



A SURVEY OF THE ASSOCIATIONS BETWEEN SLEEP AND MEMORY IN DIFFERENT AGE GROUPS

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ABSTRACT

Background: It is well established that memory problems increase with age and that sleep disorders are also associated with problems with memory. The interaction between aging and sleep problems has received less attention. **Aims:** The present study examined the effects of age and sleep problems on subjective reports of memory problems by conducting a secondary analysis of epidemiological data. The aims were to examine the main effects and interactions of these factors. **Methods:** A secondary analysis was carried out on a sub-sample of respondents from an epidemiological study of people in South Wales, UK. A young group (age: <30 years N =2300) was compared with an older group (age: > 70 years N=576). Sleep problems were measured by the presence of self-reported sleep disturbance, sleep duration and use of sleeping pills. The frequency of subjective memory problems was measured using a 5-point rating scale. **Results:** The results showed that the older group reported more memory problems, as did those with sleep problems. Some interactions between these groups were significant, with the difference between the younger and older groups being smaller in those with sleep problems. **Conclusions:** Memory problems increased with age and are more prevalent in those with sleep disorders. The age difference was smaller in those with sleep problems.

KEYWORDS: Aging; Sleep problems; Memory problems.

INTRODUCTION

It is well established that aging is accompanied by cognitive decline,^[1] which often includes problems with memory.^[2] Sleep disorders also increase with age,^[3] and there is evidence that sleep is important in the memory consolidation of young adults.^[4,5] These observations have plausible biological mechanisms. Aging leads to changes in the EEG of NREM slow wave sleep, as shown by decreased slow wave activity.^[6,7] Slow wave activity transforms episodic memories from a hippocampal-dependent state to an increasingly hippocampal-independent one.^[8,9] This suggests that NREM SWS plays a role in age-related memory decline. However, memory decline varies across individuals as they age, and so does the decrease in slow wave activity. Indeed, research has shown that structural brain atrophy in the regions controlling slow-wave activity may be an important factor. This view suggests that memory impairments are greater in the elderly than in younger adults and that sleep-dependent memory retention is impaired in the elderly compared to young adults. This view has been supported in a study of acute effects of sleep on the memory of young and older volunteers, which measured prefrontal atrophy, disrupted slow wave sleep and hippocampal activation.^[10]

Other research has examined the epidemiology of sleep and memory in the elderly.^[11] One cross-sectional study compared the cognitive performance of 133,314 patients with insomnia and 344,215 controls without insomnia. The results failed to show a negative effect of insomnia on cognition. Sleep medication use and both long (> 9 hours) and short (<7 hours) sleep durations were associated with impaired performance. Other research has investigated whether insomnia is associated with deficits in cognition, an increased risk of dementia, and changes in grey matter volume and white matter microstructure.^[12] There have been inconsistent results, but there is limited emerging evidence that insomnia is associated with an increased risk of dementia and reduced white matter integrity. Causality is often difficult to determine in the largely cross-sectional research, and it has been suggested that there is a complex bi-directional link between sleep and cognitive impairment.^[13]

Sleep disturbances can often take many forms. Another approach has been to examine sleep-disordered breathing and cognition.^[14] The results suggest that sleep-disordered breathing is associated with an increased risk of cognitive impairment and a small impairment of

executive function. One of the problems in drawing conclusions in this area is the use of multiple measures of sleep and memory. An integrative literature review of the topic^[15] found evidence that older adults (> 65 years) with < 5 hours or > 9 hours of reported sleep had poorer episodic memory than those who reported 6-8 hours of sleep. Other results, such as associations between slow wave sleep and memory, were less consistent. Also, many studies did not have a younger comparison group which means that the effect of aging is difficult to determine. Better sleep quality in younger adults is associated with better episodic memory performance¹⁶, but comparisons with older groups have rarely been made. One study^[16] found that young and old adults showed similar strength of sleep-memory relationships, but that age influenced the sleep correlates that contribute to this association. Indeed, it has been suggested that one can non-invasively manipulate the sleeping brain electrophysiology to improve cognition in the elderly.^[17] For example, acoustic stimulation to increase slow wave sleep may be an effective mechanism for declarative memory consolidation.^[18]

Overall, the brief review given above suggests that both further laboratory and epidemiological studies are required to provide more precise information on sleep, aging and memory. The main effects of aging and sleep disturbance appear to be well established, but the interaction of these variables requires further consideration. This was the main aim of the present secondary analyses of an epidemiological database.

METHOD

The study was approved by the ethics committee, School of Psychology, Cardiff University and carried out with the informed consent of the participants.

Design

A cross-sectional survey about health and wellbeing was conducted, targeting a sample in South Wales. The sample was randomly selected from the electoral registry and sent the survey in the post. Thirty thousand questionnaires were sent out, and 7980 were returned (a response rate of 27%). Analysis of the demographic data showed that the sample was representative of the population in the area. Further details of the content of the questionnaire are given in Smith et al.^[19] The present secondary analyses focus on sleep and self-reported memory in different age groups.

Measures

Sleep: Several variables relating to sleep were recorded. First, participants were asked whether they had sleep disturbances in the last 14 days (Yes/No response). Secondly, they were asked about their usual sleep duration. Finally, they were asked about the use of medication to aid sleep in the last 12 months.

