# ABSTRACT

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| Title of Thesis: | INVESTIGATING THE ASSOCIATION BETWEEN PARANOIA AND SLEEP DISTURBANCES |
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The current study investigated the relation between sleep disturbance (assessed by self-report and actigraphy) and paranoia in a transdiagnostic sample with psychosis. It also assessed the impact that negative affect (depression-anxiety) and social cognitive bias (tendency to blame others) have on this association. Twenty-seven participants with a psychotic disorder, who were recruited from a larger pilot study, completed clinical interviews and self-report questionnaires related to paranoia, sleep disturbance, sleep-related impairment, negative affect, and social cognitive bias. After completing these assessments, participants wore an actigraph watch for seven consecutive days to assess their sleep-wake patterns. Results indicated that paranoia was associated with sleep-related impairment and social cognitive bias, but it was not related to depression-anxiety or any measures of sleep disturbance. These results suggest that paranoia may be impacted by some aspects of sleep and social cognitive bias, which could inform future interventions.

INVESTIGATING THE ASSOCIATION BETWEEN PARANOIA AND SLEEP DISTURBANCES

by

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# List of Abbreviations

CHR — clinical high-risk

EMA — ecological momentary assessment

RDoC — research domain criteria

SCID-5 — Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, 5th edition

GPTS — Green et al. Paranoid Thought Scales

AIHQ — Ambiguous Intentions and Hostility Questionnaire

BPRS — Brief Psychiatric Rating Scale, Expanded Version

# Chapter 1: Introduction

Paranoia, the unsubstantiated belief that others deliberately want to cause harm (Freeman et al., 2012; Freeman & Garety, 2000), is a dimensional construct that ranges from interpersonal worries to firmly held persecutory delusions (Bebbington et al., 2013; Freeman, 2007; Freeman et al., 2005, Freeman et al., 2012; Meisel et al., 2018). Paranoia is experienced by persons from non-clinical populations and those with psychotic disorders (Freeman et al., 2005; Freeman et al., 2012; Koyanagi & Stickley, 2015; Mulligan, Haddock, Emsley, Neil, & Kyle, 2016). Approximately 50% of people with psychotic disorders experience paranoia, which makes it the most common persecutory delusion (Bentall et al., 2009; Pinkham, Harvey, & Penn, 2016). Several psychological and environmental factors contribute to the development and maintenance of paranoia including bullying, childhood trauma and adverse neighborhood environments (Freeman, 2007; Freeman & Garety, 2014; Meisel et al., 2018). Relevant to the current proposal, researchers have recently proposed that sleep disturbances are another factor associated with the development and maintenance of paranoia.

Sleep disturbances, such as difficulty falling asleep, excessive sleep, and early wakening, are experienced by non-clinical groups, persons at clinical high-risk for developing psychosis, and those with psychotic disorders (Andorko et al., 2017; Davies, Haddock, Yung, Mulligan, & Kyle, 2017; Koyanagi & Stickley, 2015; Laskemoen et al., 2019; Mulligan et al., 2016; Oh et al., 2016; Reeve, Sheaves, &

Freeman, 2015). Sleep disturbances have been associated with the onset and exacerbation of many psychotic symptoms, including paranoia (Freeman et al., 2012; Mulligan et al., 2016; Reeve, Emsley, Sheaves, & Freeman, 2018; Reeve et al., 2015). In addition to sleep, research has suggested that negative affect and social cognitive bias also contribute to paranoia (Freeman, 2007). The following sections will review previous research related to sleep disturbances and paranoia and discuss the impact that negative affect and social cognitive biases have on the association between sleep disturbances and paranoia.

*Sleep Disturbances*

Sleep disturbances have been found to co-occur with many psychiatric disorders including depression, bipolar disorder, anxiety disorders, post-traumatic stress disorder and schizophrenia spectrum disorders (Harvey, Murray, Chandler, & Soehner, 2011; Holsten, 2011; Ohayon, 2011). Consequently, sleep disturbances are considered a transdiagnostic problem that often occur before the onset of psychiatric symptoms, persist after other symptoms remit, and predict the development of future psychiatric symptoms (Harvey et al., 2011; Holsten, 2011; Laskemoen et al., 2019). Despite the prevalence of sleep disturbances in psychiatric disorders (Harvey et al., 2011), there is limited research pertaining to how sleep disturbances affect psychotic symptoms.

