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Sleep quality, psychological symptoms, and psychotic-like experiences

Arielle Ered, Shanna Cooper, Lauren M. Ellman*

Department of Psychology, Temple University, Philadelphia, PA, USA

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ABSTRACT

Poor sleep quality has been repeatedly linked to the entire psychosis continuum, including psychotic-like experiences (PLEs); however, sleep dysfunction is a component of several other psychopathologies that have also been linked to increased risk for PLEs, including depression, anxiety, and post-traumatic stress disorder (PTSD). It has yet to be examined if PLEs are a significant risk factor for poor sleep quality or if this sleep dysfunction is better accounted for by comorbid psychopathology. In 2687 undergraduates, PLEs were evaluated using the positive items of the Prodromal Questionnaire. Symptoms of anxiety, depression, and PTSD were also assessed, as was sleep quality. Mediation analysis using PROCESS was conducted to determine if poor sleep quality associated with PLEs was in fact more associated with symptoms of other psychopathologies. Symptoms of depression and PTSD mediated the relationship between PLEs and sleep quality, though anxiety symptoms did not. These findings suggest that treating symptoms of depression and PTSD may improve multiple domains of psychotic illness.

1. Sleep quality, psychological symptoms, and psychotic-like experiences

Poor sleep quality has been repeatedly linked to the entire psychosis continuum: in individuals with schizophrenia (Cohrs, 2008), in those at clinical high risk for developing psychotic disorders (Lunsford-Avery et al., 2013), and in individuals experiencing psychotic-like experiences (PLEs; subthreshold, attenuated versions of psychotic symptoms; Andorko et al., 2017; Lee et al., 2012; Oh et al., 2016). Sleep disturbances occur in 30–80% of people with schizophrenia, have been strongly associated with increases in both positive and negative symptom severity (Cohrs, 2008), and often precede relapse of psychotic episodes (Benson, 2008). People with schizophrenia demonstrate impairments in quality, continuity, efficacy, and duration of sleep, above and beyond the effects of medications (Chouinard et al., 2004). Individuals diagnosed with schizophrenia report trouble falling asleep, early awakening, and display decreased slow-wave sleep, which is considered the most restorative stage of sleep (Hofstetter et al., 2005), and often spend more time in bed attempting to sleep than non-psychiatric controls (Royuela et al., 2002). These sleep disruptions are associated with significant distress and decreases in quality of life across phases of the disorder (Hofstetter et al., 2005; Lunsford-Avery et al., 2013). Additionally, disturbances in sleep patterns precede the onset of psychotic disorders, with individuals at clinical high risk for developing psychosis showing increased latency of onset of sleep and greater difficulty staying asleep when compared to their peers (Lunsford-Avery et al., 2013). In a recent study, PLEs were significantly associated with fragmented sleep, increased night anxiety, and presence of sleep hallucinations, and initial insomnia was predicted by distress associated with PLEs (Andorko et al., 2017).

Although sleep dysfunction has been associated with the course of psychosis, it is also present in and contributes to diagnostic criteria for numerous disorders, including generalized anxiety disorder (GAD), depressive disorders such as major depression, and trauma-related disorders such as post-traumatic stress disorder (PTSD; APA, 2013). Many individuals who exhibit symptoms along the psychosis continuum experience comorbidities such as an anxiety disorder and/or a depressive disorder and are more likely to have experienced traumatic life events in childhood (Addington and Heinssen, 2012; APA, 2013). A study using National Comorbidity Survey Replication data (Oh et al., 2016) explored the relation between psychotic experiences and sleep quality while controlling for comorbid diagnoses. They found that in a large sample of adults in the United States only two types of sleep disruption were still significant for predicting psychotic experiences when controlling for comorbid diagnoses: difficulty falling asleep and early morning awakenings (Oh et al., 2016). However, by looking only at comorbid diagnoses the authors were unable to examine subclinical symptoms of anxiety, depression, and/or PTSD, which have all been previously found to be significantly higher not only in individuals experiencing psychotic symptoms but also in those with PLEs (Gibson et al., 2014; Reeves et al., 2014). Examining subthreshold symptoms of psychopathology along with symptoms at a clinically significant level

* Corresponding author. 1701 N. 13th St., Philadelphia, PA 19122, USA.
E-mail address: ellman@temple.edu (L.M. Ellman).

