Preplanned Studies

Changes in Sleep Duration and the Risk of Cognitive Impairment Among Older Adults Aged 65 Years and Over — China, 2014–2019

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Summary

What is already known about this topic?

Earlier studies indicated that shorter or excessive sleep duration at baseline was related to cognitive impairment. Yet few studies have been concerned with the association between sleep duration changes and cognitive performance, especially in low- and middle-income countries.

What is added by this report?

A prospective cohort study suggests that maintaining moderate sleep duration may lead to optimal cognitive performance. Either decreasing, increasing, or keeping a longer sleep duration is associated with the risk of cognitive impairment among Chinese elderly aged 65 years and over.

What are the implications for public health practice?

Maintaining a moderate sleep duration may be a protective factor against cognitive impairment. Therefore, we need to pay attention to the seniors' sleep health and prevent or delay the progression of cognitive impairment through sleep therapy.

Cognitive impairment is generally used to refer to an intermediate phase between natural cognitive decline and dementia in the aging process. The prevalence among Chinese aged 60 and over was estimated to be 15.5% in 2018 (*1*). The seventh national census found that there are 264 million Chinese aged 60 and over. It is estimated that about 41 million seniors suffer from cognitive impairment in China. If those older adults go on to develop dementia, there will be a socioeconomic cost of 78 billion USD (*2*). It is therefore vital to identify modifiable factors that can prevent or postpone the onset and development of cognitive impairment.

Growing epidemiological studies indicate that shorter and longer sleep durations assessed at baseline are associated with the risk of subsequent cognitive impairment (*3*). Yet, few studies have addressed changes in sleep duration as a determinant of cognition. This study explored whether sleep duration changes over time were related to subsequent cognitive impairment utilizing data from the Chinese Longitudinal Healthy Longevity Survey (CLHLS).

A prospective cohort study of 2,253 Chinese adults aged 65 years and over was included to evaluate the association. After an average follow-up of 3.79 years, 468 individuals developed cognitive impairment. Analyses were confined to those without cognitive impairment at baseline. Our findings indicated that decreased or increased sleep duration at follow-up or maintaining a longer sleep duration was associated with an increased risk of cognitive impairment. Keeping a moderate sleep duration was beneficial for cognitive function.

These findings suggest that keeping moderate sleep durations may lead to optimal cognitive performance. Therefore, we need to pay high attention to the seniors' sleep pattern and take targeted interventions to maintain stable and moderated sleep duration.

CLHLS is the first large prospective cohort study in China aimed at understanding the determinants of healthy aging. A multistage stratified sampling design was conducted and 631 cities and counties were randomly selected, covering almost 85% of the Chinese population. The initial survey was conducted in 1998 and other 7 subsequent phases were from 2000 to 2019. Details of the study design, sample distribution and collection and quality of data have already been described in a previous study (*4*). The current study used data from Phase 7 (2014) and Phase 8 (2017–2019) as baselines and follow-ups. This study was granted by the Ethics Committee of Peking University, and all respondents signed informed consent.

A total of 3,441 individuals took part in both phases; those who were under 65 years and over 105 years were deleted due to the quality of data. The

sample was then restricted to individuals who scored higher than or equal to 24 at baseline Chinese version of Mini-mental State Examination (CMMSE). Not counting the participants with no follow-up cognitive assessment and missing data of key variables, 2,253 eligible participants were included in analysis (Figure 1).

Participants reported their habitual hours of sleep in Phase 7 and Phase 8. The sample was divided into the following five groups based on the sleep duration reported at two time points: sleep less than or equal to 5 h at both phases, reduced sleep duration at follow-up (6 h–8 h or ≥9 h sleep at Phase 7 and ≤5 h or <9 h at Phase 8), sleep 6 h–8 h at both time points (reference group), increased sleep duration at follow-up (≤5 h or 6 h–8 h sleep at Phase 7 and >5 h or ≥9 h at Phase 8), and sleep more than or equal to 9 h at both phases. Cognitive function was assessed at baseline and follow-up using CMMSE, which is a scale of global cognitive function and contains different cognitive domains like orientation, registration, attention and calculation, recall, and language. Total point scores ranged from 0 (worst) to 30 (best), classifying those with less than 24 as having cognitive impairment.

Descriptive data are presented as the mean (standard deviation, SD) for continuous variables and percentages for categorical variables. The baseline characteristics of the sample were tested using t-test or F test for continuous variables and χ^2 tests for categorical variables. Multiple logistic regressions were conducted to explore the association between sleep duration changes and cognitive impairment after adjusting for age, sex, marital status, residence, living arrangement, smoking, drinking, exercise, body mass index (BMI), activities of daily living (ADL), depressive symptoms, and vascular factors (hypertension, diabetes, stroke, and heart disease) at baseline. Analyses were conducted using STATA software (MP version 14.0, Stata Corp, LLC, USA). $P<0.05$ was regarded as statistically significant.

