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Affect Variability and Sleep: Emotional Ups and Downs are Related to a Poorer Night's Rest

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Abstract

Objectives: Many studies have documented the strong associations between well-being and mean levels of both positive and negative affect. A growing number of studies are examining how fluctuations in daily reported emotional experience, known as affect variability, is related to health outcomes. Sleep is a critical correlate of healthy in functioning in late life. This study examines associations between positive and negative affect variability and facets of self-reported sleep behavior among older adults.

Methods: Participants ($N = 277$) completed a 5 to 6 day ecological momentary assessment. The first survey upon waking asked participants about their sleep the previous night, and participants rated their positive and negative affect every three subsequent hours during waking hours.

Results: Regression models indicate that greater variability in daily positive affect is associated with fewer hours of sleep ($b = -0.648$, $p = .04$) and greater morning tiredness ($b = 0.67$, $p = .006$) even after adjusting for mean levels of affect. Although greater negative affect variability is associated with worse sleep quality ($b = -0.77$, $p = .02$) and greater morning tiredness ($b = 0.91$, $p = .004$), these associations are no longer significant once mean negative affect is added into the model.

Conclusion: Findings support theory describing the downside in the variability of positive affect, and suggest that fluctuations in positive affect are related to poor sleep outcomes that have implications for overall health and well-being.

Keywords

Affect variability; Negative affect; Positive affect; Sleep

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Conflict of Interest Statement

All authors (Kate Leger, Susan Charles, and Karen Fingerman) declare that they have no competing interests.

Affect Variability and Sleep: Emotional Ups and Downs are Related to a Poorer Night's Rest Getting a good night's sleep is vital for health and well-being. Yet, many people get an insufficient amount of sleep or suffer from problems getting and staying asleep [1]. One factor closely linked to sleep is daily affective well-being, the positive and negative emotion experiences that occur throughout the day. Studies that have examined the relationship between affect and sleep have traditionally taken a static approach, where they define affective experiences in terms of overall levels. Higher levels of negative affect and lower levels of positive affect are commonly related to poorer sleep [2 – 4]. A growing number of studies, however, are focusing on the variability of this emotional experience and its relationship to well-being [5,6]. Shifts in levels of affective experience over time, known as affect variability, relate to both physical health, e.g., [7], and psychological well-being, e,g., [8] above and beyond their mean levels. These findings indicate that greater change from high levels to low levels of positive or negative affect and back again may be associated with poor physical and psychological functioning, independent of overall levels of these experiences.

Yet, no study to our knowledge has examined how affect variability is related to sleep [9]. This relationship may be particularly important in older adulthood, because healthy sleep habits in older adulthood may substantially increase the period of functional good health in late life [10]. The current study tests the relationship between affect variability and sleep behavior, including sleep duration, sleep quality, and morning tiredness in an ecological momentary assessment of older adults.

Affect Variability and Well-Being

Affect variability refers to positive and negative emotional experiences that vary and fluctuates over the course of day, week, or month [5]. Two people may be identical in their average level of negative affect but quite different in their variability, with one person fluctuating dramatically between high and low levels of affect and the other person staying consistently around their average level. Furthermore, variability in positive and negative affect are a relatively stable characteristic [11] that is partially heritable [12], meaning that one person can be characterized as generally having greater affect variability, and another person can be characterized as being less variable.

Affect that changes strongly or abruptly may be a sign of poor emotion regulation and be a signal for maladjustment and instability [13]. Research has shown that both negative and positive affect variability are linked to psychological well-being [5]. Greater daily fluctuations in negative affect are related to psychological distress [11], and a recent meta-analyses found strong links between greater negative affect variability and various indicators of psychopathology [14]. In addition to negative affect variability, greater positive affect variability is associated with lower life satisfaction, higher levels of anxiety and depression [8], and greater psychological distress [11]. Importantly, these studies also adjusted for mean levels of positive and negative affect, suggesting that the patterns of emotional fluctuations throughout the day are important for psychological well-being above and beyond how people feel in general.

Affect variability and physical health.