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allows for a better understanding of the influence of other psychopathologies on the relationship between sleep quality and PLEs. Similarly, PLEs and clinical psychosis have highly overlapping risk factors (Van Os and Linscott, 2012), and examining subthreshold PLEs, rather than full psychotic symptoms, allows for investigation of psychotic processes in larger, non-help-seeking samples, and serves to disentangle psychosis-risk factors from disease or medication-related processes later in the course of the disorder.

In order to more fully understand the relation between PLEs and other psychopathological symptoms on sleep quality, it is important to examine a range of symptoms of anxiety, depression, and PTSD, rather than solely examine clinically diagnosed forms of these disorders, as well as the mediating effects of each of these constructs. This study examined the indirect effects of anxiety, depression, and PTSD symptoms on the relation between PLEs and sleep quality in order to determine whether poor sleep quality is related primarily to PLEs, or if a greater degree of the variance is accounted for by the presence of commonly co-morbid symptoms of other psychopathologies (anxiety, depression, and PTSD symptoms). We hypothesized that symptoms of other psychopathologies— anxiety, depression, and PTSD—would mediate the relationship between PLEs and sleep quality.

2. Material and methods

2.1. Participants

Participants consisted of 2687 undergraduate students at Temple University who were recruited from an online subject pool as a requirement from various interdisciplinary courses (see Table 1 for demographic characteristics). Questionnaires were completed at a computer terminal in the laboratory, with lab staff available to provide instruction and answer questions. The study was approved by the university's Institutional Review Board and all participants provided written informed consent.

2.2. Instruments

PLEs were evaluated using the positive-item subscale (45 items) of the full length, 92-item **Prodromal Questionnaire (PQ**; Loewy et al., 2007). Individuals were asked whether they have experienced symptoms (while not under the influence of drugs, alcohol, or medications) within the last month. The variable of interest was the total number of positive items endorsed. The PQ has been validated against the Structured Interview for Psychosis-Risk Syndromes (SIPS) in predicting psychosis risk syndromes with 90% sensitivity and 49% specificity (Loewy et al., 2005; Loewy et al., 2007).

Quality of sleep was assessed using the **Pittsburgh Sleep Quality Index** (PSQI; Buysse et al., 1989). This 19-item scale assesses sleep quality over the past month, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. This scale has demonstrated 89.6% sensitivity and 86.5% specificity at distinguishing between “good” and “poor” sleepers (Buysse et al., 1989) and has shown convergent validity with clinical and physiological measures of sleep (Buysse et al., 2008). The global score was used, which reflects overall sleep quality with higher scores representing lower quality of sleep.

Depression symptoms were measured by the brief version of the **Center for Epidemiologic Studies-Depression Scale (CES-D),** which assesses presence and severity of depressive symptoms over the past week (Radloff, 1977). This scale has been found to be reliable and valid across samples (Radloff, 1977; Roberts, 1980; Roberts et al., 1989). Scores range from 0–30, with scores greater than or equal to 10 representing significant depressive symptoms (Andresen et al., 1994).

Trait generalized anxiety symptoms were assessed with the **State-Trait Anxiety Inventory, Trait Form, Anxiety Subscale** (STAI; Spielberger, 1983); this version excludes items that load predominantly onto the depression factor (Bieling et al., 1998; Spielberger, 1983). The STAI has good construct validity (Smeets et al., 1997), discriminant and convergent validity (Spielberger, 1983), and test-retest reliability (Rule and Traver, 1983). The 7-item scale asks participants to rate how frequently they experience an anxiety symptom. Total scores range from 7 to 28, and individuals with anxiety disorders generally score greater than or equal to 16 (Bieling et al., 1998).

