The Role of Dispositional Mindfulness in Age-Dependent Sleep Changes

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The Faculty of the Graduate School of Arts and Sciences
Brandeis University
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Jutta M. Wolf, Advisor

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Master of Arts
in
Psychology

by
Johnathan Maxfield

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ABSTRACT

The Role of Dispositional Mindfulness in Age-Dependent Sleep Changes

A thesis presented to the Department of Psychology
Graduate School of Arts and Sciences
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Waltham, Massachusetts

By Johnathan Maxfield

Poor sleep quality has been linked to several severe physical and mental health issues. Importantly, sleep disorders become more common in older age because of developmental changes, more frequent medical issues, and various other factors. The increased risk to suffer from declines in sleep quality with increasing age and the well-documented negative health effects of such declines calls for finding ways to prevent or reduce sleep deterioration in older age. In previous studies, dispositional mindfulness has been shown to positively correlate with sleep quality, but further investigation is needed. The current study examined associations between age and sleep, dispositional mindfulness and sleep, and whether dispositional mindfulness moderates age-related sleep changes in 73 female adults aged 48 to 73. The results demonstrated that older age was associated with higher sleep quality, alertness, and hours in bed. Alternatively, dispositional mindfulness was negatively correlated with hours in bed. Importantly, this study did not reveal a significant moderation effect for dispositional mindfulness. The unexpected direction of correlations is discussed in the context of the uniqueness of this sample, and several important methodological issues related to sleep are examined. Lastly, future directions are discussed based on this initial attempt to understand the role of dispositional mindfulness in age-related sleep changes.
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The Role of Dispositional Mindfulness in Age-Dependent Sleep Changes

Sleep is a complex biological process that even ancient cultures recognized as essential to maintaining a healthy body and mind. Over the course of the past century, advancements in medical technology have allowed researchers to scientifically study components of sleep, and demonstrate the drastic influence sleep has on physical and mental health. Specific physical conditions that have been shown to correlate with poor sleep include cardiovascular disease (Hoevenaar-Blom, 2011; Strand, 2015; Sofi, 2012) and hypertension (Guo, 2016; Gottlieb, 2006; Lusardi, 1996). Additionally, researchers have found that poor sleep is associated with decreased cognitive functioning (Theresa, 2014; Sutter, 2012), suicidal ideation (An, 2015; Turvey, 2002), and depression (Moo-Estrella, 2005). Importantly, the risk for these sleep-related health issues increases in older age.

Numerous factors contribute to the changes in sleep quality associated with older age. Among these are developmental changes, including the onset of menopause in women, and an increase in medical conditions leading to sleep problems (Crowley, 2011). Studies have shown that sleep quality deteriorates consistently throughout the lifespan, while sleep quantity decreases through middle-age and then remains fairly stable into older adulthood (Ohayon, Carskadon, Guilleminault, and Vitiello (2004). This was confirmed in a more recent study assessing a sample of men and women aged 41 to 73, for whom sleep quality, but not sleep quantity, decreased with increasing age (Madrid-Valero, Martinez-Selva, Ribeiro do Couto, Sanchez-Romera, and Ordonana (2017). Given the increased risk to suffer from declines in sleep quality
with increasing age and the well-documented negative health effects of such declines calls for finding ways to prevent or reduce sleep deterioration in older age. One promising area of research that has received significant attention in this regard is mindfulness-based meditation studies, and to a lesser extent, dispositional mindfulness.

Mindfulness is defined as a receptive attention to and awareness of present events and experience (Brown & Ryan, 2003). Thus dispositional mindfulness, or trait mindfulness, refers to how mindful a person is on average in their daily life. Although dispositional mindfulness is considered a stable and inherent personality trait (Feldman, 2007), studies have shown that it can be increased through mindfulness meditation in various populations including middle-age and older adults (Moynihan, 2013; Scherz, 2015). More importantly in the current context, studies have shown that mindfulness-based interventions effectively improve sleep quality, and that dispositional mindfulness may play a fundamental role in these improvements (Ong, Shapiro, & Manber, 2009; Shapiro, Carlson, Astin, & Freedman, 2006). Unfortunately, only a handful of studies have investigated the association between dispositional mindfulness and sleep quality outside of the context of mindfulness-based interventions. In these few studies, however, sleep quality was consistently and positively linked to dispositional mindfulness. As such, this line of research suggests dispositional mindfulness as a factor that may be helpful in countering age-related sleep deterioration.

