The Relationship between Stress and Sleep: A Cross-Lagged Panel Analysis

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Sleep is essential for both mental and physical wellbeing, particularly at young adulthood and adolescence. Poor sleep has been linked to several health issues, including inflammation and risk of mortality. For example, Park et al. (2016) revealed that those adolescents who had more variability night to night in sleep duration possessed elevated levels of C-reactive protein levels, an essential biomarker of systemic inflammation that is indicative of long-term risk of cardiovascular complications. Then Hublin et al. (2007) revealed a U-shaped relationship between sleep duration and risk of mortality among adults where both short (<7 hours) and long (>8 hours) sleep durations predicted elevated risk of death at 22-year check in periods. Overall this shows the significance of investigating determinants of sleep patterns and the possible effect they have on health throughout the life course.

According to Cohen's (2016) stage model of stress and disease, stress indirectly damages health by affecting health behaviors such as sleep. Appraised stress induces emotional and cognitive reactions that also destabilize regulating systems such as sleep, diet, and exercise. According to Lund et al. (2010), within a fairly large sample of university students, stress and emotional distress best predicted poor sleep, accounting for 24% of variance in Pittsburgh Sleep Quality Index (PSQI) scores. Further, Du et al. (2018) identified that stress predicted increases in negative emotion including anxiety, depression, etc, through rumination, potentially impairing sleep initiation and sleep quality. Overall, both acute and chronic stress impair sleep quality, although different pathways may be involved differentially across people.

Although there were high correlations between sleep and stress, most of the evidence is cross-sectional, so it isn’t entirely sure if stress is causing sleep disruption or vice versa. We attempted to address this limitation by measuring stress and sleep at two time points and

employing cross-lagged panel analysis of direction. Participants were 249 undergraduate students who at baseline and at two months filled out the Perceived Stress Scale and the Pittsburgh Sleep Quality Index. We hypothesised that Time 1 higher stress would predict Time 2 poorer sleep, controlling for Time 1 sleep, as predicted by theoretical models and existing research. Although it is also possible that poorer Time 1 sleep might predict higher Time 2 stress, but we predicted that the stress-to-sleep relationship to be the more significant relationship.

Method

Participants

Participants included 249 undergraduate students. The sample included 106 females (42.6%), 140 males (56.2%), and 3 who identified as non-binary (1.2%). Participants' mean age was 20.68 years (SD = 1.5). The racial/ethnic distribution was 87 White or European Americans (34.9%), 45 Black or African Americans (18.1%), 46 Asian or Asian Americans (18.5%), 32 Hispanic/Latino/a Americans (12.9%), and 39 who identified as other, did not wish to report, or reported multiple races (15.7%).

Procedure

Participants also filled out a series of self-report questionnaires at two points in time, two months between points. At both points in time, participants provided self-report assessments of stress and sleep quality. Information was collected over the internet through the course website, with responses at the participants' preference.

Measures

Table 1 provides descriptive statistics and Cronbach’s alpha for all measures.

Perceived Stress

We assessed stress with the 10-item Perceived Stress Scale (Cohen, Kamarck, &

Mermelstein, 1983), a standardized measure that assesses to what degree people find things stressful. Participants answered items on the 5-point scale of 0 (never) to 4 (very often). The greater the average rating, the greater the level of stress. At Time 1, Cronbach's alpha was .94. At Time 2, it was .93.

Sleep Quality

Sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), a subjectively rated, seven-item measure that assesses sleep quality across seven domains of latency, duration, and disturbances. Items were summed so higher scores reflect poorer sleep quality. Cronbach's alpha for the PSQI was .96 at Time 1 and .97 at Time 2.

Analytical Approach

To investigate bidirectional relations between sleep quality and perceived stress, we conducted cross-lagged panel analysis on Time 1 and Time 2 assessments of perceived stress (PSS) and sleep quality (PSQI). We included both the stability paths (PSS T1 to PSS T2) and the cross-lagged paths (PSS T1 to PSQI T2) while adjusting for the initial level of the variable.

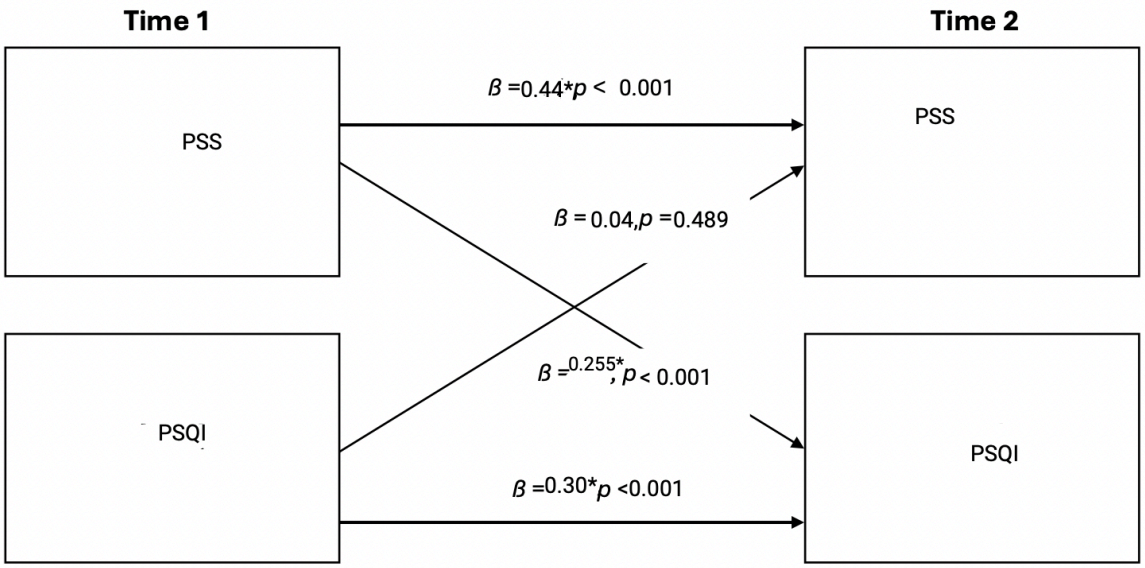
Results

Table 1 presents simple correlations among study variables

Cross-lagged panel analysis was used to assess the bidirectional relationship between perceived stress (PSS) and sleep quality (PSQI) at two time points. Perceived stress at Time 1 significantly predicted worse Time 2 sleep quality, $\beta = .255$, $p < .001$, controlling for baseline PSQI. Sleep quality at Time 1 did not significantly predict stress at Time 2, $\beta = .04$, $p = .489$. Stability paths were significant for both PSS ($\beta = .44$, $p < .001$) and PSQI ($\beta = .30$, $p < .01$) and indicated stability of these assessments over time.

Figure 1

Cross-lagged panel examining the bidirectional association between PSS *and* PSQI



Note. *p < .05. Standardized regression coefficients and p-values displayed.

Table 1

Descriptive statistics and bivariate correlation among study variables (N = 249)

	Mean (Standard Deviation)	Cronbach's alpha	1	2	3	4
1. PSS at T1	1.22(0.66)	0.94				
2. PSS at T2	1.25(0.54)	0.93	0.45*			
3. PSQI at T1	2.34(0.65)	0.96	-0.16*	-0.03		
4.PSQI at T2	2.11(0.52)	0.97	-0.30*	-0.43*	0.30*	-

Note. *p < .05. Higher values in pss and psqi indicated pss and psqi respectively.

PSS = Perceived Stress Scale; PSQI = Pittsburgh Sleep Quality Index. Higher scores indicate greater stress and poorer sleep

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