The association between habitual sleep duration and sleep quality in older adults according to health status

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Abstract

Background: research on the association between habitual sleep duration and quality in older adults is scarce and has shown conflicting results. Moreover, no previous study has assessed the influence of health status on this association.

Objectives: to examine the association between habitual duration and quality of sleep in older adults, and to test if this association varies with health status, as approximated by self-rated health, quality-of-life and functional limitation.

Design: cross-sectional study with data collected by telephone interview.

Setting: community-based study.

Subjects: a total of 1,567 community-dwelling individuals aged ≥68 years in Spain.

Methods: poor sleep quality was ascertained through nighttime complaints (sleeping-pill consumption, difficulty falling asleep, awakening during the night and early awakening), and daytime complaints (feeling unrested in the morning and daytime sleepiness). The analyses were adjusted for the main confounders, and were stratified by health status (self-rated health, health-related quality-of-life and functional limitation).

Results: when compared with those sleeping 7–8 h, those who slept ≤6 h were more likely to report difficulty falling asleep [odds ratio (OR) 3.51; 95% confidence interval (CI) 2.37–5.20], frequent awakening during the night (OR 1.97; 95% CI 1.42–2.75), early awakening in the morning (OR 2.78; 95% CI 2.02–3.82) and feeling unrested in the morning (OR 1.73; 95% CI 1.18–2.54). Moreover, those who slept ≥9 h were more likely to report daytime sleepiness (OR 1.68; 95% CI 1.17–2.42). In stratified analyses, these associations generally did not vary with health status.

Conclusions: in older adults, short sleep is associated with nighttime sleep complaints and feeling unrested in the morning, while long sleep is associated with daytime sleepiness.

Keywords: sleep duration, sleep quality, sleep disorders, older adults, elderly
Introduction

One-third of the older adult population has extreme sleep duration (≤5 or ≥10 h), and almost a half presents difficulties on sleep onset and maintenance or have daytime sleepiness [1, 2]. Both extreme duration and poor quality of sleep are associated with important health outcomes, such as worse health-related quality-of-life (HRQoL) and higher general mortality [1, 3, 4]. However, these associations may not be due to each of these two sleep characteristics separately, but rather to a harmful pattern of sleep with concurrent alterations in duration and quality. Thus, a better knowledge of this sleep pattern would be helpful to understand the relations between duration and quality-of-sleep and worse health outcomes in older adults.

The association between habitual duration and quality of sleep is uncertain. In some studies, short sleep has been associated with poorer quality of sleep, as approximated by difficulty sleeping, nighttime awakenings and daytime fatigue and sleepiness [5–8]. In another study, both short and long sleep were associated with sleeping difficulties [9]. In contrast, Buysse et al. did not observe an association between total sleep duration and quality of sleep evaluated with the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale [10]. Nor has sleep duration been associated with taking sleep medications [11]. Thus, results on the relation between duration and quality of sleep are inconsistent; moreover, little research has been done in older adults, despite the fact that this group more often has sleep disturbances [12].

Health disorders like depression and physical and mental limitation are frequent in the elderly, and are associated with short sleep and insomnia and with other complaints related with sleep quality [13–15]. Longer sleep duration, manifested as staying in bed for a long time due to physical limitations or mental impairment, may be a way of compensating for poor quality sleep. Thus, the association between extreme sleep duration and poor quality of sleep may only be present, or may be stronger, in persons with poor health status. To our knowledge, however, no study has examined the influence of health status on the association between duration and quality of sleep.

Accordingly, the objective of this study was to examine the association between habitual duration and quality of sleep in older adults, and to test whether this association varies with health status, as approximated by self-rated health, quality-of-life and functional limitation.

Methods

Study design and participants

The data for this analysis were taken from the third follow-up interview with a cohort of persons representative of the non-institutionalised Spanish population aged ≥60 years [1]. The cohort was established in 2001, and the data for this analysis were collected through phone interviews by trained staff in April 2009.

At baseline, the cohort was composed of 4,008 persons. After 8 years of follow-up, 1,050 persons had died. Thus, the analyses were conducted with 1,567 persons. In comparison with those who did not participate in the phone interview, there were no differences with regard to sex, self-rated health, HRQoL or number of chronic diseases.

Study subjects provided written informed consent to participate. The study was approved by the Clinical Research Ethics Committee of the ‘La Paz’ University Hospital in Madrid, Spain.

