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Brief report

Changes in Sleep Predict Changes in Affect in Older Caregivers of Individuals with Alzheimer's Dementia: A Multilevel Model Approach

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Abstract

Objectives: Understanding predictors of older dementia caregivers' mood could provide insight into potential treatments which may delay institutionalization of their care recipient. Research with older noncaregivers has shown that nights characterized by better subjective sleep were associated with days characterized by higher positive and lower negative affect, and vice versa. Examining daily relationships is important, as sleep and affect are state-like behaviors that fluctuate within individuals, across time. This study was a preliminary examination of whether a sample with a greater proportion of older dementia caregivers exhibits similar daily sleep/affect associations.
Methods: Sleep diaries, actigraphy, and affect data were collected concurrently for 7 days in 55 community-dwelling, dementia caregivers (M = 62.80 years, SD = 12.21; 77.8% female). Sleep and affect were examined within- (day-to-day level) and between-persons (mean level).
Results: Findings for older noncaregivers were replicated for negative affect only. Specifically, nights characterized by better subjective sleep were characterized by lower negative affect, and vice versa.
Discussion: Examining older caregivers' daily sleep/affect association is important, because caregiving-related awakenings are unavoidable, often unpredictable, and can impact mood. Future research is needed to examine whether regularization in awakenings and/or negative affect represent important secondary, or even target, treatment outcomes for this vulnerable population.

Key Words: Affect—Caregivers—Day-to-day relationships—Inconsistency—Mood—Sleep

Unpaid, informal older caregivers play an essential role in the United States' healthcare system by filling a vast gap in the full-time care of older persons with dementia (PWD). Although their service offsets large healthcare expenses for PWD each year, it comes at the cost of increased disturbances in health for the caregiver, particularly sleep and affect (McCurry & Teri, 1995; Piercy et al., 2013; Teri, Logsdon, Uomoto, & McCurry, 1997). A bilateral, negative relationship exists between average sleep and negative affect (NA) in older caregivers (Brummett et al., 2006; Rowe, McCrae, Campbell, Benito, & Cheng, 2008). In addition, while higher levels of depression predict poorer sleep in both older caregivers and noncaregivers, older caregivers report more depressive symptoms overall (McCrae et al., 2008).

Previous research has focused primarily on average levels of sleep and affect in caregivers, ignoring day-to-day inconsistency (an individual's fluctuation around their mean) (Nesselroade, 1991), which is a hallmark of chronic insomnia. The utility of examining sleep inconsistency in older caregivers is becoming more apparent, despite its limited study, due to the nature of caregivers' daily schedules, which are inherently inconsistent or irregular due to ever changing care needs (Infurna, Gerstorf, & Zarit, 2013). Recent findings suggest that older caregivers of PWD exhibit greater night-to-night inconsistency in total sleep time and sleep efficiency compared to older noncaregivers (Rowe et al., 2008).

Previous examinations of sleep and affect in older noncaregivers reveals that inconsistency in subjective (but not objective sleep) is related to inconsistency in positive affect (PA) and NA in older noncaregivers (McCrae et al., 2008). Specifically, nights with better subjective sleep (less time was spent awake or higher sleep quality ratings) were associated with days characterized by more PA and less NA. In contrast, analyses of mean sleep outcomes revealed only that overall greater wake time during the night was associated with lower PA (McCrae et al., 2008).

By extending previous findings in older noncaregivers to older caregivers of PWD, the present study represents an important preliminary step in determining whether further examination of day-to-day inconsistency in older caregivers' sleep is warranted. The present study has important clinical implications for older adult caregivers as both sleep and affect are modifiable through cognitive-behavioral and other intervention approaches. We hypothesize that: (a) on average, better subjective sleep will predict higher PA and lower NA, and (b) nights characterized by better subjective sleep will be associated with days characterized by higher PA and lower NA.

Method

Design

The current study examined seven consecutive days of sleep and affect assessments. Each morning, subjective sleep was measured using sleep diaries, and PA and NA were measured with the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Objective sleep was measured concurrently by an actigraph worn on the nondominant wrist (Mini Mitter, 2001). Participants read and signed an informed consent form approved by the University of Florida's Institutional Review Board.

Participants

Informal caregivers providing direct care to a PWD were recruited for a larger parent study. Inclusion criteria included: English fluency, not undergoing active treatment for sleep disorders, living with the PWD, a Mini-Mental Status Exam (MMSE) score > 27, worry about nighttime

activity in the PWD, and a MMSE < 23, diagnosis of dementia, and nighttime awakenings as reported by the caregiver in the PWD. Exclusionary criteria included: PWD receiving professional care at night, age of ≤21 years, and physical impairment preventing rapid assistance in caregiver. The final sample consisted of 55 community-dwelling participants that were mostly older (59.3% older than 65 years; *M* = 62.8 years, *SD* = 12.21; range = 38–86 years), female (77.8%), Caucasian (i.e., African American = 18.5%, Hispanic = 3.7%), married (72.2%), and had at least some college coursework (83.3%).