**Sleep Disturbances and Psychotic Symptoms.** Between 30 and 80% of persons with early and chronic schizophrenia spectrum disorders as well as those at clinical high-risk for developing psychosis (CHR) experience sleep disturbances

(Freeman, Pugh, Vorontsova, & Southgate, 2009; Klingaman, Palmer-Bacon, Bennett, & Rowland, 2015; Poe et al., 2017; Reeve et al., 2015; Xiang et al., 2009). Such high prevalence rates are concerning because sleep disturbances have been associated with increased severity of psychiatric symptoms, decreased medication compliance, less caregiver support, and worse quality of life in samples with schizophrenia spectrum disorders (Afonso, Brissos, Cañas, Bobes, & Bernardo-Fernandez, 2014; Xiang et al., 2009). Sleep disturbances have been frequently associated with increased severity of positive symptoms of psychosis in CHR and schizophrenia spectrum disorders samples (Afonso, Brissos, Figueira, & Paiva, 2011; Ka-Fai, Yuan-Ping, Ting-Kin, & Chui-Kwan, 2018; Laskemoen et al., 2019; Lunsford-Avery, LeBourgeois, Gupta, & Mittal, 2015; Mulligan et al., 2016; Poe et al., 2017; Reeve, Nickless, Sheaves, & Freeman, 2018; Reeve et al., 2015;Reeve et al., 2019; Wee et al., 2019; Xiang et al., 2009). Longitudinal studies of CHR groups have reported that sleep disturbances (e.g., decreased sleep efficiency) predict positive symptoms one year later (Lunsford-Avery et al., 2015) and the transition to psychosis (Davies et al., 2017; Ruhrmann et al., 2010). Only a few studies have reported that sleep disturbances are associated with increased severity of negative symptoms (Laskemoen et al., 2019; Poe et al., 2017; Reeve et al., 2015; Wee et al., 2019). Despite the above findings, some studies have failed to find an association between sleep disturbances and psychotic symptoms (Bromundt et al., 2011; Ma, Song, Xu, Tian, & Chang, 2018; Ritsner, Kurs, Ponizovsky, & Hadjez, 2004). One limitation of previous studies is that most have focused on broad symptom domains of psychosis (i.e., positive symptoms); thus, less is known about sleep disturbances impact on specific symptoms such as paranoia (Reeve et al., 2015).

Few studies have explored the link between sleep disturbances and paranoia in samples with psychotic disorders (Reeve et al., 2015). Previous studies have found that insomnia is associated with increased levels of paranoia for persons with schizophrenia spectrum disorders (Freeman et al., 2009; Reeve, Nickless, et al., 2018). Kasanova, Hajdúk, Thewissen, & Myin-Germeys (2019) utilized ecological momentary assessment (EMA) to examine how sleep disturbances affect next day levels of paranoia for persons with a psychotic disorder. They reported that worse self-reported sleep quality was related to higher levels of next-day paranoia (Kasanova et al., 2019). Finally, Mulligan et al. (2016) utilized EMA and actigraphy (i.e., a wrist-worn watch that estimates sleep-wake patterns as described below) to assess paranoia and sleep patterns in persons with schizophrenia spectrum disorders. Results indicated that increased sleep efficiency, assessed by actigraphy and self-report, were associated with decreased paranoia and auditory hallucinations (Mulligan et al., 2016). Conversely, only actigraph measured sleep fragmentation was associated with increased symptoms of paranoia and auditory hallucinations (Mulligan et al., 2016). These findings highlight that actigraph and self-report measures may provide nuanced information regarding the relation between sleep disturbances and paranoia (Mulligan et al., 2016).

Not only have sleep disturbances been associated with psychotic symptoms and paranoia as described above, they have been linked to negative affect (i.e., symptoms related to anxiety, depression, and other negative emotions; Freeman et al., 2008) and worse social cognitive functioning (Lowe, Safati, & Hall, 2017; Sagaspe et al., 2006). Therefore, it is important to evaluate how these factors affect the relation between sleep disturbances and paranoia. The following sections will review previous research related to the impact that negative affect and social cognitive biases have on this relation.

