elevated mortality.[3] This U-shaped pattern, however, is not consistently observed in other studies. In recent large prospective studies of general populations in Japan[4] and the US,[5] mortality risk due to increased sleep duration was much greater than the risk due to reduced sleep duration. On the contrary, significantly higher mortality risk appeared to be related to shorter sleep time in a Scottish study.[6] The inconsistency could be attributable to demographic differences across studies including sex, age, and sleeping habits that may affect the relationship between sleep duration and mortality.

With regard to the effect of age on sleep, several studies found that the mean sleep duration steadily increased with aging,[3,4] suggesting that older adults were more likely to sleep longer than younger adults. As a result of this shift in sleep duration, long sleep is more important than short sleep in discussing the relationship between sleep duration and death in the elderly. Unfortunately, evidence from studies focusing on older adults is limited.[7,8]

In addition to age, sleeping habits may also interact with sleep duration in the pathway to death. Previous studies have advanced our understanding about the effect on mortality of different sleeping habits, such as the time to bed and rise[9] or daytime nap.[10,11] In different cultural backgrounds, it remains unclear whether afternoon nap plays a role in the association of sleep and mortality. Afternoon nap is a traditional practice commonly seen in populations of Mediterranean, Latin American, and Chinese countries. In Chinese society, it is widely accepted that afternoon nap, as a complementary sleep, is a healthy activity and is especially good for older adults who need longer sleeping time. However, the protective effect of afternoon nap is yet to be proven, although one previous study based on Mediterranean older adults reported that "siesta" was associated with increased mortality risk.[12]

In this prospective cohort study of an older Chinese population in Taiwan, we analyzed the association between nighttime sleep duration and 10-year mortality, with particular interest in examining any potential effect of afternoon nap.

METHODS

Subjects

Data were from the Survey of Health and Living Status of the Elderly in Taiwan, a longitudinal study of the elderly initiated in 1989 with a sample of 4412 subjects aged ≥60 years old. The

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sample was drawn, through a 3-stage probability sampling method,[13,14] from the entire elderly population of Taiwan. In-person interviews were completed with 4049 older adults, resulting in a response rate of 92%. During the follow-up, 4 re-interviews were conducted respectively in 1993, 1996, 1999, and 2003. Since questions on both sleep duration and habitual afternoon nap were covered only in the 1993 interview, 3155 study participants who completed the second face-to-face interview were included. Of this number, 76 were excluded because of failure to provide sleep related information and other health conditions, leaving us a total of 3079 subjects aged ≥64 years for analysis.

Measures of Night and Afternoon Sleep and Covariates

In the 1993 home-based interview, participants were asked, on the average, the times to bed and to rise and whether they had the habit of afternoon nap. For those taking afternoon nap, time-related information in hours and minutes were further obtained. Sleep duration at night was categorized as <7 hours, 7 to 7.9 hours, 8 to 8.9 hours, 9 to 9.9 hours, and ≥10 hours. Afternoon nap duration was classified as no, <60 minutes, 60-89 minutes, 90-119 minutes, and ≥120 minutes. In addition to age and sex, other health-related items incorporated in the study were marital status, cigarette smoking, alcohol consumption, body mass index, exercise, disease history (including heart disease, stroke, and cancer), and 2 important factors that have recently been found to affect sleep duration: income and depression.[15] We calculated cumulative pack-years of smoking, the average daily consumption of cigarettes across interviews multiplied by cumulative smoking years divided by 20, to estimate the amount of cigarette smoking. Average weekly ethanol consumption, defined as the average amount of weekly ethanol consumption across interviews, was used to represent the amount of alcohol consumption. BMI was calculated as reported weight in kg/height in m^2. Physical activity was defined as regularly engaging in any of walking, jogging, or mountain climbing in the last half year. Diseases were determined by the presence of heart disease, stroke, and cancer told by the physicians. Income was decided by asking the average amount of all personal incomes in a month. Depressive symptom was measured by an abridged Chinese version of the Center for Epidemiologic Studies-Depression Scale. The depression score ranges from 0 to 24, with higher scores representing more severe depression.