It should be pointed out that the populations assessed to date include undergraduate students (Howell, Digdon, & Buro, 2010; Howell, Digdon, Buro, & Sheptycki, 2008) as well as older adults ranging in age from 64 to 91 (P. L. Visser, Hirsch, Brown, Ryan, & Moynihan, 2014). Thus, the link between dispositional mindfulness and sleep quality has yet to be examined in the target population of middle-aged to older adults. Furthermore, previous studies relied on
self-report of habitual sleep quality over the prior month; however, more recent research suggests that these measurements are not adequate evaluations of sleep behavior (Landry, Best, & Liu-Ambrose, 2015). Hence, research assessing the role of dispositional mindfulness for sleep quality in the context of daily sleep behavior is needed.

In order to address these gaps in the literature, the current study assessed sleep quality and dispositional mindfulness in a sample of middle-aged to older adults (50-75). More specifically, habitual sleep quality assessed by the Pittsburgh Sleep Quality Inventory (PSQI) was complemented by sleep quality assessment in the context of daily sleep diaries. This approach was chosen based on observations suggesting that sleep diaries are not only superior to retrospective measures, but also comparable to more invasive objective measurements of sleep quality (actigraphy and polysomnography; Jungquist, Pender, Klingman, and Mund (2015).

The first aim of this study was to confirm the association between age and sleep quality across a middle-aged to older population, and it was hypothesized that sleep quality would be negatively correlated with age, particularly when assessed in the context of daily sleep behavior. The second aim was to expand the literature on positive links between dispositional mindfulness and sleep quality to middle-aged adults and it was hypothesized that across age, higher dispositional mindfulness would be correlated with higher sleep quality (PSQI and diary). Lastly, the study aimed at testing whether dispositional mindfulness may moderate the relationship between sleep quality and age. Specifically, it was hypothesized that dispositional mindfulness may buffer against lower sleep quality associated with older age.
Methods

Participants

A total of 100 male and female middle-aged and older adults were recruited for this study. However, the majority of participants were women, thus the nine male participants were excluded from analyses. Additionally, participants had to be excluded from analyses due to missing Mindfulness Attention Awareness Scale (MAAS) data (n=9), Pittsburgh Sleep Quality Index (PSQI) data (n=2), and sleep diary data (n=7). The 73 participants included in analyses ranged in age from 48 to 73 (M=59.1, SD=6.4) and were primarily white (n=69, 94.5%). Participants had an average education level of 17.3 years (SD=2.3). Most participants (n=36, 49.3%) were married, 16 were single (21.9%), and 4 (5.5%) were widowed.

Procedure

The current study was part of a larger Fitbit-assisted 12-week walking intervention targeting middle-aged and older adults interested in becoming more active. Participants were recruited from across northeastern Massachusetts through flyers, in-person recruitment efforts, and online postings. In order to be eligible, individuals were required to be 45 to 75 years old, inactive, and distressed by their inactivity. After determining eligibility via phone screening, participants scheduled two in-person meetings with study personnel. During the first meeting, informed consent was obtained, participants completed a set of questionnaires including the PSQI and MAAS, and participants were given a Fitbit and instructed on how to record steps and sleep information in daily diaries. Participants were instructed to wear the Fitbit for the first week of the study and maintain their normal physical activity and sleep behavior to determine
their baseline recordings. Study procedures were approved by the Brandeis University Institutional Review Board and participants received a Fitbit One as compensation for their time.

**Measures**

Daily diaries, consisting of items from the Pittsburgh Sleep Diary were used to analyze average weekly sleep behavior of participants. Items included “bedtime”, “minutes to fall asleep”, “wake time”, “sleep quality”, and “alertness upon waking”. These items were used to calculate hours in bed, sleep latency, sleep quality, and alertness. Importantly, sleep quality and alertness were measured with a line marking scale that was used to calculate a percentage. Previous studies have shown that diaries are useful, valid, and reliable measures of sleep as shown by comparisons using polysomnographic and actigraphic sleep measures (Monk, 1994).