*Negative Affect in Sleep Disturbances and Paranoia*

Recent research has found that negative affect, to varying degrees, influences the association between sleep disturbances and paranoia (Davies et al., 2017; Freeman et al., 2013; Kasanova et al., 2019; Reeve, Nickless, et al., 2018). Using EMA, Mulligan et al. (2016) reported that sleep fragmentation, as measured by actigraphy, and self-reported sleep quality predicted next-day paranoia, after controlling for negative affect. They proposed that negative affect had a weaker influence on the relation between sleep disturbances and paranoia compared to other psychotic symptoms (e.g., auditory hallucinations, thought control) (Mulligan et al., 2016). However, two recent publications have suggested that negative affect completely mediates the relation between sleep disturbances (i.e., insomnia and sleep quality) and paranoia (Kasanova et al., 2019; Reeve, Nickless, et al., 2018). These mixed findings may be due to previous studies utilizing various definitions and measurements of sleep, which is a notable limitation of the current research (Davies et al., 2017; Reeve et al., 2015; Xiang et al., 2009).

Even though negative affect appears to be related to sleep disturbances and paranoia, only a few studies have examined this relation in clinical samples of persons with psychotic disorder. Lincoln et al. (2010) have proposed that negative affect may not impact persons with psychotic disorders and paranoia as strongly when other deficits (e.g., cognitive deficits) are present (Lincoln, Lange, Burau, Exner, & Moritz, 2010). Because persons with paranoia also demonstrate difficulties with general and social cognitive functioning (Bromundt et al., 2011; Pinkham, Harvey, et al., 2016), future research needs to examine whether these impairments influence the association between sleep disturbances and paranoia.

*Social Cognition and Paranoia*

Recent studies have suggested that persons with schizophrenia spectrum disorders and paranoia demonstrate specific social cognitive biases that distinguish them from those with schizophrenia spectrum disorders without paranoia (Buck et al., 2017; Buck, Pinkham, Harvey, & Penn, 2016; Pinkham, Harvey, et al., 2016; Pinkham, Penn, Green, & Harvey, 2016). Specifically, persons with schizophrenia or schizoaffective disorder who experience paranoia demonstrate a bias to perceive hostile intent and a bias to blame others more frequently when evaluating ambiguous social situations compared to those without paranoia (Buck et al., 2016; Buck et al., 2017; Pinkham, Harvey et al., 2016; Pinkham, Penn et al., 2016). In one study, social cognitive biases related to hostility and blame distinguished persons with schizophrenia and paranoia from those without paranoia (Pinkham, Harvey et al., 2016). In another study, persons with schizophrenia and paranoia demonstrated the tendency to blame others three months after an inpatient hospitalization despite improvement in other psychiatric symptoms (i.e., delusions and overall symptom severity) (Berry, Bucci, Kinderman, Emsley, & Corcoran, 2015). Although evidence suggests that social cognitive bias is linked with increased levels of paranoia, we are not aware of studies that have examined the combined influence that sleep disturbances and social cognitive bias have on paranoia. The current study explored this issue as well as addressed some of the limitations related to previous studies of sleep disturbances and psychotic symptoms, such as paranoia.

### *Limitations of Previous Research*

Although there appears to be an association between sleep disturbances and psychosis in persons with psychotic disorders, several limitations must be considered when interpreting these findings. First, most research evaluating the relation between sleep disturbances and psychotic symptoms involved people from non-clinical populations; consequently, it difficult to determine whether clinical samples are similarly affected by sleep disturbances (Andorko et al., 2017; Holsten, 2011; Reeve et al., 2015). Second, most studies assessed the relation between sleep disturbances and global measures of positive symptoms of psychosis and did not report whether sleep disturbances were linked with specific symptoms like paranoia (Reeve et al., 2015). Third, several studies assessed sleep disturbances using non-validated sleep measures (Reeve et al., 2015). Finally, many studies used self-report measures to assess sleep disturbances (Reeve et al., 2015); thus, responses may have been affected by recall bias (Lunsford-Avery et al., 2015; Xiang et al., 2009).

Some researchers have addressed the limitation of relying on self-report measures of sleep by including actigraphy. Actigraphy commonly consists of individuals wearing wrist-worn watches that contain an accelerometer and sensors to measure physical activity and light exposure, to estimate sleep-wake patterns (Reeve et al., 2015). Actigraph software estimates sleep parameters including total amount of sleep and sleep efficiency (i.e., the percentage of time actually asleep during a designated sleep period) (Baandrup & Jennum, 2015; Hennig & Lincoln, 2018; Mulligan et al., 2016). Actigraphy has been used to confirm that self-reported sleep behaviors are similar to the sleep-wake patterns that it measures (Afonso et al., 2011; Hennig & Lincoln, 2018; Mulligan et al., 2016; Reeve et al., 2018). Actigraphy is less expensive, invasive, and time consuming for participants compared to sleep laboratory measurements such as polysomnography (Gordon et al., 2017; Tahmasian, Khazaie, Golshani, & Avis, 2013), and actigraphy can potentially assess sleep behaviors in natural settings over longer time periods (Davies et al., 2017; Lowe et al., 2017; Lunsford-Avery et al., 2015; Tahmasian et al., 2013). Moreover, researchers have successfully utilized actigraphy in studies involving persons with severe mental illnesses including bipolar disorder and schizophrenia spectrum disorders (Baandrup & Jennum, 2015; Mulligan et al., 2016; Tahmasian et al., 2013). As shown by Mulligan et al.'s (2016) study, actigraphy may extend our understanding of the association between sleep disturbances and paranoia by identifying unique associations that may not be found using self-report measures.