Fewer studies have examined links between affect variability and physical health, but similar patterns have begun to emerge as those described above. For example, one study found greater positive and negative affect variability was predictive of lower antibody levels after an influenza vaccine among a sample of undergraduate students [7]. Another study found that greater positive affect variability is associated with greater risks of chronic health conditions such as angina and depression [15]. Studies of older adults also suggest that affect variability is related to poorer health outcomes. One study, for example, found that higher positive affect variability both within days and across weeks was associated with more favorable cortisol profiles (i.e. lower overall levels and steeper diurnal slopes) in middle-age and older adults [16]. Another study found that greater dynamic fluctuations in positive affect, but not negative affect, in response to daily stressors predicted a higher risk for mortality among older adults [17]. Results from this emerging research has begun to illustrate the important links between affect variability and physical health, concluding that higher variability in patterns of emotional experience is associated with worse physical health.

Affect Variability and Sleep

Despite emerging evidence that affective variability is related to physical and mental health, no studies have examined the relationship between affect variability and sleep behavior. Although sleep may fluctuate from day to day based on daily experiences, people have general sleep patterns where some people typically sleep poorly, and others generally sleep well by getting an appropriate number of hours with good sleep quality [18]. Given the known detrimental effects of generally poor sleep on physical and psychological health, it is critical to understand factors that may influence the ability to get a good night's sleep. Researchers have examined affective responses to daily events and how these responses relate to sleep, finding that greater positive affect reactivity (i.e. greater decreases in positive affect in response to a stressful event) are associated with impaired sleep quality [19]. However, no studies to our knowledge have examined positive or negative affect variability and sleep.

The association between affect variability and sleep may be particularly important in older adulthood. Older adults engage in regulatory strategies that allow them to maintain high levels of positive affect [20], and sleep is a resource that aids in the ability to regulate emotions [21]. Inadequate sleep may increase vulnerability in older adults because it renders them unable to use optimal emotion regulation strategies in the face of negative events, thus leading to greater affect variability. Higher affect variability may also lead to poorer sleep in older adults through physiological dysregulation. Greater affect variability may be related to increased cognitive and somatic arousal, such as worry or muscle tension, which may also result in poorer sleep outcomes [22]. Increases in arousal may contribute to both shorter sleep duration and poorer sleep quality [23]. This may be particularly harmful for older adults, given that older age is accompanied by reduced physiological flexibility and prolonged recovery from negative events. In general, older adults experience low levels of negative affect variability compared to younger adults [24]. Despite generally low levels of

variability in negative affect, even low levels of variability are important in older adulthood. Variability in emotional and cognitive functioning is considered a behavioral indicator of cognitive and physical decline in later life [25]. Thus, even slightly higher levels of affect variability compared to their peers may constitute a vulnerability for people in an age group where declines are more common. Given the complex and close-tied links between affect and sleep in older adulthood, a better understanding of the relationship between affect variability and sleep is needed.

Current Study

The current student examines associations between affect variability and self-reported sleep across several days in a sample of older adults. This relationship may be of particular importance to assess in older adulthood, as healthy sleep habits in older adulthood are critical for functional health [10]. In this study, affect variability is operationalized as the within-person standard deviation (iSD), or variance of emotional states across time. The larger the within-person SD, the more extreme an individual's fluctuation in affect. This method is widely used across a number of studies and provides a concise measure of variability (the larger the standard deviation, the more variable a person's affect; e.g. [24]). Because sleep is a multidimensional construct, we examined three dimensions of sleep: hours of sleep, morning tiredness, and sleep quality. Hours of sleep reflects amount of sleep obtained and is the measure most commonly used in sleep-affect research [26]. Morning tiredness and sleep quality are holistic and subjective evaluations of how well a person slept and have been linked with health and well-being [27]. Based on previous findings that show a relationship between higher levels of both positive and negative affect variability and poorer health and well-being [5], we hypothesized that greater positive and negative affect variability would be associated with poorer sleep outcomes (e.g. hours of sleep, morning tiredness, and sleep quality) in older adults.