In addition, the Pittsburgh Sleep Quality Index (PSQI) was used to measure habitual sleep behavior. The PSQI was designed to be used in clinical practice and research for discriminating between good and poor sleepers based on an overall global score generated from 19 self-report items (Buyesse et al., 1989). This study focused on hours in bed, sleep latency, sleep quality, and daytime dysfunction. It is important to note that sleep quality was measured on an ordinal scale ranging from 0=“very good” to 3=“very bad”. Similarly, daytime dysfunction was measured on an ordinal scale indicating the frequency of impairment to daily activities resulting from sleep issues ranging from 0=“not during the past month” to 3=“three or more times a week”. Internal consistency has been supported across samples with alphas ranging from .77 to .83 (Buyesse et al., 1989; Carpentar and Andrykowski, 1998; Doi et al., 2000) and test-retest reliability has been supported among both healthy and sleep disturbed individuals (Buyesse et al., 1989).
The Mindfulness Attention Awareness Scale (MAAS) was used to measure dispositional mindfulness. The MAAS is a 15-item self-report questionnaire that averages responses to each item to generate an overall score with higher scores indicating greater dispositional mindfulness. Dispositional mindfulness is defined as a receptive state of mind in which attention, informed by a sensitive awareness of what is occurring in the present, and simply observes what is taking place (Brown & Ryan, 2003). This questionnaire has demonstrated good internal consistency (α=.82) and high test-retest reliability (r=.81) in university student samples (Brown and Ryan, 2003). Additionally, the MAAS has demonstrated high internal consistency (α=.82) in older adults (Visser et al., 2015).

**Analytic Plan**

Data were analyzed using the IBM statistics software package SPSS. Prior to hypothesis testing, descriptive statistics were examined for age, sleep behavior, and dispositional mindfulness. For the first hypothesis, the association between age and sleep variables was tested using Pearson’s product-moment correlation coefficient (r) and Spearman’s rank correlation coefficient. The second hypothesis, testing the association between dispositional mindfulness and sleep variables also used Pearson’s product-moment correlation coefficient (r) and Spearman’s rank correlation coefficient. Finally, linear and ordinal regression analysis was used to test the moderation effect of dispositional mindfulness on the association between age and sleep.
Results

Descriptive Statistics

Overall, sleep indices assessed by the PSQI and sleep diaries correlated highly (see Table 1), with r-values among the corresponding values ranging between .41 and .61. Furthermore, no significant mean differences between corresponding sleep variables were observed (dependent t-tests and chi-square: all p’s > .05; see Figures 1 and 2). For example, mean hours in bed differed by 0.14 hours (PSQI: 8.0+/-.1.2, diary: 8.14+/-.1.1). Correlations between sleep variables on the PSQI revealed that sleep quality was significantly correlated with daytime dysfunction (r=.389, p=.001), but no other sleep variables were significantly associated. The sleep diary revealed that sleep quality was significantly correlated with alertness (r=.74, p<.001). Lastly, the mean score on the MAAS was 4.01 (SD=.72).

Hypothesis Testing

Based on previous studies, it was hypothesized that sleep quality would be lower in older age. However, age was positively correlated with sleep quality as measured by the sleep diary (r=.265, p=.023), indicating older participants reported better sleep. Additionally, age was positively correlated with alertness as measured by the sleep diary (r=.273, p=.019), indicating that older participants were more alert upon waking up in the morning. Age was also positively correlated with hours in bed as measured by the PSQI (r=.296, p=.011), but age was not correlated with daytime dysfunction or sleep latency as measured by the PSQI or sleep diaries (all p’s > .05).
It was also hypothesized that dispositional mindfulness would be positively correlated with sleep quality, given the findings of previous research. However, dispositional mindfulness was not significantly correlated with sleep latency, sleep quality, alertness, or daytime dysfunction (all p’s > .05). Alternatively, dispositional mindfulness was negatively correlated with hours in bed as measured by the sleep diary ($r = -.271$, $p=.021$), and a similar trend was found for hours in bed measured by the PSQI ($r = -.196$, $p=.097$). This indicates that participants with higher dispositional mindfulness reported spending less time in bed. The correlation coefficients from these analyses are reported in Table 1.