PTSD symptoms were measured by the **PTSD Checklist-Civilian Version** (PCL-C; Conybeare et al., 2012). This 17-item checklist assessed the presence of PTSD symptoms, as well as the distress level that these symptoms cause. The scale has been found to have strong validity and reliability (McDonald and Calhoun, 2010).

Table 1
Participant demographics and clinical characteristics.

	Overall sample (N = 2687)
Male, *n* (%)	689 (26%)
Age, mean (SD) [range]	20.22 (3.21) [18–34]
Ethnicity, Hispanic *n* (%)	149 (18%)
Race, *n* (%)	
American Indian/Alaska Native	6 (.2%)
Asian	384 (14%)
Native Hawaiian/Other Pacific Islander	3 (.1%)
Black/African American	404 (15%)
White	1586 (59%)
Biracial	129 (5%)
Unknown	162 (6%)
PLEs, mean (SD) [range]	9.30 (7.45) [0–44]
PSQI, mean (SD) [range]	7.17 (2.8) [1–16]
PCL-C, mean (SD) [range]	30.29 (12.34) [17–85]
CES-D, mean (SD) [range]	7.69 (5.22) [0–28]
STAI, mean (SD) [range]	12.32 (4.68) [0–59]

PLEs = Psychotic-like Experiences; PSQI = Pittsburgh Sleep Quality Index; PCL-C = PTSD Checklist- Civilian Version; CES-D = Center for Epidemiologic Studies-Depression Scale; STAI = State Trait Anxiety Index, Trait Form, Anxiety Subscale, SD = standard deviation.

2.3. Data analysis

Prior to mediation analyses, the dependent variable (sleep quality) was examined for normality by examining skewness and kurtosis values and by visually inspecting the data. Next, bivariate analyses using Pearson's correlations were conducted to determine whether there were significant relationships between the main independent variable (PLEs) and potential mediators (anxiety, depression, PTSD) and the dependent variable (sleep quality), as well as if the potential mediators (anxiety, depression, PTSD) were associated with the dependent variable (sleep quality; Baron and Kenny, 1986). Only variables that met both conditions were examined in the mediation model. Additionally, age and gender were tested as potential covariates by determining if they were associated with the independent and dependent variables (PLEs and sleep quality, respectively). Hayes' PROCESS macro for SPSS (Hayes, 2012) was used to test for multiple mediation. The indirect effect was tested using a bootstrap estimation approach with 5000 samples. Significant mediation was determined by the 95% confidence interval not including zero (Preacher and Hayes, 2008).

3. Results

Sleep quality was found to be normally distributed within the sample. Bivariate correlations were significant for number of PLEs endorsed and sleep quality ($r = 0.28$, $p < .01$), as well as with all potential mediating variables: number of symptoms of depression ($r = 0.20$, $p < .01$), anxiety ($r = 0.54$, $p < .01$), and PTSD ($r = 0.58$, $p < .01$). Sleep quality was significantly correlated with all mediators including depression ($r = 0.39$, $p < .01$), anxiety ($r = 0.31$, $p < .01$),

Table 2
Indirect effects of psychotic-like experiences (PLEs) and sleep quality through symptoms of other psychopathologies.

Sleep Quality (N = 2687)					
IV	Mediator	Effect	SE	LLCI	ULCI
PLEs	STAI	-0.0048	0.0058	-0.0161	0.0063
PLEs	CES-D	0.0386	0.0056	0.0277	0.0498
PLEs	PCL-C	0.0579	0.0069	0.0451	0.0718
PLEs	Total	0.0918	0.0061	0.0801	0.1044

PLEs = Psychotic-like Experiences; PCL-C = PTSD Checklist- Civilian Version; CES-D = Center for Epidemiologic Studies-Depression Scale; STAI = State Trait Anxiety Index, Trait Form, Anxiety Subscale, SE = standard error, LLCI = lower limit confidence interval, ULCI = upper limit confidence interval.

and PTSD (r = 0.41, p < .01).