Mortality Data

Deaths that occurred between the 1993 interview and December 31, 2003 were reported by the families of study participants at subsequent interviews and were confirmed by the national death registry at the Department of Health, Taiwan, where detailed information of death including dates and major causes were also obtained. Causes of death were classified by using the coding system of the *International Classification of Disease, 9th Revision, Clinical Modification* (ICD-9).[16] All deaths were divided into cancer (ICD-9 codes 140 to 208), cardiovascular conditions (ICD-9 codes 390 to 459), respiratory conditions (ICD-9 codes 460 to 519), and other causes including well-defined conditions with too small numbers of death and those mainly due to senility or other ill-defined conditions.

Statistical Analyses

Cox proportional hazards model, separated by sex, was adopted to estimate the risk of death calculated with hazard ratios, under the adjustment of covariates. All-cause mortality was used as the outcome in the primary analysis separately for nighttime sleep and afternoon nap, with nighttime sleep duration of 7 to 7.9 and no afternoon nap respectively as the reference groups. To better examine the effect of different covariates considered as potential confounders related to mortality, we built 4 models in the primary analysis with age, sociodemographic factors, disease history, and finally nighttime sleep or afternoon nap added in the models. The sociodemographic factors include marital status (married, widowed, other), income (less than NT$ 5000 per month defined as low, between NT$ 5000 and 15000 defined as middle, higher than NT$ 15000 defined as high), cigarette smoking (never, <12 pack-years, between 12 and 36 pack-years, >36 pack-years, ever smokers without detailed smoking information), alcohol intake (never, <10 ml ethanol per week, ethanol between 10 and 85 ml per week, >85 ml ethanol per week, ever drinkers without detailed drinking information), BMI (<18.5, 18.5-24, 24.1-27, >27, missing), and physical activity (yes, no). Disease history consists with or without a history of heart disease, stroke, and cancer, and depressive symptoms (0, 1-4, ≥5, missing). Information of covariates was updated in the subsequent interviews. In addition, as noted by other studies that the mortality estimates may be biased by study participants whose sleep duration and habits are affected by undiagnosed diseases or conditions that cause death,[4,5] the same primary analyses were also conducted to exclude study participants who were dead within 2 years after the 1993 interview. A test for trend was also conducted by treating nighttime sleep duration as a continuous variable. To investigate the potential effect modifications of both night sleep and afternoon nap on death, the interaction terms of nighttime sleep hours and afternoon nap durations were further added in the Cox model. We then conducted secondary analysis of specific causes of death for nighttime sleep duration. Finally, to estimate the independent effect of nighttime sleep and afternoon nap on total mortality, both male and female participants were classified by stratifying nighttime sleep hours and afternoon nap duration; those without the habit of afternoon nap were set as the reference group. P values for all tests were two-tailed, and statistical differences were considered at <0.05 level. All analyses were performed using SPSS version 14 (SPSS Inc, Chicago, IL).

RESULTS

The baseline characteristics stratified by nighttime sleep duration and sex are shown in Table 1. Around half of older adults (54.5% in men and 49.7% in women) reported to sleep between 7 and 8.9 hours at night. Mean age, low-income percentage, stroke prevalence, and depression score tended to increase with nighttime sleep duration, whereas the proportion of physical activity decreased with nighttime sleep duration in both men and women. Longer sleepers were more likely to live alone and have a history of cancer. Habitual afternoon nap was reported by around two-thirds of older persons at baseline. The average time spent in afternoon nap was higher in those with nighttime sleep duration of ≥10 hours.

During the 10-year follow-up, 1338 deaths (816 men and 522 women) occurred. The mean follow-up years were 8.4 (standard

Table 1—Baseline Characteristics of Study Population by Sex and Reported Nighttime Sleep Duration