Subjective Sleep Measures

The present study selected two sleep variables a priori from the sleep diaries: (a) subjective total wake time (TWTs)—total unwanted awake time in bed; and (b) sleep quality rating (SQR), scaled from 1 (very poor) to 5 (excellent). It was theorized that TWT and SQR would be of greater relevance to caregivers as concerns about the PWD would disturb overall wake time and alterations to subjective TWT would affect SQR. TWTs and SQR were averaged over the seven days. Centered variables, which give the daily deviation from the participant's mean, were computed to examine day-to-day inconsistency (Kreft, de Leeuw, & Aiken, 1995; Singer, 1998).

Objective Sleep Measures

Objective total wake time (TWTo) was measured by actigraphy with the Actiwatch-L. The Actiwatch-L monitors ambient light exposure and gross motor activity and contains an omni-directional, piezoelectric accelerometer with a sensitivity of ≥0.01 g-force and a light sensor with a recording range of 0.1–150,000 Lux. Bedtime and time out of bed in the morning were based on sleep diary entries (Mini Mitter, 2001). TWTo represents the sum of all wake epochs within the sleep period. Similar to the sleep diaries, TWTo was averaged over the seven days and then centered variables were computed.

Affect Measure

Participants completed a shortened version of the PANAS (Watson et al., 1988) following completion of the sleep diary. The study's PANAS consisted of five items (i.e., excited, strong, alert, determined, active) measuring PA, and five items (i.e., distressed, scared, irritable, nervous, jittery) measure NA. Participants rated the degree to which each mood was experienced at that time using a 1 (*very slightly or not at all*) to 5 (*extremely*) Likert scale. Daily PA and NA scores were calculated by summing the scores of the five PA and five NA items, respectively.

Statistical Analysis

The current study used daily sleep (i.e., objective and subjective TWT, and subjective SQR) to predict PA and

NA, separately, applying a multilevel modeling (MLM) approach. MLM, or hierarchical linear modeling (Bryk & Raudenbush, 1992), is an extension of the general linear model, and does not require observations to be independent. Thus, MLM is very flexible and especially suited for daily data because of its autoregressive nature and hierarchical structure with daily observations nested within each participant (Singer, Davidson, Graham, & Davidson, 1998).

Utilizing MLM provided the opportunity to examine how well sleep predicted affect on a day-to-day level (level 1) and on average (level 2). All models were estimated using the Maximum Likelihood method. The ability of a model to predict affect better than a baseline (null) model was used as an index of Goodness of Fit. Improvements in predictability were determined by the proportional reduction of within- and between-person residual variances compared to this baseline model (Bryk & Raudenbush, 1992). The models were built in a series of five steps as follows: step 1: null model (no predictors); step 2: fixed and random effects of time (coded 0–6) were estimated; steps 3–5: effects of three sleep variables (TWTo, TWTs, SQR) were estimated.

Results

Sleep and Affect

Intraclass correlation coefficients served as an index of variability (Bryk & Raudenbush, 1992). For PA (M = 8.85, SD = 3.39), 33% of the overall variability was within-person and 67% was between-person. For NA (M = 3.24, SD = 2.56), 44% was within-person and 56% was between-person. Therefore, there was a significant amount of variability for both PA and NA in both level 1 and level 2 estimates which could be explained by the models.

For TWTs (M = 105.50, SD = 80.04), 59% of the overall variability was within-person and 41% was between-person. For TWTo (M = 46.31, SD = 30.84), 80% of the overall variability was within-person and 20% was between-person. For SQR (M = 3.03, SD = 0.95), 69% of the overall variability was within-person and 31% was between-person.

Sleep and PA

The level 2 (average) and level 1 (day-to-day) results suggested that TWTs, TWTo, and SQR were not significantly associated with PA. See Table 1 for the PA final model parameters.

Sleep and NA

The level 1 (day-to-day) results revealed significant effects of TWTs and SQR; on days when persons had above average TWTs or below average SQR, NA was higher. The level 2 effects (average) results suggested a significant association between average SQR and NA. Caregivers with higher SQR, on average, displayed lower NA, on average. In the final model, level 2 explained 21% of the between-person variation and level 1 explained 43% of the within person (daily) variation in NA.