Table 1 presents the demographic characteristics of the sample. Significant gender differences were found for PLEs [$t(2683)$ = 4.14, p < .01], sleep quality [$t(2640)$ = 2.58, p = .01], and PTSD symptoms [$t(2676)$ = 2.27, p = .02], and approached significance for anxiety symptoms [$t(2680)$ = 1.95, p = .052], with men experiencing a greater number of PLEs, better quality sleep, fewer PTSD symptoms, and slightly fewer anxiety symptoms than women. There were no significant differences in depression symptoms by gender [$t(2682)$ = 1.21, p = .23]. Age was significantly related to PLEs (r = *-0.05*, p = .01) and anxiety symptoms (r = *-0.06*, p < .01), but no other variables of interest (p = .12–.37); thus, to take a conservative approach, age and gender were controlled for in subsequent analyses.

As Table 2 demonstrates, indirect bootstrapping results indicated that depression symptoms and PTSD symptoms individually mediated the relation between PLEs and sleep quality, as did the total model. The total model was significant when controlling for covariates, as well as without this adjustment [CI = 0.5956 - 0.7371 without age and gender covariates]. Anxiety symptoms alone were not a significant mediator. The relation between PLEs and sleep quality was no longer significant after adding all three mediators into the model (p = .12).

4. Discussion

This is the first study, to our knowledge, to demonstrate that symptoms of depression and PTSD mediate the association between greater PLEs and higher levels of sleep disturbances. The significant multiple mediation model, as well as loss of the direct effect of PLEs on sleep quality after accounting for mediating variables, indicates that, although PLEs and sleep quality are related, this relationship is perhaps better explained by other symptoms of psychopathology (i.e., depression and PTSD) that are commonly comorbid with PLEs.

Sleep dysfunction is related to the other types of psychopathology examined, including symptoms of anxiety, depression, and PTSD. Insomnia/hypersomnia are part of the diagnostic criteria for depressive disorders, and trauma-related disorders are characterized, in part, by persistent nightmares related to the traumatic events (APA, 2013). Future studies may seek to further investigate these overlapping dimensions, as well as their relationship to PLEs. Additionally, the majority of people who report insomnia in sleep laboratories and epidemiological studies have primary diagnoses of GAD, and GAD symptoms tend to precede the onset of insomnia (Monti and Monti, 2000). In these cases, insomnia related to GAD was significantly reduced both by targeting GAD symptoms through psychological treatments (including both psychodynamic approaches and cognitive behavioral therapy) as well as pharmacological approaches using benzodiazepines (Monti and Monti, 2000). The use of melatonin has been found to be successful at treating insomnia related to depression (Dolberg et al., 1998) and chronic schizophrenia (Shamir et al., 2000), though in both studies, symptoms of psychopathology were not improved despite improvements in sleep quality. Both typical and atypical antipsychotics have been shown to improve sleep quality and psychotic symptoms in people with schizophrenia (Monti and Monti, 2004). These findings suggest that treatments targeting depression and PTSD symptoms in psychosis samples may serve to improve multiple domains of the disorder.

This study utilized a large, non-help-seeking undergraduate sample, though this sample may not generalize to a non-college population. It should be noted that this sample was composed of undergraduates, though the university from which they were recruited is demographically and socioeconomically diverse. An additional limitation is the cross-sectional nature of the study. Furthermore, our self-report questionnaires rely heavily on retrospection. This is of particular relevance to the PQ, as this sample may contain more false-positives than clinical high-risk studies, where individuals are often already experiencing some amount of symptom distress, causing them to seek mental health services. Future studies may employ a longitudinal design to better elucidate how sleep quality, PLEs, and symptoms of other psychopathologies interact over time.

Though sleep quality has long been associated with positive psychotic symptoms across the course of illness, our findings indicate that previous results may in fact function through other types of psychopathologies, which in turn also influence sleep. By treating underlying psychopathologies, such as PTSD symptoms and depression, in addition to the resulting sleep disruptions, clinicians may be able to provide individuals with better outcomes that have the potential to influence sleep and psychological symptoms.

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Conflicts of interest

The authors report no conflicts of interest.

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