	Hours of nighttime sleep				
Male	**<7**	**7 - 7.9**	**8 - 8.9**	**9 - 9.9**	**≥10**
Number	271	436	516	313	212
Age, y (SD)	69.7 (4.6)	69.8 (5.0)	70.5 (5.4)	71.7 (6.2)	74.2 (6.5)
Marital status, married %	75.3	75.7	74.4	72.5	68.9
Income, low %	21.0	18.8	26.6	38.7	45.8
Cigarette, %	49.1	47.2	49.2	45.4	42.0
Alcohol, %	34.3	31.4	29.8	23.6	21.2
BMI, normal[a] %	60.1	56.2	59.3	66.1	51.4
Physical activity, %	68.6	66.3	57.6	54.0	41.5
Disease history, %					
Heart disease	13.7	16.3	17.2	14.4	17.0
Stroke	2.2	4.8	6.2	9.6	16.5
Cancer	0.7	1.8	1.0	1.6	2.8
Depression, score ≥5 %	19.6	20.0	24.4	27.2	34.0
Afternoon nap, %	70.1	70.4	67.4	64.5	68.4
Nap time[b] in minutes (SD)	74.5 (35.7)	70.7 (31.1)	70.5 (31.1)	78.4 (39.0)	85.9 (39.4)
Female					
Number	179	267	394	268	223
Age, y (SD)	70.2 (5.0)	70.3 (5.3)	71.3 (5.8)	72.4 (5.9)	75.2 (6.6)
Marital status, married %	46.4	47.2	50.3	50.0	38.6
Income, low %	31.3	36.3	48.5	54.9	69.1
Cigarette, %	8.9	4.9	7.4	5.2	4.0
Alcohol, %	5.6	2.6	4.1	4.5	2.2
BMI, normal[a] %	46.4	55.4	55.1	60.8	54.7
Physical activity, %	57.5	56.9	46.4	35.4	22.4
Disease history, %					
Heart disease	22.9	23.2	20.8	22.4	24.7
Stroke	3.9	1.1	6.3	5.2	7.6
Cancer	1.7	1.1	1.0	2.2	2.7
Depression, score ≥5 %	25.1	27.7	37.6	39.2	47.1
Afternoon nap, %	60.3	59.9	65.5	61.9	67.7
Nap time[b] in minutes (SD)	69.5 (37.8)	72.3 (33.8)	71.3 (34.4)	73.0 (37.8)	84.4 (42.2)

[a] Based on the definition from the Department of Health in Taiwan, the normal range of BMI value is from 18.5 to 24.
[b] For those who take an afternoon nap only.

deviation = 3.3). After adjustment for age (Model 1 in Table 2), significantly higher mortality risk was observed in men with nighttime sleep duration of ≥9 hours and women with ≥8 hours. Additional adjustments for sociodemographic factors (Model 2) plus selected disease history (Model 3) attenuated the mortality risk of those with longer sleeping time and led to the disappearance of significant mortality risk in men reporting 9 to 9.9 hours of sleep. When afternoon nap duration was added in the model (Model 4), the mortality risks were nearly the same as those in the previous model. Similar patterns for both men and women as seen in previous model were also observed in the 2-year lag model.

Multivariate analysis was also conducted to estimate mortality risk of afternoon nap or nap duration. Differently, no significant relationship emerged between mortality and afternoon nap or nap duration in both men and women in all 5 adjusted models, including the 2-year lag model (data not shown). To examine the potential interaction effect between the durations of nighttime sleep and afternoon nap on death, nighttime sleep duration, afternoon nap duration, and their interaction term were added into the fully adjusted model. Both afternoon nap duration and the interaction term were statistically insignificant, but the pattern of nighttime sleep duration remained similar to those in the full and 2-year lag models seen in Table 2. Significantly higher mortality risk was observed in men with nighttime sleep duration of ≥10 hours (hazard ratios = 1.68 and 95% CI = 1.12 – 2.53 in the full model; hazard ratios = 1.68 and 95% CI = 1.07 – 2.64 in the 2-year lag model) and in women with 9-9.9 hours (hazard ratios = 1.76 and 95% CI = 1.08 – 2.88 in the full model; hazard ratios = 1.81 and 95% CI = 1.06 – 3.10 in the 2-year lag model) and ≥10 hours (hazard ratios = 1.84 and 95% CI = 1.11 – 3.05 in the full model; hazard ratios = 2.15 and 95% CI = 1.25 – 3.71 in the 2-year lag model).

Table 3 presents the cause-specific hazard ratios of death by hours of sleep at night. Older male adults sleeping ≥10 hours were at significantly higher risk of death from cardiovascular and respiratory conditions. For women, a clear rise in risk was observed for cancer deaths in those sleeping ≥10 hours and for other deaths in those with ≥9 hours. An increased cardiovascular mortality risk was seen in those sleeping ≥8 hours. Because of the small number of death from respiratory conditions, the results of higher risk for longer female sleepers were relatively less reliable.