Method

Participants and Procedure

Participants were from the Daily Experiences and Well-being Study (DEWS). The study included 333 adults aged 65 and older who were recruited from the greater metropolitan area of Austin, Texas. The procedure included a baseline in-person interview that lasted between 90 and 120 minutes. The interview was followed by a 5 to 6 day ecological momentary assessment (EMA) where participants reported their daily experiences on a mobile device every 3 hours during waking hours at roughly the same time each day (for a full description, refer to [28]). The three-hour time interval was chosen to capture variability in people's experiences throughout the day while minimizing participant burden. This interval has been used in previous EMA studies with older adults [29]. The first survey upon waking (morning interview) asked participants about their sleep the previous night, followed by subsequent surveys asking about their mood over the past 3 hours. Respondents received $50 for completing the baseline survey and $100 for completing the EMA component. Of the 333 adults who completed the initial interview, 313 adults participated in the ecological momentary assessment portion of the study. Of these participants, 291 completed at least

one survey at the start of the day (necessary to assess previous night sleep) and 288 had at least two EMA surveys (necessary to compute affect variability). Participants completed an average of 20 within day surveys.

The mean age of this sample was 73.94. 56% of the participants were female. A total of 93% of the participants reported having a high school degree or higher, and 57% reported having a bachelor's degree or higher. Of note, participants in this study were slightly more highly educated than the general population of Austin, which has a high education level in general. DEWS oversampled participants in neighborhoods with high-density under-represented populations; as such, 33% of the participants self-identified as ethnic or racial minorities (e.g., African Americans, Hispanic or Latinos).

Measures

Sleep.—Each morning, participants completed three items to assess prior night's sleep.

Hours of sleep.: Participants rated the number of hours of sleep they had gotten the previous night. This item was adapted from the Pittsburgh Sleep Quality Index by taking the original item (an open ended response) and adapting it to include a six category response [30]. The PSQI has excellent validity and reliability [31]. Scores ranged from 1 (fewer than 5 hours), 2 (5 to 6 hours), 3 (6 to 7 hours), 4 (7 to 8 hours) 5 (8 to 9 hours), 6 (more than 9 hours). Scores were averaged across each day to create one overall mean score for each participant.

Morning tiredness.: Participants also reported how tired they felt each morning. This item was adapted from the Daily Pittsburgh Sleep Diary by taking the original item (rated on a sliding scale that was coded from 0 to 100) and adapting it to include a five category response [32]. The Daily Pittsburgh Sleep Diary has been well validated [33]. Scores ranged from 1 (not at all) to 5 (a great deal). Scores were averaged across each day to create one overall mean score for each participant.

Sleep quality.: Participants reported their previous night's sleep quality on a scale from 1 (poor) to 5 (excellent). Scores were averaged across each day to create an overall mean score for each participant. This item was adapted from the Consensus Sleep Diary by taking the original item (a five category response from 1 (very poor) to 5 (very good)) and adapting it to 1 (poor) to 5 (excellent) [34]. The Consensus Sleep Diary has excellent reliability and validity [34].

Positive and negative affect.—Every 3 hours throughout the day, participants rated the extent to which they experienced five negative affect items: nervous/worried, irritated, bored, lonely, and sad and four positive affect items: proud, content, loved, and calm. Items were adapted from measures by Watson et al., [35] and Shaver et al., [36]. Original items from these scales included a 4-point rating scale ranging from 1 (I definitely would not call this an emotion) to 4 (I definitely would call this an emotion). The adapted items were rated on a 5-category scale (1= not at all to 5= a great deal). Items for both negative affect (NA) and positive affect (PA) were summed and averaged to create one NA and one PA score for each time point. Cronbach alphas were .72 for NA and .69 for PA.

Affect mean and variability.—To calculate overall mean affect, NA scores across each time point were averaged so that each person received one overall mean NA score. The procedure was repeated for PA scores. To calculate negative affect variability, a standard deviation was calculated for NA scores across all time points so that each person received one standard deviation score to reflect affect variability. The procedure was repeated for PA scores.