Among 2,253 participants who were free of cognitive impairment at baseline, the mean (SD) age was 79.44 (7.66) years old, and 53.31% of them were men. After an average follow-up of 3.79 years, 468 cases of cognitive impairment were recorded, accounting for 20.77% of all participants. Table 1 depicts characteristics of the study participants at baseline by grouping of sleep duration changes.

Table 2 shows the association between sleep duration changes and cognitive impairment along with the odds ratio (OR) and 95% confidence interval (CI). After adjusting for demographic, socio-economic, lifestyle behavioral and health status factors, individuals with decreased and increased sleep duration at follow-up had an increased risk of cognitive impairment by 54% (OR=1.54, 95% CI: 1.14–2.08) and 61% (OR=1.61, 95% CI: 1.20–2.17), respectively. And the risk of cognitive impairment was 1.67 (95% CI: 1.11–2.50) times higher for people who slept 9 h or more at both phases. No association was observed between sleeping 5 h or less and cognitive function.

DISCUSSION

This study suggests that any changes, whether a

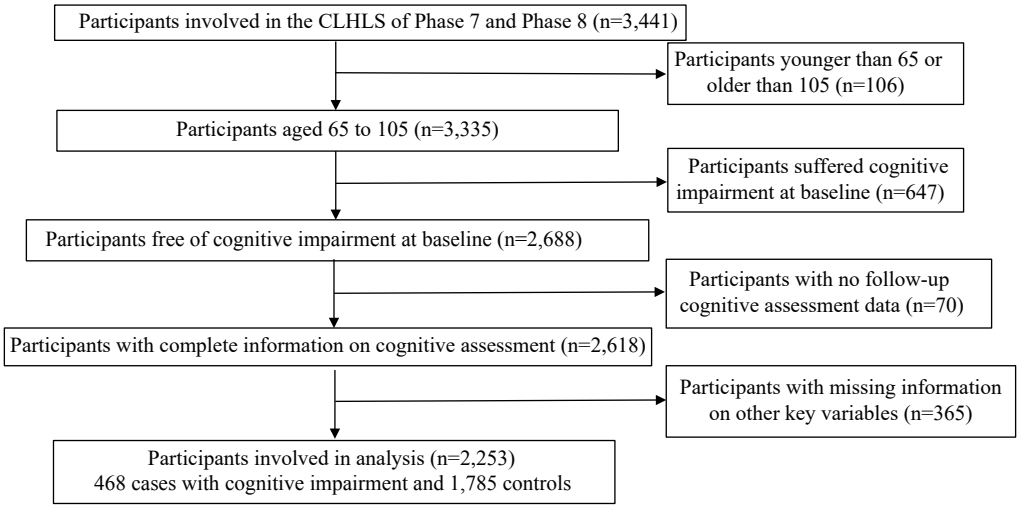

FIGURE 1. Flow chart of sample selection.
Abbreviation: CLHLS=Chinese Longitudinal Healthy Longevity Survey.

TABLE 1. Baseline characteristics of participants by changes in sleep duration among Chinese older adults aged 65 years and over, 2014–2019 (N=2,253).

Characteristics	Changes in sleep duration				
	≤5 h at both phases* (n=131) n (%)	Decreased at follow-up† (n=567) n (%)	6 h–8 h at both phases§ (n=831) n (%)	Increased at follow-up¶ (n=534) n (%)	≥9 h at both phases** (n=190) n (%)
Age [years, (mean±SD)]	79.79±6.91	79.29±7.86	78.23±7.37	80.36±7.63	82.33±7.79
Female	79 (60.31)	249 (43.92)	379 (45.61)	263 (49.25)	82 (43.16)
Married	69 (52.67)	322 (56.79)	490 (58.97)	259 (48.50)	91 (47.89)
Rural	74 (56.49)	333 (58.73)	476 (57.28)	252 (47.19)	102 (53.68)
Living alone	35 (26.72)	109 (19.22)	153 (18.41)	110 (20.60)	38 (20.00)
Education [years, (mean±SD)]	2.45±3.52	2.94±3.51	3.45±3.83	2.97±3.65	2.49±3.23
Smoking	15 (11.45)	124 (21.87)	158 (19.01)	104 (19.48)	50 (26.32)
Drinking	18 (13.74)	107 (18.87)	179 (21.54)	105 (19.66)	36 (18.95)
Exercise	47 (35.88)	195 (34.39)	278 (33.45)	204 (38.20)	68 (35.79)
BMI (mean±SD)	23.21±4.75	22.42±4.06	23.18±7.59	22.55±3.83	23.11±5.68
Intact ADL	129 (98.47)	542 (95.59)	792 (95.31)	495 (92.70)	171 (90.00)
Depression (mean±SD)	6.56±3.25	5.98±2.98	5.91±3.00	5.98±2.97	5.33±3.03
Any vascular factors	72 (54.96)	228 (40.21)	330 (39.71)	250 (46.82)	76 (40.00)
CMMSE scores at baseline (mean±SD)	27.98±1.97	28.04±1.79	28.49±1.67	28.26±1.77	27.68±1.88
CMMSE scores at follow-up (mean±SD)	24.95±6.17	25.64±5.63	26.76±4.74	24.96±6.90	24.52±6.46