Results of the stratification of different nighttime sleep hours and afternoon nap durations are shown in Table 4. Compared to older adults with nighttime sleep only, those taking additional

Table 2—Multivariate-Adjusted Mortality Hazard Ratios (95% Confidence Intervals) by Reported Nighttime Dleep Duration, Stratified by Sex

	Hours of nighttime sleep					P for trend
Male (n = 1748)	**<7**	**7 – 7.9**	**8 – 8.9**	**9 – 9.9**	**≥10**	
Multivariate model 1[a]	0.97 (0.76-1.23)	1	1.11 (0.91-1.36)	**1.33 (1.08-1.65)**	**1.86 (1.48-2.34)**	<0.001
Multivariate model 2[b]	0.97 (0.76-1.25)	1	1.09 (0.90-1.33)	1.21 (0.97-1.50)	**1.62 (1.29-2.05)**	<0.001
Multivariate model 3[c]	0.99 (0.77-1.27)	1	1.09 (0.89-1.33)	1.15 (0.92-1.44)	**1.53 (1.20-1.94)**	<0.001
Multivariate model 4[d]	0.98 (0.76-1.25)	1	1.09 (0.89-1.33)	1.14 (0.91-1.42)	**1.51 (1.19-1.92)**	<0.001
2-year lag model[e]	1.07 (0.82-1.39)	1	1.13 (0.91-1.41)	1.24 (0.97-1.58)	**1.42 (1.08-1.86)**	0.001
Female (n = 1331)						
Multivariate model 1[a]	1.04 (0.71-1.51)	1	**1.45 (1.08-1.95)**	**1.96 (1.45-2.65)**	**2.49 (1.84-3.37)**	<0.001
Multivariate model 2[b]	1.10 (0.75-1.62)	1	**1.38 (1.02-1.86)**	**1.89 (1.39-2.58)**	**2.19 (1.60-2.99)**	<0.001
Multivariate model 3[c]	1.14 (0.77-1.67)	1	**1.36 (1.00-1.83)**	**1.85 (1.36-2.53)**	**2.07 (1.51-2.84)**	<0.001
Multivariate model 4[d]	1.14 (0.77-1.67)	1	**1.36 (1.01-1.84)**	**1.86 (1.36-2.53)**	**2.06 (1.50-2.83)**	<0.001
2-year lag model[e]	1.11 (0.73-1.70)	1	**1.46 (1.05-2.03)**	**1.95 (1.38-2.75)**	**2.26 (1.59-3.22)**	<0.001

[a] Hazard ratios have been adjusted for age at 1993.
[b] Hazard ratios have been adjusted for age at 1993, marital status, monthly income, cigarettes smoking, alcohol consumption, body mass index, and exercise.
[c] Hazard ratios have been adjusted for above plus disease history (heart disease, stroke, and cancer), and depression.
[d] Hazard ratios have been adjusted for above plus afternoon nap duration.
[e] Hazard ratios adjusted for all above variables are calculated only for 2834 study participants (1602 males and 1232 females) who survived at least 2 years after the 1993 interview.
Bold figures indicates statistically different from 7-7.9 hours of sleep.

afternoon nap, no matter how long, reported no statistical differences of mortality risk. There was also no difference among no nap and different times spent on the nap in the 2-year lag models (data not shown). In general, the additional advantage or disadvantage of afternoon nap on survival was small and not statistically significant.

DISCUSSION

The present study showed that longer nighttime sleep duration was associated with increased mortality in older persons, with a significantly higher mortality risk observed in males sleeping ≥10 hours and females sleeping ≥8 hours. Excessive deaths for longer sleepers were mainly cardiovascular or respiratory deaths in men, and cancer, cardiovascular, and other deaths in women. Our data further revealed that afternoon nap was not an independent predictor of mortality in older adults. Different afternoon nap durations neither lower nor increase mortality risk for those who had the same nighttime sleep duration.

Given the potential shift in nighttime sleep duration due to aging mentioned previously, it is not surprising that in our study a significantly higher mortality risk was only observed in longer sleepers. However, this does not necessarily mean that shorter sleepers (for example, less than 6 hours) were not at higher risk in older adults. Whether short nighttime sleep duration is also associated with increased mortality risk in older adults remains both unproven and unclear in our study because of the small number of such short sleepers.