Study variables

Main variables

Sleep duration was obtained with the question: ‘How many hours do you usually sleep per day (including sleep at night and during the day)?’ Participants were asked to specify the number of hours and minutes they slept, and the interviewer rounded the figure to the nearest whole number.

Quality of sleep was rated according to four complaints related with nighttime sleep (use of sleeping medications, difficulty falling asleep, awakening during the night, early awakening with difficulty getting back to sleep) and two daytime sleep complaints (feeling tired on awakening in the morning, and being so sleepy during the day as to need a nap). Participants reported the frequency of each complaint with the following options: ‘almost always’, ‘sometimes’ and ‘rarely or never’. For analyses, a complaint was deemed to be present when it was reported to occur ‘almost always’.

Potential effect modifiers (indicators of health status)

To examine the influence of health status on the association between sleep duration and quality, we collected information on self-rated health, quality-of-life and functional limitation. Self-rated health was ascertained with the question, ‘How would you say your health is, in general?’

Physical and mental HRQoL were evaluated with the physical component summary (PCS) and the mental component summary (MCS) of the Spanish version of the SF-36 questionnaire [16, 17]. Higher scores for PCS and MCS correspond to better quality-of-life [18]. The Spanish version of the SF-36 has been used previously to measure HRQoL in older adults [19] and has good reliability and validity [18].

Finally, functional limitation in the instrumental activities of daily living (IADL) was evaluated with Lawton and Brody’s test [20]. IADL limitation was considered to exist where Lawton and Brody’s test score was ≤4 in men and ≤7 in women (these cut-offs correspond to the presence of disability in at least one IADL in each sex).

Potential confounders

The sociodemographic variables collected were sex, age, educational level and social network. Information was also
obtained on variables associated with lifestyle, such as leisure-time physical activity, smoking, consumption of alcohol and coffee and measured weight and height.

Major depression was defined as physician-diagnosed depression, or receipt of medical treatment for this disorder, as reported by the study subject. Respondents were also asked about the frequency of involuntary loss of urine and about the following diseases diagnosed by a physician: hypertension, diabetes mellitus, cancer at any site, myocardial infarction, stroke, heart failure and Parkinson’s disease. Finally, information was collected on whether respondents snored and on the number of times they woke up in the night to urinate.

Statistical analysis
The study associations were summarised with odds ratios (OR) and their respective 95% confidence intervals (CI) obtained from logistic regression. In these models, the dependent variable was each of the sleep complaints, and the main independent variable was sleep duration classified in three categories: short sleep (≤6 h), long-sleep (≥9 h) and intermediate sleep duration (7–8 h) which served as the reference.

Analyses were adjusted for the sociodemographic, lifestyle and health status variables described above, as well as for those sleep complaints which were not the dependent variable in each model. We also examined whether the association between duration and quality-of-sleep varied with health status; for this purpose, the analyses were stratified by self-rated health (optimal/suboptimal), PCS (score ≥45, <45) and MCS (score ≥56, <56) on the SF-36 and IADL limitation (yes/no). A score of 45 for the PCS and 56 for the MCS were chosen because they approximately correspond to the medians scores in the study sample. We tested for interaction between sleep hours and the stratification variables using likelihood ratio tests. We also tested for interaction by sex, but since this did not reach statistical significance the results are presented for both sexes together.

Statistical significance was set at P < 0.05. Analyses were performed with SAS, version 9.0 for windows (SAS Institute, Inc., 2004).

Results
The mean (±SD) age of study participants was 77.5 (±6.3) years, and the proportion of women was 58.0%. Mean sleep duration was 7.6 (±1.7) hours. Two out of three participants had ≥1 sleep-related complaint, and 22.7% had three or more complaints.

Table 1 shows the characteristics of participants according to sleep complaints. In comparison with the whole study sample, those with sleep complaints were more frequently women, sedentary and obese, and had lower educational level and fewer social ties. Moreover, they more frequently rated their health as suboptimal, reported to suffer from depression, and had worse scores in the PCS and MCS on the F-36. Finally, individuals with sleep complaints were more likely to report limitation in IADL, urinary incontinence and nocturia, and to have higher comorbidity.

Table 2 shows the association between habitual sleep duration and sleep complaints. When compared with those sleeping 7–8 h, those who slept ≤6 h were less likely to use sleeping pills, and more likely to report difficulty falling asleep, frequent awakening during the night, early awakening in the morning and feeling unrested on awakening. Those sleeping 9 or more hours per 24 h period were less likely than those sleeping 7–8 h to experience difficulty falling asleep, awakening during the night, early awakening in the morning or feeling unrested on awakening, although the difference was statistically significant only for early awakening in the morning and feeling unrested on awakening. On the other hand, those who slept ≥9 h were more likely to report daytime sleepiness (Table 2).