Covariates.—All models included demographic factors that were collected in the baseline interview and included: age, gender (0 = female, 1= male); years of education (1 = no formal education, 2 = elementary school, 3 = some high school, 4 = high school, 5 = some college, 6 = college graduate, 7 = post college education, 8 = advanced degree); marital status (0 = never married, divorced, or separated, 1 = married or cohabitating); and race (0 = racial minority, 1 = non-Hispanic White). We also included the average number of stressors that participants experienced over the EMA assessment. To assess stressors, at the end of each day, participants reported whether they had 1) a social interaction that made them feel irritated, hurt or annoyed, 2) thought about a relationship problem or worry about someone, and 3) anything else happen that they would consider stressful (1 = yes, 0 = no). Items were summed and averaged across all days to give one score of average stress. Finally, participants were asked whether they had ever been diagnosed with any of the following health problems: 1) high blood pressure or hypertension, 2) diabetes or high blood sugar, 3) cancer or tumor, 4) chronic lung disease, 5) heart problems, 6) stroke, 7) arthritis or rheumatism, and 8) osteoporosis (0 = did not have this problem, 1 = has this problem). Items were summed to indicate the total number of health conditions each participant had.

Analytic Strategy

We used OLS regression models to analyze associations between affect variability and sleep behavior. Dependent variables were hours of sleep, sleep quality, and morning tiredness. First, each dependent variable was regressed on NA variability and relevant covariates. These covariates included age, gender, education, race, marital status, average stress, and chronic conditions. Then, mean NA was added to each model to assess the relationship between NA variability and each sleep variable above and beyond mean levels of NA. These analyses were then repeated for PA.

Results

Descriptive Statistics

Of the 288 participants with sufficient EMA data, 11 people were missing data on the "stressor" covariate (asked at the end of the day). The final sample consisted of 277 people with data for all variables of interest. Over the six day period, people reported higher mean levels of PA ($M = 3.45$) than NA ($M = 1.23$) ($t(276) = 41.95$, $p<.001$), where reports of negative affect were generally quite low. Given the low ratings of negative affect, people also experienced greater PA variability ($M = 0.37$) than NA variability ($M = 0.20$) ($t(276) = 16.02$, $p < .001$). Mean NA and mean PA were negatively correlated, indicating that people with higher mean NA tended to report lower overall mean PA ($r = -0.36$, $p < .001$). In contrast, NA variability and PA variability were positively correlated ($r = 0.44$, $p < .001$),

such that people who fluctuated more in positive affect also fluctuated more in negative affect. Additionally, mean NA was positively correlated with NA variability (r =0.72, p <.001) and PA variability (r = 0.25, p<.001), meaning that participants who generally experienced more negative affect were also more variable. Mean PA was negatively correlated with NA variability (r = −0.25, p <.001) and PA variability (r = −0.17, p =.01), meaning more positive participants typically were less variable. Correlations and descriptive statistics of all variables of interest are shown in Table 1.

Affect Variability and Sleep

Hours of sleep.—In regression models examining negative affect variability and hours of sleep, higher NA variability was not associated with fewer hours of sleep (b = −0.64, p = .09) (Table 3, Model 1). After adding mean NA into the model, higher NA variability was still not significant (Model 2). For PA, higher PA variability was not significantly associated with fewer hours of sleep (b = −0.57, p =.08) when not adjusting for mean PA (Table 3, Model 1). After adding mean PA into the model, higher PA variability was significantly associated with fewer hours of sleep (b =−0.65, p =.04; Table 3, Model 2).

Morning tiredness.—Similar to patterns found between affect variability and hours of sleep, higher NA variability was significantly associated with greater morning tiredness (b = 0.91, p =.004) in a model not adjusting for mean NA (Table 4, Model 1). After including mean NA to the model, NA variability was no longer significant (Model 2). Higher PA variability was significantly associated with greater morning tiredness both without and with the inclusion mean levels of PA in the model (Table 5, Models 1 and 2). Of note, including hours of sleep as an additional covariate did not change the pattern of significant findings in these models.

Sleep quality.—Higher negative affect variability was associated with worse sleep quality (b = −0.77, p = .018) when not adjusting for mean NA (Table 6, Model 1), but no longer so when mean NA was included (Model 2). Unlike associations with hours of sleep, PA variability was not associated with sleep quality in models either with or without adjusting for mean PA (Table 7, Models 1 and 2).

