Subjective sleep problems in later life as predictors of cognitive decline. Report from the Maastricht Ageing Study (MAAS)

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SUMMARY

Background Although biological sleep criteria seem to be associated with cognitive changes in older people, it is not clear if subjective sleep parameters are related to cognitive decline in later life.

Objectives The aim of this study was to determine whether subjective sleep complaints in a population-based sample of 838 middle aged and older adults (≥ 50 years) predicted cognitive decline over a period of 3 years.

Methods Sleep complaints at baseline, assessed with the subscale Sleep Problems of the Symptoms Checklist–90, were used as a predictor variable. Cognitive performance at follow-up, measured with the Mini Mental Status Examination, was employed as a dependent variable.

Results Controlling for the effects of age, gender, length of follow-up interval, systemic diseases, and cognitive function at baseline, subjective sleep complaints were negatively associated with cognitive performance at follow-up.

Conclusion Subjective sleep complaints predict cognitive decline in middle aged and older adults. Mechanisms behind the effect of subjective sleep complaints on cognitive performance are discussed. Copyright © 2002 John Wiley & Sons, Ltd.

KEY WORDS—cognitive decline; sleep complaints; middle age; elderly

INTRODUCTION

It is well-documented that the quality of sleep decreases during the aging process (Feinberg et al., 1967; Webb and Campbell, 1980). Recent research suggests that sleep disorders in old age are related to cognitive dysfunction. Crenshaw and Edinger (1999) studied polygraphic sleep measures and cognitive performance in older adults with or without insomnia. They found that certain sleep parameters in insomniacs were associated with cognitive impairments. In a related vein, Prinz (1977) observed that polygraphic sleep criteria in older people were associated with a decline in cognitive function over a period of 18 years. These findings were replicated by Spiegel et al. (1999b), who reported that polygraphic sleep measures in older adults predicted cognitive impairment 14 years later. Thus, biological sleep parameters seem to be associated with cognitive changes in old age.

Subjective sleep problems may also be related to cognitive function in older adults. Subjective daytime sleepiness is an indicator of poor subjective sleep quality (Moldofsky, 1992). Although no association between subjective daytime sleepiness and cognitive performance in old age was found in a cross-sectional study (Whitney et al., 1998), Foley et al. (1999) reported that subjective sleepiness predicted cognitive decline three years later. To shed more light on the possible relationship between subjective sleep

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parameters and cognitive function in later life, we used data from the Maastricht Ageing Study (MAAS) to determine whether middle aged and older adults’ subjective sleep complaints predicted cognitive decline over a period of three years. Since depression in old age is accompanied by sleep problems as well as cognitive changes (cf. Poon, 1992), we conducted additional analyses controlling for the effect of depressive symptomatology. Recent longitudinal evidence suggests that depression does not seem to cause sleep disturbances, but sleep problems predict depression (Roberts et al., 2000). Hence, depressive symptomatology was treated as a mediating variable (and not as a confounder).

METHODS

Subjects

The MAAS is a prospective cohort study of cognitive ageing in southern Netherlands. Participants in the baseline of the MAAS were randomly drawn from a register of general practitioners affiliated with the University of Maastricht. Exclusion criteria, employed at baseline but not at follow-up, were brain-related disorders, cerebrovascular disease, psychiatric disorders, mental retardation, or psychotropic drug use. The sample consisted of 1869 subjects, stratified for age (12 discontinuous age classes [ranging from 25 ±1 years to 80 ±1 years]), gender, and occupational achievement (in two levels) as an indicator of general ability (see Van Boxtel et al., 1998, for more information on subject recruitment and stratification). All subjects underwent an extensive medical and neuropsychological examination. Three years after the 1993–1995 baseline measurement, all subjects older than 49 years (n = 1,069) were invited to undergo a second neuropsychological assessment. Due to refusal (n = 138), death (n = 50), and lost-to-follow-up (n = 43), 838 subjects (78%) were retested. The average age at baseline was 63.3 years (SD = 9.1). There were 402 women and 436 men. Note that subjects who dropped out of the study (for whatever reason), had lower educational levels and poorer baseline cognitive function than those who took part in the follow-up.

Dependent variable

For the purpose of the present study, the Mini Mental Status Examination (MMSE; Folstein et al., 1975), was selected as a measure of cognitive function. The MMSE consists of 20 items measuring different aspects of cognitive performance. Scores range from 0 to 30. Basic statistics for the MMSE score at baseline and the follow-up wave (corrected for a practice effect) were: 28.0 and 27.8 (mean), 1.7 and 1.9 (SD), 20–30 and 16–30 (range), respectively. Paired t-test showed that the three-year decrease in the MMSE score from 28.0 to 27.8 was statistically significant.

Predictor variable

Sleep complaints at baseline were measured with the subscale Sleep Problems of the Dutch version of the Symptoms Checklist—90 (SCL—90; Arrindell and Ettema, 1986). This subscale consists of three items pertaining to sleep problems. The items were: ‘To what extent were you distressed by difficulties with falling asleep’, ‘To what extent were you distressed by waking up too early’, and ‘To what extent were you disturbed by a restless or disturbed sleep’. Subjects had to indicate on a 5-point scale how much they had suffered from the complaint over the past week (1 = not at all, 5 = very much). These items were summed, resulting in a score ranging from 3 (no problems) to 15 (many problems). Finally, a dichotomous variable was also created, with 0 = no score of 4 or 5 on any of the three items, and 1 = one or more times a score of 4 or 5 on any of the items.

