Effect of age on the macro- and microstructure of sleep in women

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Background
Changes in sleep across age are well documented, but most large-scale studies focus on either healthy individuals and/or use only measures of sleep macrostructure. Whereas sleep microstructure has been primarily assessed in small and selected samples. Moreover it is unclear, whether age-related changes in sleep are primarily related to co-occurring changes in health status and mood, as recently shown regarding subjective sleep complaints (Grandner et al., 2012).

Objectives
• Investigate the effect of age on sleep macrostructure, spectral composition of sleep, intra state elements and sleep continuity
• Investigate whether changes in physiological sleep across age are related to the co-occurrence of depressed mood, subjective health and sleep-disordered breathing

Methods
Sample
2,535 women (age: 48.9±11.2, range 22-72 years) from a randomly selected representative sample of 4,000 women (oversampling of snorers)
Exclusion criteria: severe somatic disease, being on drugs that might interfere with sleep architecture & insufficient PSG quality

Procedures
One night of ambulant PSG recording & questionnaires

Measures
Sleep scoring, spectral analysis and microstructure analysis (C3-A2) were conducted using automatic analysis and verified manually by a sleep scoring expert
Depressed mood was assessed using the Hospital Anxiety and Depression Scale, subjective health was measured using one question from the SF36

Statistical analysis
Linear regression analyses (non-weighted)

Results
Age was associated with a significant reduction in Total Sleep Time, time in N3 and REM sleep (see figure), as well as a reduction in number of sleep cycles.

Changes across age in power density as well as spindle, K-complex and REM density are displayed in table 1.

Table 2
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SEM)</th>
<th>35-45yrs</th>
<th>45-55yrs</th>
<th>&gt; 55yrs</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>REM density</td>
<td>0.07 (0.05)</td>
<td>0.18 (0.01)</td>
<td>0.05 (0.01)</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>N3 sleep</td>
<td>67 (3)</td>
<td>69 (3)</td>
<td>76 (1)</td>
<td>73 (1)</td>
<td>0.05</td>
</tr>
<tr>
<td>NREM sleep</td>
<td>24 (3)</td>
<td>26 (4)</td>
<td>31 (3)</td>
<td>31 (3)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Effect of covariates
• Higher AHI was associated to an increase in N4 sleep
• Worse subjective health was associated to a decrease of the number of sleep cycles, higher beta 2 power density during NREM sleep, and to an increase in fragmentation of SW sleep
• Higher depression scores were related to a decrease in delta and theta power density during NREM sleep, and a decrease of K-complex density
• The effect of age was largely not altered by including the covariates

Conclusions
Increasing age was as expected associated to a reduction of the number of sleep cycles, decreased sleep time and decreased N3 and REM sleep. The decrease in sleep spindles and K-complexes during N2 sleep presumably indicates a decrement of sleep protective mechanisms with increasing age. Sleep fragmentation was slightly increased in particular in women in the perimenopause age-range (45-55yrs). Including covariates did against expectations by and large not affect the effect of age on the sleep parameters.