Follow-up Tests

The prior analyses examined questions related to more stable characteristics; people who have greater affect variability in general also have poorer sleep in general. We conducted models to examine the directionality of these effects and tested for lagged associations (i.e., whether quality or hours of sleep predicted next day's affect variability, and vice versa). We estimated three multilevel models treating the three nightly sleep ratings as the outcomes, predicted by prior day's positive and negative affect variability. Multi-level models examined the data nested as days (level 1) within people (level 2). For affect variability predicting next night sleep, daily affect variability and mean affect were centered around a person's mean and entered in as level 1 predictors of sleep variables. Because morning reports of sleep captured sleep the previous night, morning reports were lagged minus one day. These models did not show significant daily associations, perhaps because within-person variability in sleep is lower than between-person variability.

We also examined whether poorer sleep in a given night predicted greater affect variability the following day, with sleep quality, hours of sleep, and morning tiredness each centered around a person's mean and entered as level 1 predictors of affect variability. Results of these models indicated no clear relationship between daily affect variability and daily sleep, perhaps again due to lower within-person variance for sleep in the models. See supplementary tables 1 and 2 for results.

Discussion

The current findings indicate that positive affect variability in general had a significant and meaningful association with sleep in older adults. Consistent with previous work showing that higher affect variability is detrimental for physical and psychological well-being, e.g., [7, 8], greater affect variability was related to poorer sleep. Specifically, greater positive affect variability was associated with sleeping fewer hours and waking up feeling tired, even after adjusting for mean levels of affect. Although greater negative affect variability was associated with worse sleep quality and greater morning tiredness, this relationship did not hold once mean negative affect was added into the model.

These findings join a growing body of literature that show that positive affect variability in particular has important implications for health and well-being [5]. High levels of mean positive affect were generally associated with better sleep, whereas variability in positive affect was associated with worse sleep. This study reinforces current theory that higher positive emotion is adaptive if it is stable over time, but not if it is highly variable [6]. Researchers have coined the term "fragile positive affect" to describe positive affect variability, and they hypothesize that this variability may be a sign of maladaptive functioning and the inability to regulate emotions in older adulthood [17]. Relative to stable positive affect, fragile positive affect may be harmful because it involves extreme highs and lows which have been shown to relate to higher levels of psychological distress [8]. Variability in positive affect may be particularly harmful for older adults, as research has shown that variability in other life domains (i.e. cognitive functioning) predicts declines in cognition, physical health, and mortality. Variability in affect may therefore be an indicator of vulnerability and declines in older adulthood.

Interestingly, we did not find a relationship between affect variability and sleep quality (as opposed to hours of sleep and morning tiredness), indicating that affect variability may not be harmful for all facets of sleep. The reason for this contrast is unknown; perhaps feelings of tiredness refers to feelings of fatigue or feelings of restfulness. These feelings, in turn, may be relate to malaise, or other emotions that would be associated with low positive affect. In older adults, fatigue reflects many psychosocial factors [37]. In addition, sleep quality refers to aspects of sleep such as waking or getting up in the night, and may be more related to other physiological reasons for poor sleep, such as restless leg syndrome, nocturia or other problems associated with sleep disturbances that are common in old age [38].

Given the cross-sectional nature of the findings, the causal direction is unknown. One possibility is that affect variability may influence subsequent sleep. Greater variability in emotion, in particular positive emotion, is associated with increased physiological and

cognitive arousal [22]. These increases in arousal may in turn lead to poor sleep. This may be particularly harmful for older adults, given that older age is accompanied by reduced physiological flexibility. Additionally, affect variability may be an indication of poor affect regulation. Difficulties in regulating positive emotions have been shown to contribute to disturbances in sleep onset latency, and greater fluctuations in positive affect may confer vulnerability to poor sleep [39]. Another possibility is that poor sleep may also impact affect variability. Inadequate sleep may increase vulnerability in older adults that renders them unable to use their emotion regulation strategies in the face of negative events, thus leading to greater affect variability. Thus, poor sleep may promote increased affect variability through an inability to control emotion in response to daily experiences.

