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Original Study

Long Sleep Duration Is Associated With Higher Mortality in Older People Independent of Frailty: A 5-Year Cohort Study



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A B S T R A C T

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Objectives: Although general adult population studies show a U-shaped association between sleep duration and mortality, prolonged rather than short sleep duration was more consistently associated with higher mortality in older populations. Failing health or frailty is a possible mechanism. Thus, we examined the relationship among sleep duration, frailty status, and mortality in an elderly cohort.

Methods: A total of 3427 community-living adults 65 years or older were examined for general health, mood, subjective sleep measures (insomnia, napping, sleep apnea, nighttime sleep duration, sleep medications), frailty, and 5-year mortality.

Results: After 5 years, 12.9% of men and 4.5% of women had died. Mean nighttime sleep duration was 7.3 hours. Proportion of participants who slept 10 or more hours increased with increasing frailty. Age-adjusted hazard ratio (HR) for 5-year mortality of long nighttime sleep (≥ 10 hours) was 2.10 (95% confidence interval [CI] 1.33–3.33) in men, and 2.70 (95% CI 0.98–7.46) in women. The HR in men was attenuated (HR 1.75; 95% CI 1.09–2.81) after adjustment for frailty and other covariates, whereas that of women strengthened (HR 2.88; 95% CI 1.01–8.18). Mortality increased sharply with nighttime sleep of 10 hours or more. Nighttime sleep of 10 or more hours (HR 1.75, men; HR 2.88, women) and frailty (HR 2.43, men; HR 2.08, $P = .08$ in women) were independently associated with 5-year mortality after full adjustment for covariates.

Conclusion: Frailty and long nighttime sleep duration of 10 or more hours were independently associated with 5-year mortality in older adults.

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General population studies have shown a U-shaped association between nighttime sleep duration and mortality, with the lowest mortality usually at 7 to 8 hours of sleep.^{1–4} Yet, findings among the older population were less definite: whereas some found no association between duration of nighttime sleep and mortality,^{5,6} recent studies have reported increased mortality only with prolonged sleep.^{2,7–10} Overall, the association between prolonged sleep and higher mortality became stronger with increasing age.⁴

The mechanisms that linked prolonged nighttime sleep to higher mortality are unclear. A common postulation is that prolonged sleep

may be the result of frailty or failing health.^{11,12} Mesas et al,⁷ however, demonstrated that longer nighttime sleep was associated with higher mortality even after adjustment for general health status and limitations in instrumental activities of daily living. Another author suggested that increasing frailty was more associated with shorter sleep (≤ 5 hours) than longer sleep.¹³

Nevertheless, frailty may mean more than simply self-reported health status and functional limitations. Frailty is an emerging geriatric syndrome that has gained wide recognition in the recent 2 decades. It describes a state of lack of reserve in multiple systems that leads to vulnerability to stressors, resulting in adverse outcomes in older persons (falls, disability, hospitalizations, and mortality).^{14–21} Several definitions of the frailty syndrome have been proposed, including Rockwood et al's Deficits Model and the Clinical Frailty Scale (CFS),^{18,22} the FRAIL scale,²³ and Fried et al's phenotype for frailty.¹⁵ The latter is one of the most widely adopted frailty definitions,

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defining frailty status according to the presence of unintentional weight loss, weakness, slowness, low activity level, and a lack of energy or exhaustion.¹⁵ We examined whether frailty, as defined by this set of parameters, may be the underlying mechanism of the association between long nighttime sleep and higher mortality in a cohort of older adults.

Methods

A total of 4000 Chinese men and women older than 65 were invited to participate in a health check at The Chinese University of Hong Kong from August 2001 to December 2003. Participants were recruited by posters and advertisements placed in elderly centers and housing estates where a large proportion of the older population lives in Hong Kong. Those who (1) were unable to walk independently, (2) had had bilateral hip replacements, and (3) were not competent to give informed consent were excluded. The procedure included a health questionnaire, physical activity level, physical assessments, and a battery of physical performance tests. The study was approved by the Clinical Research Ethics Committee of the Chinese University of Hong Kong and all subjects signed an informed consent.