Abbreviation: SD=standard deviation; BMI=body mass index; ADL=activities of daily living; CMMSE=Chinese version of mini-mental state examination.
* ≤5 h sleep at Phase 7 and ≤5 h at Phase 8;
† 6 h–8 h or ≥9 h sleep at Phase 7 and ≤5 h or <9 h, respectively, at Phase 8;
§ 6 h–8 h sleep at Phase 7 and 6 h–8 h at Phase 8;
¶ ≤5 h or 6 h–8 h sleep at Phase 7 and >5 h or ≥9 h, respectively, at Phase 8;
** ≥9 h sleep at Phase 7 and ≥9 h at Phase 8.

TABLE 2. Association between changes in sleep duration and the risk of cognitive impairment among Chinese older adults aged 65 years and over, 2014–2019. (N=2,253)

Changes in sleep duration	OR (95% CI)	aOR (95% CI)
≤5 h at both phases*	1.78 (1.10–2.83)	1.47 (0.91–2.39)
Decreased at follow-up†	1.66 (1.25–2.21)	1.54 (1.14–2.08)
6 h–8 h at both phases§	Reference	Reference
Increased at follow-up¶	1.91 (1.44–2.54)	1.61 (1.20–2.17)
≥9 h at both phases**	2.29 (1.55–3.35)	1.67 (1.11–2.50)

Note: Multiple logistic regression was adjusted for age, sex, marital status, residence, living arrangement, education, smoking, drinking, exercise, body mass index, activities of daily living, depressive symptoms, and vascular factors at baseline.
Abbreviation: OR=odds ratio; CI=confidence interval; aOR=adjusted odds ratio.
* ≤5 h sleep at Phase 7 and ≤5 h at Phase 8;
† 6 h–8 h or ≥9 h sleep at Phase 7 and ≤5 h or <9 h, respectively, at Phase 8;
§ 6 h–8 h sleep at Phase 7 and 6 h –8 h at Phase 8;
¶ ≤5 h or 6 h –8 h sleep at Phase 7 and >5 h or ≥9 h, respectively, at Phase 8;
** ≥9 h sleep at Phase 7 and ≥9 h at Phase 8.

decrease or an increase, from an intermediate sleep duration, are detrimental to seniors' cognition. Furthermore, keeping a longer sleep duration at both phases is also associated with a higher risk of cognitive impairment. Hence, it's necessary to introduce targeted therapies to maintain an intermediate sleep duration for the elderly's cognitive health.

This study was consistent with the findings of prior studies. A study on behalf of middle-aged office staff in London showed that a move from a moderate sleep duration of 6 h–8 h per night to a shortened or lengthened sleep duration was related to worse cognition (5). However, in a small sample of 695 elderly Germans reported 6 h–7 h of sleep duration at

baseline, only prolonged sleep duration was observed to be related to cognitive impairment (*6*). Meanwhile, national representative data from Mexico suggested that, among individuals who reported moderate sleep duration at baseline, increased sleep duration at follow-up was detrimental to cognitive performance (*7*). On the other hand, reduced sleep duration was related to a higher incidence of all-cause dementia and Alzheimer's disease in a sample of elderly Swiss (*8*).

Currently, the biological mechanisms of sleep and cognition remain unknown. What is certain is that sleep and cognition are mutually influential (*9*). We restricted our sample to individuals without cognitive impairment at baseline in order to reduce recall bias and minimize the likelihood of reverse causation. First, sleep duration may indirectly affect cognitive function through cardiovascular pathways or other underlying health problems such as depression. In the present study, sleep duration changes and cognitive impairment remained relevant after adjusting for cardiovascular diseases and depressive symptoms. Second, an extreme change of sleep duration may mirror poor sleep quality and thus directly affects the formation and accumulation of amyloid-β in the brain, which is a marker of neurodegenerative diseases (*9*).

This study was subject to some limitations. First, instead of using actigraphy, single-item and self-reported measurement was used to assess the sleep duration changes. Nonetheless, most large cohort studies have obtained sleep-related information through self-reporting because of the high cost of objective measurements. Second, although considerable variables have been included in the analyses, other unmeasured or unknown factors are likely to explain the findings, such as other sleep problems.

In conclusion, this study observed that decreased or increased sleep duration at follow-up or maintaining a longer sleep duration was associated with an increased risk of cognitive impairment. Keeping a moderate sleep duration is beneficial for cognitive function. Therefore, we need to pay attention to the sleep health of the elderly and adopt sleep therapy to prevent and delay the development of cognitive impairments.

Conflicts of interest: No conflicts of interest.

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