There may be some speculations on the association between prolonged night sleep and increased mortality. First, longer sleep may be associated with sleep fragmentation resulting from sleep disorder, which is related to early death.[1] Second, because of relatively poorer sleep quality, long nighttime sleep duration fails to provide sufficient restoration against stress and diseases, and therefore is correlated with higher mortality risk.[17] Third, physiologically, persons with long night sleep receive shorter photoperiod that has been found in many species to increase the mortality risk.[18] It is possible that the similar mechanism also applies to human beings. Finally, for older adults, longer nighttime sleep duration could be regarded as a sign of physiological deviation from normal aging process leading to premature death.

Our findings of cardiovascular and respiratory conditions for men, and cancer, cardiovascular, and other causes for women were generally in agreement with those reported in previous studies based on adults.[5,19] The elevated risk of cardiovascular death may be explained by the relatively higher prevalence of sleep disordered breathing, mainly sleep apnea, in older adults.[20,21] Sleep apnea has been linked to cardiovascular risk.[1,19] It is possible that older men with sleep apnea are more likely to sleep more to compensate their sleep fragmentation caused by sleep apnea and are at higher risk to die from cardiovascular events because of this disorder. On the other hand, the data of other causes of death such as respiratory conditions in men and cancer in women indicate that long sleep or a number of potential causal factors behind it might trigger physiological changes that damage different organ systems and ultimately lead to death.

In contrast to nighttime sleep duration, afternoon nap duration was not associated with mortality in either men or women, with or without adjustment of nighttime sleep duration and their potential interaction. To most Chinese older adults, afternoon nap might be merely a traditional habit as it provides insignificant benefit. It is interesting to understand why our results on afternoon nap are different from previous studies on daytime sleepiness[10,11] and siesta,[12] all of which suggested a close association with significantly higher mortality risk. The difference between daytime sleepiness and siesta or afternoon nap, as noted by Bursztyn et al,[12] is that daytime sleepiness, measured and defined by the frequency of sleepy feeling during the daytime, is both a symptom of sleep disorder and a potential geriatric syndrome of weakness, but siesta or afternoon nap is purely a habit usually taken after

Table 3—Hazard Ratios[a] (95% Confidence Intervals) of Cause-Specific Death by Reported Nighttime Sleep Duration, Stratified by Sex

	No. of death	Hours of nighttime sleep					P for trend
		<7	7 – 7.9	8 – 8.9	9 – 9.9	≥10	
Male (n = 1748)							
Cancer	186	1.11 (0.69-1.78)	1	1.02 (0.68-1.53)	1.18 (0.75-1.86)	1.30 (0.76-2.22)	0.3
Cardiovascular conditions	209	0.91 (0.53-1.57)	1	1.40 (0.93-2.10)	1.26 (0.80-1.98)	**1.81 (1.13-2.89)**	0.002
Respiratory conditions	138	0.94 (0.52-1.71)	1	0.96 (0.60-1.56)	0.74 (0.41-1.31)	**1.81 (1.06-3.10)**	0.01
Other	283	1.00 (0.66-1.52)	1	1.02 (0.72-1.45)	1.29 (0.89-1.86)	1.34 (0.89-2.02)	0.03
Female (n = 1331)							
Cancer	92	1.19 (0.56-2.56)	1	0.92 (0.48-1.79)	1.11 (0.54-2.28)	**2.53 (1.29-4.95)**	0.03
Cardiovascular conditions	170	1.07 (0.54-2.15)	1	**1.77 (1.05-2.98)**	**1.75 (1.00-3.07)**	**1.85 (1.04-3.27)**	0.005
Respiratory conditions	48	0.70 (0.12-4.06)	1	1.55 (0.48-5.05)	**4.06 (1.33-12.39)**	2.65 (0.83-8.44)	0.03
Other	212	1.22 (0.66-2.27)	1	1.30 (0.80-2.12)	**2.06 (1.26-3.38)**	**2.09 (1.26-3.46)**	<0.001

[a] Hazard ratios have been adjusted for age at 1993, marital status, monthly income, cigarettes smoking, alcohol consumption, body mass index, exercise, disease history (heart disease, stroke, and cancer), and depression.
Bold figures indicates statistically different from 7-7.9 hours of sleep.

the midday meal. Nevertheless, this is still unable to explain the different results of mortality risk between siesta in Mediterranean population and afternoon nap in Chinese population found in our study. Except for potential physiological differences existing across populations, one possibility is the difference between siesta and Chinese afternoon nap in terms of duration, yielding thereby different physiological mechanisms and outcomes. Siesta is traditionally no longer than 30 minutes, whereas Chinese afternoon nap usually lasts over one hour.[22] In our study, 78.9% of older adults having the habit of afternoon nap spent 1 to 2 hours on the activity. It is therefore possible that only longer duration of afternoon nap could avoid the potential health hazards observed in the siesta studies. Obviously, further studies are needed to support this hypothesis.