In stratified analyses, these associations generally did not vary (interaction P-values >0.05) between those with optimal and suboptimal self-rated health, between those with scores above and below the sample median for the PMC and SMC on the SF-36 and between those with and without limitation in IADL (data not shown, but available from the authors upon request).

Discussion
Older adults with short sleep duration more frequently have sleep complaints, especially nighttime complaints and feeling unrested in the morning. In contrast, long sleep duration is associated with daytime sleepiness. These associations are generally independent of health status.

To our knowledge, this is the first study to examine the association between sleep duration and nighttime complaints in older adults. Three previous studies analysed this association, but they included younger adults. In persons aged 18 and older, Ohayon observed a larger proportion of short sleepers among those who woke up every night than among those who did so fewer than three times a week, but found no association between long sleep (>8 h) and nocturnal awakenings [7]. Kronholm et al., in persons aged 30 and over, reported that those sleeping ≤6 or ≥9 h had more difficulty in falling asleep; moreover, those who slept ≤6 h awoke during the night more frequently than those who slept 7–8 h [9]. Finally, in individuals aged 18 and over, Grandner and Kripke found that extreme sleep durations were associated with nighttime and daytime complaints [21]. Our results in those with long sleep showing a lower probability of nighttime complaints, which reached statistical significance for early wakening in the morning, differ from those obtained in the latter two studies[9, 21]. Work-related activity and/or different circadian rhythms in young adults may partly explain this discrepancy [22, 23].

More research has been done among older adults on the relation between sleep duration and daytime sleep
complaints. In persons aged 75–84 years, Goldman et al. observed that short sleep (≤6 h), but not long sleep (>8 h), was associated with daytime fatigue [8]. However, Walsleben et al. reported a lack of association between sleep duration and excessive daytime sleepiness in ‘healthy’ persons aged 40–91 years [24]. Nor did Buysse et al. found an association between excessive daytime sleepiness and sleep duration in individuals aged 45–75 years selected for their better health status [10]. In our study, feeling tired in the morning was associated with short sleep, while daytime sleepiness was more frequent among those with long sleep. Some methodological aspects may help to explain the apparent inconsistencies between the results of these studies and ours. First, the concept of fatigue used by Goldman et al. also included level of energy, vitality and strength, which are not necessarily related with daytime sleepiness. Furthermore, the results of Walsleben et al. and of Buysse et al. were not specific to the elderly, and it is possible that the type of associations between duration and quality-of-sleep vary with age.

Some mechanisms have been postulated for the association between short sleep and nighttime sleep complaints. Certain health disorders such as depression, obesity, worse physical and mental HRQoL and nocturia are related both with short sleep and with more sleep fragmentation [1, 25, 26]. However, it does not appear to be a necessary mechanism, because the association between short sleep and nighttime complaints was also observed in persons with better health status and after adjusting for certain comorbidity. It has also been suggested that longer sleep duration could compensate for nighttime sleep fragmentation, and that the latter might contribute to explain the higher morbidity and mortality associated with long sleep [27]. However, our results do not support this hypothesis, since the frequency of persons with nighttime sleep complaints, and particularly early awakening in the morning, was lower in those with longer sleep duration, even in persons with worse PCS on the SF-36 or IADL limitation.

Excessive daytime sleepiness is frequent in patients with sleep apnoea. Moreover, long sleep could compensate for the poor quality of sleep in patients with sleep apnoea. Thus, in some cases, the association between long sleep and daytime-sleep complaints could be explained by sleep apnoea, which was not specifically controlled for in our study [23]. It does not appear to be a very important mechanism, however, because daytime sleepiness was more
Table 2. Odds ratios (95% confidence interval)\(^a\) for the association between habitual sleep duration and sleep complaints

<table>
<thead>
<tr>
<th>Sleep complaints</th>
<th>Sleep duration (hours per 24-h period)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>≤6 (n = 461)</td>
</tr>
<tr>
<td>Sleeping pill consumption</td>
<td>0.56 (0.38, 0.84)**</td>
</tr>
<tr>
<td>Difficulty falling asleep</td>
<td>3.51 (2.37, 5.20)**</td>
</tr>
<tr>
<td>Frequent awakening during the night</td>
<td>1.97 (1.42, 2.75)**</td>
</tr>
<tr>
<td>Early awakening in the morning</td>
<td>2.78 (2.02, 3.82)**</td>
</tr>
<tr>
<td>Feeling unrested on awakening</td>
<td>1.73 (1.18, 2.54)**</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>0.77 (0.51, 1.16)</td>
</tr>
</tbody>
</table>