Finally, it was hypothesized that dispositional mindfulness would moderate the association between age and sleep. Regression analyses did not reveal a significant age-by-mindfulness interaction effect for any of the sleep variables (all $p$’s > .05; see Table 2 for details). It is noteworthy that controlling for dispositional mindfulness, age significantly predicted hours in bed as measured by the PSQI ($\beta = .047$, $p=.025$), as well as quality and alertness as measured by the sleep diary (Quality: $\beta = .525$, $p=.036$, Alertness: $\beta = .575$, $p=.040$), thus corroborating the correlation analyses findings presented above. Similarly, dispositional mindfulness significantly predicted hours in bed for the PSQI and sleep diaries over and above age effects (PSQI: $\beta = -.403$, $p=.03$, Diary: $\beta = -.414$, $p=.021$).
Discussion

Interestingly, this study found that older age was associated with better sleep quality which contrasts with previous studies examining sleep changes in aging. This finding suggests that another factor besides age may be influencing sleep quality to a greater extent, and one possibility is the level of physical activity. Furthermore, dispositional mindfulness was not related to better sleep quality as expected, implying that this trait alone is not enough to account for better sleep in the group of women in this study. This finding is the opposite of what has been shown previously in groups of undergraduate students and older adults (Howell et al., 2010; H. Visser, Brown, Ryan, Moynihan, 2015), and suggests that further research is needed to determine who benefits most from being mindful in terms of sleep quality. Additionally, dispositional mindfulness did not change the relationship between age and sleep quality as expected, but future studies are needed to confirm this is true for other groups.

Age and Sleep

This study revealed that both sleep quality and alertness were higher in older age. This finding is unexpected, as it conflicts with well-documented declines in sleep quality associated with aging (Madrid-Valero et al., 2017). One possible explanation for this finding is that the average global PSQI score, which represents overall sleep impairment, was 7.7 (SD=3.8). In comparison, Madrid-Valero et al. (2017) reported a mean global PSQI score of 5.74 (SD=4.2) for females aged 43-71 in a sample of 1173 women. Given this high average degree of sleep impairment across the group, it is possible that the decreased sleep quality related to aging was not as pronounced as in other studies. In fact, the observed sleep problems observed in this group
may be associated with their low level of physical activity (Koh, Jang, Paik, Kim, & Lim, 2014). If this overall level of sleep impairment is due to low physical activity, age-related sleep declines may play less of a role in sleep differences across age. Alternatively, older women may experience better sleep resulting from decreased work-related stress after retirement (Mehra, 2009). Interestingly, this change in routine would presumably allow for a more flexible daily schedule, and therefore could also help explain the finding that older women spent more hours in bed.

It is important to note that hours in bed as operationalized in the current study does not indicate more sleep, rather it signifies more time in bed, whether that is time sleeping, time spent falling asleep, or time spent waking up in the middle of the night. However, spending more time in bed may account for the higher sleep quality and alertness reported by older women. Based on the hypothesis that retired women have more flexible schedules allowing for longer times spent in bed, they may be able to obtain necessary rest leading to higher sleep quality. In particular, spending more time in bed may lessen the impact of disrupted sleep on sleep quality. Studies show that changes in sleep associated with aging include shifts in sleep architecture and an increase in waking up during the night (Kuo, Li, Kuo, Chern, & Yang, 2016). While objective sleep measures are needed to assess this aspect of sleep, 52.1% of women in the current sample reported waking up in the middle of the night or early morning three or more times a week. It is possible that spending more time in bed compensates for the fragmented sleep occurring in aging leading to better sleep quality.