Data analysis

Multiple regression analysis was performed to determine if sleep problems at baseline were associated with cognitive function at follow-up. Age, gender, education, length of follow-up interval, systemic diseases, cognitive function at baseline, and psychotropic drug use at follow-up, were treated as confounders. To find out if the relationship between sleep complaints and cognitive decline was mediated by depression, we conducted additional analyses with depressive symptoms (as measured with the subscale Depression from the SCL—90) as a covariate.

RESULTS

Controlling for age, gender, education, length of follow-up interval, health factors, MMSE score at baseline, and psychotropic drug use, sleep complaints predicted cognitive function three years later (see Table 1). Waking up too early had the strongest association of the three items. Each unit higher (more problems) on this item resulted in a 0.13 MMSE-point more decline between baseline and follow-up. Both compound scores showed that general sleep problems were related to cognitive decline. Subjects who reported problems on any of the three items declined...
Table 1. Unstandardised regression coefficients (95% CI) of the association between sleep problems and cognitive decline (MMSE score), adjusted for age, sex, educational level, and length of follow-up interval (n = 838)

<table>
<thead>
<tr>
<th>Individual items</th>
<th>Coefficient</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falling asleep difficulty (1–5)</td>
<td>−0.05</td>
<td>(−0.16, 0.06)</td>
<td>0.330</td>
</tr>
<tr>
<td>Waking up too early (1–5)</td>
<td>−0.13</td>
<td>(−0.24, −0.03)</td>
<td>0.012</td>
</tr>
<tr>
<td>Restless sleep (1–5)</td>
<td>−0.09</td>
<td>(−0.20, 0.02)</td>
<td>0.094</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall scores</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Continuous score (3–15)</td>
<td>−0.05</td>
<td>(−0.09, −0.00)</td>
<td>0.033</td>
</tr>
<tr>
<td>Dichotomous score (0–1)</td>
<td>−0.38</td>
<td>(−0.71, −0.05)</td>
<td>0.025</td>
</tr>
</tbody>
</table>

Figure 1. MMSE-scores at baseline and follow-up for persons with and without sleep problems at baseline

0.38 MMSE-point more during follow-up than those without sleep problems. Figure 1 illustrates the steeper longitudinal decline for subjects reporting any sleep problems. It should be noted here that the magnitude of the effect, less than one point on the MMSE, is relatively small.

Taking into account sleep problems at the follow-up measurement wave showed that subjects reporting sleep problems at either baseline or follow-up experienced 0.25 MMSE point more decline (95% confidence interval (CI): −0.56, 0.06) than those without problems at both measurements. Subjects with sleep problems at both waves experienced 0.47 MMSE points more longitudinal decline (95% CI: −0.92, −0.03). Outliers and influential cases did not bias our findings. Sleep problems had similar effects on MMSE—decline in middle-aged and old subjects (i.e. there was no interaction between sleep problems and age).

There was a strong association between depressive symptoms and sleep complaints at baseline (Pearson correlation coefficient: $r = 0.48$, $p < 0.01$). The relationship between sleep complaints and decline in MMSE score disappeared after controlling for depressive symptomatology. For the continuous sleep variable the regression coefficient changed to $−0.02$ ($p = 0.36$), for the dichotomous variable to $−0.27$ ($p = 0.17$).

DISCUSSION

We found that sleep complaints in middle-aged and older adults were associated with cognitive dysfunction three years later. Our results are in line with a study by Foley et al. (1999), who reported that subjective daytime sleepiness in older people predicted cognitive decline over a period of three years.
Why do subjective sleep problems have a relationship with cognitive decline? One possibility is that subjective sleep complaints reflect genuine sleep problems. Poor quality of sleep may derange metabolic and endocrine function (see Spiegel et al., 1999a), which in turn would result in cognitive dysfunction. It could also be the case that sleep complaints lead to increased depression, which in turn induce cognitive impairments. In line with this argument, we found that the association between sleep complaints and change in cognitive function disappeared after controlling for depressive symptoms. It is unlikely that depression at baseline caused both sleep problems (at baseline) and cognitive decline. We performed additional analyses using data from the MAAS and found that (controlling for age, gender, education, length of follow-up interval, sleep complaints at baseline, and cognitive function at baseline) depressive symptomatology at baseline was not a reliable predictor of cognitive function at follow-up (regression coefficient was −0.02, p = 0.083). Also, (controlling for age, gender, education, length of follow-up interval, and sleep complaints at baseline) depressive symptoms did not predict sleep complaints at follow-up (regression coefficient was −0.01, p = 0.41). On the other hand, sleep complaints at baseline (controlling for age, gender, education, length of follow-up interval, and depression at baseline) were associated with depressive symptoms at follow-up (regression coefficient was 0.28, p < 0.01). These findings are in accordance with a recent study by Roberts et al. (2000). They investigated the relationship between sleep disturbances and depression prospectively, and found that sleep problems at baseline predicted depressive symptoms at follow-up. One could argue that subjective sleep problems do not pertain to actual sleep quality, but might be related to complaining behaviour or neuroticism. Jorm et al. (1993) found, in an elderly sample, that neuroticism was associated with impaired cognitive performance. Since people with high levels of neuroticism experience more stress than those with low neuroticism scores, the correlation between neuroticism and cognitive dysfunction was believed to reflect the effect of chronic stress on cognitive ageing. Neuroticism was measured in a subsample of MAAS participants (n = 185) at baseline. We found no association between neuroticism and change in cognitive function in this particular subsample.

Summing up, we found that sleep complaints in middle-aged and older adults predicted cognitive decline three years later. The mechanism behind the effect of subjective sleep problems on cognitive deterioration, is not entirely clear. Sleep complaints may reflect poor quality of sleep leading to cognitive dysfunction, or cause an increase in depressive symptoms resulting in cognitive deterioration.

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