In contrast to positive affect, greater variability in negative affect was associated with fewer hours of sleep, greater morning tiredness, and worse sleep quality, only when mean levels were not considered. After adjusting for mean levels of negative affect, the associations between negative affect variability and sleep disappear. These findings are consistent with results from previous studies demonstrating that positive affect variability, but not negative affect variability, is associated with health and well-being independently of mean levels of affect [7]. Potential reasons for these findings could be that mean levels of negative affect and negative affect variability were highly correlated, so any relationship between high negative affect variability and poor sleep is being driven by mean levels of negative affect. Alternatively, it could be that there was not enough variability in negative affect to detect associations with sleep. Older adults experience lower levels of mean negative affect and affect variability than younger adults [24]. A relationship may exist between negative affect variability and sleep in a younger population who experience greater amounts of variability in negative affect.

Limitations and future directions.

The contributions of the study must be qualified by its limitations. First, the sample consisted of a cross-sectional analysis of (relatively) healthy older adults which prevents drawing causal claims about the observed associations between affect variability and sleep. Previously documented birdirectional relations between sleep and affect suggest that affect variability may very well be both a cause and consequence of poor sleep behavior. This study provides an important step in understanding the association between affect variability and sleep, and now further research is needed to disentangle the temporal nature of this relationship.

Second, due to the fact that participants were part of a large EMA study that assessed aspects of cognitive, social, and physical health and well-being in daily experiences, questions were limited to ease participant burden. In particular, questions about sleep habits were adapted from well-validated scales but have not yet been validated themselves. Additionally, other factors that are known to influence sleep such as medications, presence of a sleep disorder, and caffeine consumption were not assessed in this study and thus we were unable to examine them. Future work should further examine these factors and other that may account for the relationship between sleep and affect variability.

Third, these findings relied on self-reports of both affect and sleep. Although self-reports of sleep correspond with more objective sleep measurements methods including actigraphy [40], people's perceptions of their own sleep are subject to report bias. Future work should extend these findings to incorporate multiple methods, both subjective and objective, to assess quality and quantity of sleep. Finally, older adults often show significantly lower levels of variability for both positive and negative affect compared to younger adults, e.g., [24]. This low daily variability may have reduced the ability to study daily fluctuations across five to six days in this older sample. In particular, several negative affect items (e.g. nervous, irritated) in this study were also indicators of arousal. As these affects are less often experienced by older adults, this could help explain the low levels of negative affect variability found in the study. As such, these findings may be particular to older adults, and need to be examined in younger samples.

In sum, this study joins a growing body of literature that emphasizes the importance of examining the effects of affect variability on health and well-being and extends current research by assessing the relationship between affect variability and sleep, a previously unexplored but important contributor to health and well-being. These results point to the importance of affect variability, and in particular positive affect variability, as having important and unique associations with sleep that extend beyond mean levels of affect. This study underscores the importance of assessing associations between affect variability and daily health behaviors that have implications for both physical and psychological well-being.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- The study examined associations between positive and negative affect variability and sleep
- Greater variability in daily positive affect is associated with getting fewer hours of sleep and greater morning tiredness even after adjusting for mean levels of affect
- Greater negative affect variability is associated with sleep, but these associations were no longer significant once adjusting for mean negative affect
- Findings highlight the downside of variability, or fragility, of positive affect.

Table 1

Descriptive Statistics Among Main Variables of Interest

	M	SD	Range	1	2	3	4	5	6	7
1. NA Mean	1.23	0.30	1.00 – 2.73	-						
2. PA Mean	3.45	0.73	1.00 – 5.00	-0.36***	-					
3. NA Variability	0.20	0.16	0.00 – 0.85	0.72***	−0.30***	-				
4. PA Variability	0.37	0.18	0.00 – 1.09	0.25***	−0.17**	0.44***	-			
5. Hours of Sleep	3.30	0.92	1.20 – 5.40	−0.07	−0.08	−0.12*	−0.14*	-		
6. Morning Tiredness	2.05	0.73	1.00 – 4.50	0.32***	−0.21***	0.28***	−0.24***	−0.19**	-	
7. Sleep Quality	3.09	0.74	1.33 – 5.00	−0.23***	0.21***	−0.20**	−0.14*	0.42***	−0.42***	-

* p<.05

** p<.01

*** p<.001

Note. PA = positive affect, NA = negative affect. PA and NA variability were calculated by taking the standard deviation for all NA scores (and PA scores, respectively) across all time points for each person so that each person received one standard deviation score to reflect affect variability.