General Health Questionnaire

Participants were invited to return for a follow-up visit 2 years later, and 3399 participants returned for an interview consisting of a general health questionnaire, a sleep questionnaire, brief physical measurements, and physical performance tests. The questionnaire covered demographic data, age, smoking status, and medical conditions. Body mass index (body weight in kilograms divided by the square of body height in meters) was measured. Overweight was defined as a BMI higher than 23 kg/m² according to the Asia-Pacific World Health Organization criteria.²⁴ The presence of diabetes, chronic obstructive pulmonary diseases (COPD), and heart disease, and a history of cancer and stroke was defined as self-report of having ever been informed of the diagnoses by a physician, supplemented by identification of current medications. Heart disease includes coronary heart disease, heart failure, and myocardial infarction. Mood was assessed by the Geriatric Depression Scale.²⁵

Sleep Questionnaire

Self-reported average nighttime sleep duration was defined as the duration between the usual time falling asleep and the usual time waking up.²⁶ Frequencies of having difficulty falling asleep, difficulty getting back to sleep after waking up at night, waking up too early or having trouble staying asleep, and nonrestorative sleep were categorized as 0, 1, 2 to 3, 5 to 15, or 16 to 30 nights per month. Insomnia was defined as answering “16 to 30 nights per month” to any of these questions. Self-reported sleep apnea syndrome was defined as having been told the diagnosis by a doctor or health care professional. Daily napping was defined as taking naps 7 days per week. Self-reported use of medications was recorded and frequency of sleep medications use was classified as never, once, 2 to 3, 5 to 15, or 16 to 30 times per month.

Frailty Status

Frailty status was categorized according to parameters based on Fried et al's criteria.¹⁵ Grip strength (maximum strength of both hands) was measured using a dynamometer (Jamar Hand dynamometer 5030 J1; Sammons Preston, Inc., Bolingbrook, IL), and walking speed was measured by the time taken for a 6-meter walk. Performance in these 2 tests was categorized into quintiles stratified according to gender. Weakness was defined as being in the lowest

quintile of grip strength (adjusted for BMI quartiles), and slowness, the lowest quintile of walking speed (adjusted for median standing height). Lack of energy or exhaustion was defined as a negative answer to the question “Do you feel full of energy?” in the Geriatric Depression Scale. Significant weight loss or wasting was defined as having unintentional weight loss of 5% or more of body weight since the baseline assessment 2 years earlier. As a detailed physical activity questionnaire was not carried out at the sleep assessment visit, we used a surrogate measure for “low physical activity.” If a participant answered “yes, with much limitation” to “would your physical condition limit you in (1) mild activities, such as moving a table or pushing a vacuum cleaner; and (2) walking up a flight of stairs,” this would be taken as a state of low physical activity. Frailty status was defined as the presence of having 3 or more of these features, intermediate frailty was defined as having 1 or 2 of these features, and robust state was defined as having none of the features.¹⁵

Ascertainment of Mortality

Mortality status and date of death was ascertained by the death registry kept by the Department of Health under the Hong Kong Specialist Administration Region government. Participants were matched to the registry by their Hong Kong Identity Card number, which is unique to every Hong Kong resident. The last check of the registry was conducted on March 30, 2010.

Statistical Analysis

Analyses were done for men and women separately. Characteristics of robust, intermediate frail, and frail participants were compared by using parametric or nonparametric statistical tests where appropriate. Participants were categorized according to nighttime sleep duration, and age-adjusted mortality rates were calculated. Relationship between 5-year mortality and nighttime sleep duration of 10 or more hours was studied using Cox regression models with adjustments for possible confounders (age, medical conditions, smoking, use of sleep medications, insomnia, self-reported sleep apnea, daily napping, overweight, and frailty status). In the final multivariate models, sleep time of less than 10 hours per night was used as the reference for the long sleep-time variable. The frailty states were entered as 1 single variable with 3 different levels (frailty score = 0 or robust as reference, 1–2 as “intermediate,” and 3 or higher as “frail”). Analysis was performed with the statistical package SAS, version 9.1.3 (SAS Institute, Inc., Cary, NC). A *P* value less than .05 was taken as statistically significant.

Results

A total of 221 (12.9%) men and 76 (4.5%) women died within 5 years after the sleep assessment. The mean follow-up period was 61.7 ± 10.9 months (range 12.2–79.5). The mean nighttime sleep duration was 7.4 ± 1.3 hours in men and 7.1 ± 1.3 hours in women. Sixty-two (3.6%) men and 26 (1.6%) women reported sleep duration of 10 or more hours. Insomnia was reported by 1475 (43.0%), self-reported diagnosis of sleep apnea syndrome was made by 31 (0.9%), daily napping by 778 (22.7%), and use of sleep medications by 155 (4.5%).

Table 1 compares the characteristics of participants in different frailty states. In both men and women, older age, being ex- or current smokers, lower cognition, more depressive symptoms, lower BMI, and having diabetes and COPD were associated with more frailty. Men with heart disease and women with a history of stroke were also more likely to be frailer. Both insomnia and daily napping were associated with being frailer. Longer nighttime sleep was associated with increasing frailty only in men.

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