**Mindfulness and Sleep**

This raises the question how dispositional mindfulness may influence the amount of time spent in bed. In fact, higher mindfulness was associated with fewer hours in bed, but was not
correlated with sleep latency, quality, or alertness. This suggests that in this group of women dispositional mindfulness is a principal factor influencing sleep routines, but not necessarily overall sleep quality. One explanation for more mindful women spending less time in bed is that they spend more time sleeping and less time lying awake, thereby requiring less time in bed to feel rested. In our study, dispositional mindfulness was not associated with less time spent falling asleep, but it could have impacted the amount of time spent awake during the night. Theoretical models propose that mindfulness facilitates cognitive deactivation skills necessary to inhibit distracting thoughts and emotions, thereby increasing the ability to fall asleep (Lundh, 2005), and these cognitive skills could be useful in dealing with frequently waking up throughout the night.

As noted, dispositional mindfulness was not correlated with sleep latency, sleep quality, alertness, or daytime dysfunction as expected based on previous studies (Howell et al., 2010; Howell et al., 2008; H. Visser, Brown, Ryan, Moynihan, 2015). Once again, the rather high degree of sleep impairment reported by the women in the current study may play an important role in understanding why, unlike observed in other populations, being more mindful is not indicative of better sleep. In particular, it suggests that simply being more mindful is not sufficient to ensure better sleep quality in a group with fairly low sleep quality that may be linked to a physically inactive lifestyle. Alternatively, focusing on improving physical activity in this sample could lead to better sleep quality (Koh et al., 2014).

**Moderation Effect**

This study looked at whether dispositional mindfulness moderates age-related sleep changes, which had not been previously examined. The results did not reveal a significant interaction effect for any of the sleep variables, but there are a few points to consider before drawing broad conclusions. It is possible that dispositional mindfulness does not moderate age-
related sleep changes, or our finding may be specific to this sample. As discussed above, the
level of overall sleep issues was especially high in this sample, and is hypothesized to be related
to low physical activity. Further studies are needed to determine the generalizability of this
finding.

**Sleep Habits versus Sleep Behavior Assessment**

It is noteworthy that although all sleep indices correlated highly and further, were not
significantly different when assessed retrospectively (PSQI) versus more behaviorally (diary).
However, correlations with age and dispositional mindfulness differed between measures for
sleep quality and alertness/daytime dysfunction. One reason for this difference may be due to the
fact that sleep quality and effects of sleep on daytime functioning as assessed by the PSQI
requires participants to characterize their sleep by choosing from four rather broad descriptors,
while the sleep diary allows participants to describe their sleep quality and alertness levels on a
continuous scale. This reflects the fact that the PSQI was designed to differentiate between
“good” and “poor” sleepers, whereas sleep diaries have been shown to more closely resemble
objective sleep measures (Jungquist et al., 2015). Furthermore, this suggests that sleep diaries
may be a more effective measure of sleep quality when looking at changes related to age,
especially considering it is still much less invasive than objective sleep measures. On the other
hand, the continuous variable of hours in bed did not follow this pattern. Age was associated
with hours in bed for the PSQI but not the sleep diary. This suggests that retrospective accounts
of time spent in bed (PSQI) are significantly related to age in this context, while measures more
similar to objective sleep patterns (sleep diary) are not. Furthermore, dispositional mindfulness
was associated with hours in bed for both the PSQI and sleep diary, demonstrating that important
differences can be detected using both measures.
Limitations and Future Studies

This study successfully addressed several gaps in the literature regarding the role of dispositional mindfulness in age-related sleep changes, but it is important to note some relevant limitations. First, the assessment of sleep data relied on self-report measures only, and objective measures of sleep quality and quantity may be important future areas for investigation. However, this study highlights the fact that subjective sleep ratings may be useful in detecting changes not showing up in data from more behaviorally based measures. Second, this study used the Mindfulness Attention Awareness Scale (MAAS) to measure dispositional mindfulness, but there are several alternative methods available to measure this construct that may be more suitable for older participants. One area of concern for the MAAS is the use of questions that may reflect cognitive skills rather than characteristics of dispositional mindfulness. For instance, the item “I forget a person’s name almost as soon as I learn it” could be more representative of memory changes associated with aging. Lastly, the generalizability of this study is a limitation given that participants were all female, had especially low levels of sleep quality, and reported low physical activity. However, this study provides a starting point for better understanding what level of intervention is needed to improve sleep in women in this age range.