Table 2

OLS regression models with negative affect variability and hours of sleep

Variable	Model 1 NA Variability			Model 2 NA Variability + Mean NA		
	b	SE	95% CI	b	SE	95% CI
Intercept	2.63***	0.72	1.22, 4.04	2.49**	0.76	1.01, 3.98
NA Mean	--	--	--	0.15	0.26	−0.36, 0.67
NA Variability	−0.64†	−0.37	−1.37, 0.10	−0.85	0.52	−1.88, 0.18
Gender (ref=female)	−0.10	0.12	−0.35, 0.14	−0.11	0.13	−0.35, 0.14
Age	0.01	0.01	−0.01, 0.02	0.01	0.01	−0.01, 0.02
Education	0.03	0.04	−0.05, 0.10	0.03	0.04	−0.05, 0.10
Race (ref = non-white)	0.25	0.15	−0.05, 0.54	0.25†	0.15	−0.05, 0.55
Marital Status (ref = never married)	0.28*	0.13	0.03, 0.53	0.27*	0.13	0.02, 0.52
Number of stressors	0.00	0.27	−0.53, 0.54	−0.01	0.27	−0.54, 0.55
Chronic Conditions	−0.02	0.04	−0.10, 0.07	−0.02	0.04	−0.10, 0.07

Note. NA = negative affect.

† p<.10

* p<.05

** p<.01

*** p<.001

Table 3

OLS regression models with positive affect variability and hours of sleep

Variable	Model 1 PA Variability			Model 2 PA Variability + Mean PA		
	b	SE	95% CI	b	SE	95% CI
Intercept	2.75***	0.73	1.32, 4.18	3.43***	0.80	1.86, 5.01
PA Mean	--	--	--	−0.15*	0.08	−0.31, −0.00
PA Variability	−0.57†	0.32	−1.20, 006	−0.65*	0.32	−1.28, −0.02
Gender (ref=female)	−0.18	0.13	−0.36, 0.13	−0.14	0.13	−0.38, 0.11
Age	0.01	0.01	−0.01, 0.02	0.01	0.01	−0.01, 0.02
Education	0.02	0.04	−0.06, 0.10	0.02	0.04	−0.06, 0.09
Race (ref = non-white)	0.23	0.15	−0.07, 0.53	0.21	0.02	−0.08, 0.51
Marital Status (ref = never married)	0.26*	0.13	0.01, 0.52	0.29*	0.13	0.04, 0.55
Number of stressors	−0.03	0.10	−0.22, 0.17	−0.05	0.10	−0.25, 0.14
Chronic Conditions	−0.02	0.04	−0.10, 0.06	−0.03	0.04	−0.11, 0.05

Note. PA = positive affect.

† p<.10

* p<.05

** p<.01

*** p<.001

Table 4

OLS regression models with negative affect variability and morning tiredness

Variable	Model 1 NA Variability			Model 2 NA Variability + Mean NA		
	b	SE	95% CI	b	SE	95% CI
Intercept	1.70**	0.54	0.66, 2.74	1.11*	0.56	0.01, 2.21
NA Mean	--	--	--	0.65**	0.20	0.26, 1.04
NA Variability	0.91**	0.31	0.00, 1.52	0.11	0.39	−0.66, 0.88
Gender (ref=female)	−0.18	0.09	−0.36, 0.01	−0.20*	0.09	−0.39, −0.02
Age	−0.01	0.01	−0.02 0.01	−0.01	0.01	−0.02, 0.01
Education	0.04	0.03	−0.02, 0.09	0.05	0.03	−0.01, 0.10
Race (ref = non-white)	0.08	0.11	−0.14, 0.31	0.12	0.11	−0.11, 0.34
Marital Status (ref = never married)	−0.04	0.10	−0.23, 0.15	−0.05	0.09	−0.23, 0.14
Number of stressors	0.14†	0.08	−0.03, 0.31	0.07	0.09	−0.09, 0.24
Chronic Conditions	0.11***	0.03	0.05, 0.17	0.11***	0.031	0.05, 0.17

Note. PA = positive affect.