Self-reported memory problems: A single question asked about the frequency of memory problems (a five-point rating scale from not at all to very frequently).

Age: Two age groups were compared: those under 30 and those over 70.

Participants

There were 2300 participants under 30 years old (mean age=28.0 years s.d. 4.5 years) and 576 over 70 years old (mean age=77.2 years s.d. 4.9 years). 41% of the sample were male, 34.7% single, and 35.5% educated to a degree level.

Analysis strategy

Analyses of variance were carried out. The frequency of memory problems was the dependent variable. The independent variables were age and sleep measures. Sleep duration was dichotomised, with 6-8 hours being one group and shorter and longer durations in the other.

RESULTS

Sleep disturbance

36.8% of the younger group reported sleep disturbance compared to 28.6% of the older group. The analysis of variance (ANOVA) showed that there was a significant main effect of age ($F(1, 2872) = 45.6, p < 0.001$) with the older group reporting more memory problems (mean rating = 1.72 s.e. 0.05) than the younger group (mean rating = 1.38 s.e. = 0.02). There was also a main effect of disturbed sleep ($F(1, 2872) = 33.9, p < 0.001$) with those with disturbed sleep reporting more memory problems (mean rating = 1.69 s.e. = 0.04) than those with no sleep disturbance (mean rating = 1.40 s.e. = 0.03). The interaction between age and sleep disturbance was also significant ($F(1, 2872) = 8.6, p < 0.005$) with the difference between sleep disturbed and non-disturbed groups being greater in the younger group (Mean ratings: No sleep disturbance: 1.16 s.e. 0.03; Sleep disturbance: 1.64 s.e. = 0.05) than the older group (Mean ratings: No sleep disturbance: 1.60 s.e. 0.03; Sleep disturbance: 1.79 s.e. = 0.08).

Sleep medication

3% of the younger group used sleep medication in the last year compared to 11% of the older group. The ANOVA showed a significant effect of sleep medication ($F(1, 2838) = 21.0, p < 0.001$) and a significant interaction between age and sleep medication use ($F(1, 2838) = 8.8, p < 0.005$). Those who took sleep medication reported more memory problems (mean rating = 1.89 s.e. 0.09) than those who did not (mean rating = 1.48 s.e. = 0.025). The effect of sleep medication was greater in the younger group (mean ratings: no medication: 1.29 s.e. = 0.02; medication: 1.97 s.e. = 0.12) than the older group (mean ratings: no medication: 1.67 s.e. = 0.04; medication: 1.81 s.e. = 0.13).

Sleep duration

35.8% of the young group had very short or very long sleep compared to 26.9% of the older group. The ANOVA showed significant main effects of age ($F(1, 2883) = 48.9, p < 0.001$) and sleep duration ($F(1, 2883) = 8.5, p < 0.005$) but no significant interaction ($F < 1$). The

older group reported more memory problems (mean rating = 1.65 s.e. = 0.02) than the younger group (mean rating = 1.29 s.e. = 0.05). Shorter/longer sleep was associated with more reported memory problems (mean rating = 1.55 s.e. = 0.03) than sleep between 6-8 hours (mean rating = 1.40 s.e. = 0.04).

DISCUSSION

The present results confirm that older volunteers report more frequent memory problems than younger volunteers. It should be noted that the community sample studied here was generally fit and well and reported a low frequency of memory problems. This shows that the aging effect is very general and will have an impact on a large percentage of the population. In terms of prevention and management of such problems, it may well be the case that those with very mild impairments may be easier to treat than when the problems become severe, as in Alzheimer's disease patients. The use of a simple rating scale for the frequency of memory problems may be very useful for large studies of general population samples.

One positive feature of the present study was that it assessed sleep problems in several ways. Sleep duration is a common measure, and long or short sleep was associated with memory problems in both the young and old samples. Interestingly, it was the young sample that had more long or short sleepers, and this may reflect the impact of external factors such as working hours, the timing of social events and the sleep-wake cycle of children. In contrast, the older group may have greater choices over their sleep hours.

The second measure of sleep was reported sleep disturbance, and again this was associated with memory problems. The younger group reported more sleep disturbance, and the difference in reported memory problems between the young and old groups was smaller in those who reported sleep disturbance. Again, one of the limitations of the present study is that it provides little information on the causes of sleep disturbance, and these may be different in the two age groups.

The final sleep measure was taking sleep medication. Those who took sleep medication reported more memory problems, and the use of sleep medication was higher in the older sample. The effect of sleep medication was greater in the younger group than in the older group. In other words, the use of medication reduced the size of the difference due to age. Again, it is unclear what medications were being taken or the reasons for the need for such medication. Future research should collect this information, and this may allow one to identify the direct effects of the sleep problem and also those due to the medication.

In conclusion, the present study has confirmed that older people report more memory problems and that problems with sleep also influence memory. The interaction

between age and sleep depended on the sleep parameter. When significant interactions did occur, they reflected a reduction of the age difference in those reporting sleep problems. This is in contrast to earlier views which suggested that sleep disturbance would have a great effect on the elderly. Further research on this topic is now required using different sleep measurement techniques and assessing both the acute and longer-term effects of sleep problems. Objective measurement of memory should also be carried out, as there is often a weak correlation between subjective reports and objective performance.

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