To our knowledge, this is the first study on the interrelationships among nighttime sleep duration, afternoon nap, and mortality in older Chinese population. The study sample was from local communities and could be regarded as representative of most healthy, older community dwellers in Taiwan. Instead of total hours or time of night sleep commonly employed in other studies as the measure of nighttime sleep duration, we asked the actual time to bed and to rise so as to trace sleep duration in a more accurate manner. Thus, the potential misclassification of sleep duration could be avoided. In addition, mortality events were followed up completely for at least 10 years. All these reinforce the credibility of the findings of our study.

In addition to the above-mentioned strengths, some potential limitations of our research should also be noted. First, although attempts had been made to collect more accurate information on sleep, it is still not known whether the reported information is the same as the actual one and there is no sleep latency. Second, certain health-related factors that could also affect sleep duration and habits, such as the history of insomnia, snoring, sleep apnea, and the use of sleep medications or antidepressant medications were not considered. Several objective measures of health conditions such as blood pressure were also not included in the study. The exclusion of these factors could inevitably yield potential bias in the estimation of mortality hazard. Finally, the information of primary cause of death provided for use in the secondary analysis could be inaccurate due to the misclassification of causes. How-

Table 4—Hazard Ratios[a] (95% Confidence Intervals) of Death by Reported Nighttime Sleep Duration and Afternoon Nap Duration, Stratified by Sex

Nap duration (In minutes)	Hours of nighttime sleep				
Male	**<7**	**7 – 7.9**	**8 – 8.9**	**9 – 9.9**	**≥10**
No	1.00	1.00	1.00	1.00	1.00
<60	0.64 (0.28-1.47)	0.68 (0.37-1.25)	0.82 (0.51-1.33)	1.06 (0.54-2.11)	0.48 (0.23-1.02)
60-89	0.97 (0.56-1.67)	1.06 (0.72-1.55)	0.90 (0.65-1.25)	1.27 (0.86-1.89)	0.69 (0.40-1.17)
90-119	0.96 (0.46-2.03)	0.98 (0.60-1.61)	0.91 (0.55-1.49)	1.08 (0.60-1.94)	0.69 (0.37-1.28)
120 and over	1.15 (0.61-2.18)	1.23 (0.72-2.10)	0.79 (0.50-1.25)	1.33 (0.79-2.23)	1.13 (0.69-1.85)
Female					
No	1.00	1.00	1.00	1.00	1.00
<60	0.92 (0.36-2.35)	1.24 (0.51-3.04)	1.58 (0.91-2.75)	0.98 (0.52-1.83)	0.93 (0.47-1.81)
60-89	0.54 (0.22-1.34)	0.76 (0.39-1.50)	1.37 (0.86-2.17)	0.93 (0.58-1.50)	0.96 (0.59-1.58)
90-119	0.19 (0.02-1.46)	0.47 (0.16-1.41)	1.79 (0.88-3.63)	0.96 (0.48-1.90)	1.53 (0.86-2.73)
120 and over	1.75 (0.56-5.43)	1.04 (0.46-2.37)	1.76 (0.99-3.13)	1.20 (0.66-2.20)	1.10 (0.63-1.91)

[a] Hazard ratios have been adjusted for age at 1993, marital status, monthly income, cigarettes smoking, alcohol consumption, body mass index, exercise, disease history (heart disease, stroke, and cancer), and depression.

ever, previous reviews on the national mortality records found death certificates and codes to be fine in overall agreement.[23]

In summary, our study indicates that longer nighttime sleep duration is associated with increased mortality in older adults. In contrast to the negative effect of siesta on survival in the elderly, Chinese afternoon nap does not have any significant effect on death. Further studies with a larger sample size are needed to better understand the possible mechanisms of death.

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