Discussion

This preliminary study suggests that, for older caregivers of PWD, nights characterized by below average subjective total wake time and above average sleep quality were followed by days with lower NA, similar to previous findings. Greater overall sleep quality rating was associated with lower NA. However, older caregivers in the present study did not demonstrate a significant daily relationship between subjective sleep and PA, unlike noncaregivers in previous studies. Overall, subjective sleep predicted larger amounts of the variance both day-to-day and average NA of older caregivers than the previous study of older noncaregivers (McCrae et al., 2008). Collectively, the present results highlight the importance of studying inconsistency in subjective sleep to obtain better insight into the relationship between sleep perception and affect in caregivers.

The results of this study suggest that caregivers' subjective sleep inconsistency is an important predictor of their NA. Interventions focused on promoting stability in subjective nighttime awakenings may represent a more realistic and novel approach to treating sleep and mood difficulties in caregivers. A potential technique for improving caregiver subjective sleep inconsistency may be scheduled nightly awakenings, which could provide regularization of night-time awakenings for the caregiver between nights when PWD require nighttime care. Given the results of this study, modulating the subjective experience of nighttime awakenings may provide important benefit to caregivers' potential for NA, which in turn would improve their ability to provide care and perhaps prevent the PWD from being institutionalized.

Potential limitations of the current study deserve mention, including the lack of measurement of possible covariates in the sleep-affect relationship. Previous research has demonstrated that the prevalence of sleep difficulties and depression increases with age (Williams, Kay, Rowe, & McCrae, 2013). Our sample included middle aged adults to oldest older aged adults, and age differences may have played a role in the present results. However, when examined as a potential covariate, age was not significantly correlated with affect or sleep, and was therefore not included in the models. Our study did not collect data on perceived stress or caregiving burden and therefore, could not account for these variables in assessing the relationship between sleep and affect. As our sample was highly educated and predominantly Caucasian, a more ethnically or educationally diverse sample may reveal a different relationship between sleep and affect, as culture and ethnicity has been shown to modify the caregiving experience (Pinquart & Sorensen, 2005). As the extant literature on

Table 1. Sleep Variables Predicting Positive and Negative Affect

Predictor variable	Positive affect Fixed effects					Negative affect				
	B	*SE*	*df*	*t*	*p* Value	*B*	*SE*	*df*	*t*	*p* Value
Within-person										
Occasion	−0.03	0.01	221.70	−2.03	.04	−0.02	0.01	183.82	−1.70	.09
TWTo	−0.001	0.001	222.01	−0.62	.54	−0.001	0.002	11.30	−0.61	.55
TWTs	−0.001	0.001	21.99	−1.13	.27	0.001	0.001	13.96	2.34	.03
SQR	0.03	0.06	59.25	0.57	.57	−0.18	0.04	32.42	−4.39	.0001
Between-person										
TWTo	−0.0001	0.01	48.05	−0.02	.98	−0.004	0.003	49.03	−1.28	.21
TWTs	−0.002	0.002	46.04	−1.03	.31	0.002	0.001	45.92	1.52	.14
SQR	−0.29	0.19	45.14	−1.50	.14	−0.36	0.13	45.06	−2.85	.01

Random effects								
Covariance parameter	*B*	*SE*	*Z*	*p* Value	*B*	*SE*	*Z*	*p* Value
Within-person								
TWTo	—	—	—	—	0.00003	0.00003	0.90	.37
TWTs	0.00001	0.00001	1.22	.22	0.000001	0.000003	0.38	.70
SQR	0.06	0.02	2.59	.01	0.02	0.02	1.43	.15
		Within pseudo R^2		.22		Within pseudo R^2		.43
		Between pseudo R^2		.08		Between pseudo R^2		.21

Note. TWTs = subjective total wake time; TWTo = objective total wake time; SQR = sleep quality rating.

caregiving for PWD expands, research will likely focus on the unique effects of caregiving on sleep (e.g., physical and financial burden, role changes, perceived stress) and thus, increasingly include such variables.

Future research on the role of nightly sleep variation and affect is warranted based on these preliminary findings. Greater focus on the association between subjective sleep and affect in the context of potential covariates (i.e., age, physical health conditions, physical activity, stress) and group differences (i.e., noncaregivers vs. caregivers) is needed.

Conclusion

The present results highlight the need for greater focus on dynamic processes in sleep research and reinforce the importance of caregivers' perceptions of their sleep as it relates to their daytime functioning and caregiving quality. Irregularity is inherent in the nature of caregiving and it is likely that fluctuations in sleep and affect impact other aspects of caregiver health. Fortunately, affect and sleep can be improved with behavioral and other treatments. Our results suggest that subjective sleep inconsistency should be a potential target of further investigations in caregivers.

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Conflict of Interest

The authors have no conflicts of interest to disclose.

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