\(^a\)Logistic regression models adjusted for: sex (male, female), age (years), body mass index (18.5–24.9, 25–29.9, ≥30 kg/m\(^2\)), educational level (no formal education, primary, secondary, university), size of municipality of residence (population ≤5,000, >5,000–30,000, >30,000–100,000, >100,000–500,000, >500,000 inhabitants), social ties (≥3, <3 ties), leisure-time physical activity (inactive, occasional, regular/intensive), smoking (never-smoker, ex-smoker, smoker), alcohol consumption (never drinker, ex-drinker, occasional drinker, habitual drinker), coffee consumption (non-drinker, <1 cup/day, 1–2 cups/day, >2 cups/day), self-rated health (optimal, suboptimal, missing category), depression (yes, no), SF-36 physical summary (score ≥245, <45, missing category), SF-36 mental summary (score ≥56, <56, missing category), limitation in instrumental activities of daily living (none, ≥1 limitation), urine incontinence (every day, lower frequency), hypertension (yes, no), diabetes mellitus (yes, no), cancer at any site (yes, no), myocardial infarction (yes, no), stroke (yes, no), heart failure (yes, no), Parkinson disease (yes, no), snoring (yes, no), nocturia (less than two, two or more times/night), sleeping pill consumption (yes, no), difficulty falling asleep (yes, no), frequent awakening during the night (yes, no), feeling unrested in the morning (yes, no), daytime sleepiness (yes, no).

Our study has some limitations. First, although data were taken from a cohort that at baseline was representative of older adults in Spain, study participants were survivors of an 8-year follow-up. To mitigate the survival effect, we adjusted the principal analyses for co-morbidity and for indicators of health status. Second, the cross-sectional design does not permit to establish the direction of the association between duration and quality-of-sleep. This may help to interpret the inverse association between sleeping pill consumption and short sleep. While those with sleep problems may tend to use sleeping pills, it is also true that such medication might contribute to a lower frequency of short sleep duration. Third, the response rate of the 2009 phone interview was relatively low because 1,350 individuals were not located, were unable to speak by the phone or refused to do so. These results are not surprising because this was a national cohort and older adults tend to move when they become frail or sick, and hearing limitations are very frequent among the very old. Moreover response rates to phone surveys are decreasing at any age in Spain and other countries, because surveys are increasingly used for marketing purposes. Fourth, the study collected data on total sleep duration, without separating daytime and nighttime sleep. Thus, we could not examine the relation between sleep quality and afternoon naps, which are very frequent among the oldest old. Fifth, given that our measure of sleep duration also included daytime sleep, it might tend to overestimate the relationship between long sleep and daytime sleepiness. However, Spain has a traditional ‘siesta’ culture, particularly in the older people. Siesta is precisely a pre-emptive intervention against afternoon sleepiness, so that is not likely that all the association observed between long sleep and daytime sleep complaints could be completely accounted by using total sleep duration. Notwithstanding this, our results should be confirmed in very old populations from countries without a ‘siesta’ culture. Finally, the information on sleep was self-reported. Nonetheless, the correlation between self-reported and actigraphy-measured sleep duration is good, and is independent of sleep quality [29].

In conclusion, in older adults the duration and quality of sleep show specific patterns of association: short sleep is associated with nighttime complaints and feeling unrested in the morning, and long sleep with daytime sleepiness. These associations are not due to worse health status in persons with poorer sleep quality and extreme sleep durations. These findings indicate that an in-depth clinical evaluation is needed in older adults reporting short or long sleep duration, because even those with better health status may suffer from a health disorder which affects sleep quality. Lastly, we suggest that future studies on the relation between mortality and quality and duration of sleep should examine the effect of concurrent alterations in these two variables.

Key points

- In older adults, short sleep is associated with nighttime sleep complaints and feeling unrested in the morning and long sleep with daytime sleepiness.
- These associations are not due to worse health status in persons with poorer sleep quality and extreme sleep duration.
- Future studies on the relation between mortality and quality and duration of sleep should examine the effect of concurrent alterations in these two variables.

Conflicts of interest

None declared.
Funding

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References