† p<.10

* p<.05

** p<.01

*** p<.001

Table 5

OLS regression models with positive affect variability and morning tiredness

Variable	Model 1 PA Variability			Model 2 PA Variability + Mean PA		
	b	SE	95% CI	b	SE	95% CI
Intercept	1.52**	0.55	0.44, 2.59	2.15***	0.60	0.97, 3.33
PA Mean	--	--	--	−0.14*	0.06	−0.25, −0.03
PA Variability	0.74**	0.24	0.27, 1.22	0.67**	0.24	0.19, 1.14
Gender (ref=female)	−0.15	0.09	−0.34, 0.03	−0.17†	0.09	−0.35, 0.01
Age	−0.01	0.01	−0.02, 0.01	−0.01	0.01	−0.02, 0.01
Education	0.04	0.03	−0.01, 0.10	0.04	0.03	−0.01, 0.10
Race (ref = non-white)	0.11	0.11	−0.12 0.33	0.09	0.11	.13, 0.31
Marital Status (ref = never married)	−0.03	0.10	−0.22, 0.16	0.00	0.10	−0.19, 0.19
Number of stressors	0.21**	0.07	0.06, 0.36	0.12*	0.07	0.04, 0.33
Chronic Conditions	0.12***	0.03	0.06, 0.18	0.12***	0.03	0.05, 0.17

Note. PA = positive affect.

† p<.10

* p<.05

** p<.01

*** p<.001

Table 6

OLS regression models with negative affect variability and sleep quality

Variable	Model 1 NA Variability			Model 2 NA Variability + Mean NA		
	b	SE	95% CI	b	SE	95% CI
Intercept	3.75***	0.56	2.63, 4.86	4.13***	0.59	2.96, 5.29
NA Mean	--	--	--	−0.44*	0.21	−0.85, −0.02
NA Variability	−0.77*	0.32	−1.41, −0.13	−0.23	0.41	−1.04, 0.58
Gender (ref=female)	−0.08	0.10	−0.27, 0.11	−0.06	0.10	−0.26, 0.13
Age	−0.01	0.01	−0.02, 0.01	0.00	0.01	−0.02, 0.01
Education	−0.01	0.03	−0.07, 0.05	−0.02	0.03	−0.07, 0.04
Race (ref = non-white)	0.08	0.12	−0.15, 0.32	0.06	0.12	−0.17, 0.30
Marital Status (ref = never married)	0.21*	0.10	0.01, 0.40	0.21*	0.10	0.01, 0.40
Number of stressors	−0.05	0.09	−0.22, 0.13	0.00	0.09	−0.18, 0.17
Chronic Conditions	−0.09**	0.03	−0.15, −0.02	−0.09**	0.03	−0.15, −0.03

Note. NA = negative affect.

† p<.10

* p<.05

** p<.01

*** p<.001

Table 7

OLS regression models with positive affect variability and sleep quality

Variable	Model 1 PA Variability			Model 2 PA Variability + Mean PA		
	b	SE	95% CI	b	SE	95% CI
Intercept	3.77***	0.58	2.64, 4.90	3.06***	0.63	1.82, 4.30
PA Mean	--	--	--	0.16**	0.06	0.04, 0.28
PA Variability	−0.38	0.25	−0.88, 0.12	−0.29	0.25	−0.79, 0.21
Gender (ref=female)	−0.10	0.10	−0.29, 0.09	−0.08	0.10	−0.27, 0.11
Age	0.00	0.01	−0.02, 0.01	0.00	0.01	−0.02, 0.01
Education	−0.01	0.03	−0.07, 0.05	−0.01	0.03	−0.06, 0.05
Race (ref = non-white)	0.07	0.12	−0.16, 0.31	0.09	0.12	−0.15, 0.32
Marital Status (ref = never married)	0.21*	0.10	0.01, 0.41	0.18†	0.10	−0.02, 0.38
Number of stressors	0.12	0.08	0.28, 0.03	0.10	0.08	0.25, 0.05
Chronic Conditions	0.10**	0.03	0.16, 0.03	0.09**	0.03	0.15, 0.03

Note. PA = positive affect.

† p<.10

* p<.05

** p<.01

*** p<.001