Relevance and Outlook

The interesting patterns of age-related sleep changes for this group of women demonstrate the importance of choosing which methods are employed to measure sleep. Additionally, this data suggests that the severity of sleep issues and probable causes of those disruptions are important factors to consider. Furthermore, this study revealed that the individual-level characteristic of dispositional mindfulness was not enough to account for better sleep quality in older age. However, the next logical step in this research area is to determine if
dispositional mindfulness acts as a protective factor in middle-age and older adults with less severe sleep issues. While the sample observed in the current study likely require some sort of intervention to achieve improvements in sleep, dispositional mindfulness could be effective for those dealing with less severe difficulties.
References


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doi:10.3389/fnagi.2015.00166


### Table 1. Correlations of age and mindfulness with variables from the Pittsburgh Sleep Quality Index and sleep diaries.

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<th>Age</th>
<th>Mindfulness</th>
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<th>4</th>
<th>5</th>
<th>6</th>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Latency</td>
<td>-.039</td>
<td>-.179</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Quality</td>
<td>-.130</td>
<td>-.083</td>
<td>.211</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>3. Daytime Dysfunction</td>
<td>-.117</td>
<td>-.221</td>
<td>.059</td>
<td>.389**</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Hours in bed</td>
<td>.296*</td>
<td>-.196</td>
<td>.141</td>
<td>-.035</td>
<td>-.011</td>
<td></td>
<td></td>
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<td><strong>Diary Variables</strong></td>
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<td></td>
<td></td>
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<tr>
<td>5. Latency</td>
<td>-.095</td>
<td>-.039</td>
<td>.486**</td>
<td>.279*</td>
<td>.094</td>
<td>.227</td>
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<tr>
<td>6. Quality</td>
<td>.265*</td>
<td>.197</td>
<td>-.199</td>
<td>-.420**</td>
<td>-.367**</td>
<td>.032</td>
<td>-.122</td>
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<td>7. Alertness</td>
<td>.273*</td>
<td>.169</td>
<td>-.249*</td>
<td>-.367**</td>
<td>-.413**</td>
<td>-.093</td>
<td>-.126</td>
<td>.740**</td>
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<td>8. Hours in bed</td>
<td>.084</td>
<td>-.271*</td>
<td>-.037</td>
<td>-.091</td>
<td>-.049</td>
<td>.609**</td>
<td>.127</td>
<td>-.029</td>
<td>-.116</td>
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*p<.05, **p<.01
Table 2. Summary of regression analysis for variables predicting sleep components on Pittsburgh Sleep Quality Inventory (PSQI).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Latency</th>
<th>Quality</th>
<th>Daytime Dysfunction</th>
<th>Hours in Bed</th>
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<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
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<tr>
<td>Age</td>
<td>-0.11</td>
<td>0.36</td>
<td>-.04</td>
<td>-0.03</td>
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<td>MAAS</td>
<td>-4.76</td>
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<td>-.18</td>
<td>-0.17</td>
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<td>Age x MAAS</td>
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<td>-.01</td>
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<td>$R^2$</td>
<td>.03</td>
<td></td>
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<tr>
<td>Chi-Square</td>
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<td>208.2</td>
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*p < .05.
Table 3. Summary of regression analysis for variables predicting sleep components on sleep diaries.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Latency</th>
<th>Quality</th>
<th>Alertness</th>
<th>Hours in Bed</th>
</tr>
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<tr>
<td></td>
<td>$B$</td>
<td>$SE B$</td>
<td>$\beta$</td>
<td>$B$</td>
</tr>
<tr>
<td>Age</td>
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<td>0.27</td>
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<td>Age x MAAS</td>
<td>-1.93</td>
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*R^2* values:

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<th>Latency</th>
<th>Quality</th>
<th>Alertness</th>
<th>Hours in Bed</th>
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<tr>
<td></td>
<td>.03</td>
<td>.108</td>
<td>.113</td>
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*p < .05.*
Figure 1. Comparison of hours in bed and sleep latency between the Pittsburgh Sleep Quality Inventory (PSQI) and sleep diaries.
Figure 2. Comparison of sleep quality, alertness, and daytime dysfunction between the Pittsburgh Sleep Quality Inventory (PSQI) and sleep diaries.