*Aims and Hypotheses*

The current study aimed to extend previous literature by evaluating the association between sleep disturbance (as assessed by self-report and actigraphy), paranoia, negative affect (as assessed by symptoms related to depression-anxiety), and social cognitive bias in a transdiagnostic sample of persons with psychosis. First, we hypothesized that higher levels of paranoia would be related to greater sleep disturbance and self-reported sleep-related impairment. With regard to actigraph measures of sleep disturbance, we expected that increased paranoia would be associated with increased time awake after sleep onset and increased number of awakenings, and that increased paranoia would be related to decreased sleep efficiency and decreased total sleep time. Second, we predicted that greater depression-anxiety would be associated with greater sleep disturbance and sleep-related impairment, and higher levels of paranoia. In addition, we hypothesized that this relation between sleep variables and paranoia would remain significant above and beyond the influence of depression-anxiety. Third, we expected that greater social cognitive bias (i.e., the tendency to blame others) would be associated with greater sleep disturbance and sleep-related impairment and with higher levels of paranoia. Finally, we hypothesized that both forms of sleep disturbance and self-reported sleep-related impairment would be related to paranoia above and beyond the contribution of social cognitive bias.

# Chapter 2: Method

## *Participants*

Participants were enrolled in a larger pilot neuroimaging study called "Understanding the Role of Negative Affect in Psychosis Using Multimodal Imaging and Wearable Sensors" that assessed how paranoia is associated with personality, social factors, daily experiences, and sleep. Participants were recruited from outpatient programs within the Baltimore and Washington D.C. metro areas and previously completed another NIMH funded neuroimaging study in our lab called "Understanding Social Affiliation Deficits in Psychopathology" (referred to as Social Affiliation study below). The current study, as well as the previous studies mentioned, followed the NIMH research domain criteria (RDoC) framework to examine symptoms of paranoia dimensionally (Cuthbert, 2014; Insel et al., 2010; Insel, 2014), which allowed us to assess levels of paranoia from mild to clinically severe.

For the current study, we enrolled 27 participants with a psychotic disorder (e.g., schizophrenia, schizoaffective disorder, bipolar disorder with psychosis). Four participants were excluded from actigraphy analyses because of insufficient sleep data (as described below). Inclusion criteria included (1) successful participation in the Social Affiliation study, (2) aged 18-60, (3) lifetime history of a psychotic disorder, (4) basic proficiency in English, and (5) willingness to be videotaped during study participation. Exclusion criteria included (1) any MRI contraindications (e.g., MRI unsafe metal in body, weight that exceeds the limitations of MRI machine), (2) clinically unstable (i.e., psychiatric hospitalization during the 3 months prior to telephone screening or change in psychiatric medication in the month prior to the screening) as determined by staff review of medical records, (3) alcohol or substance use disorder six months prior to telephone screening to participate in the current study (4) clinically significant neurological disease or pervasive developmental disorder, (5) any history of serious head injury, and (6) evidence of intellectual disability as determined by cognitive testing conducted during the Social Affiliation study.

*<u>Measures</u>*

**Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (SCID-5; First, Williams, Karg, & Spitzer, 2015).** With participant's consent, the clinical diagnostic interview administered during the Social Affiliation study was incorporated into this study. The SCID-5 was administered by trained research staff to evaluate participants for psychiatric disorders (First et al., 2015). All participants completed the SCID-5 mood, psychotic disorder, and alcohol and substance use modules. Individuals who met criteria for alcohol or substance use disorder(s) in the past 6 months were withdrawn from the study.

**Demographic Information.** A demographic form was completed to obtain the following information: age, race, ethnicity, gender, marital status, education, and employment.

**Green et al. Paranoid Thought Scales (GPTS; Green et al., 2008**). The

GPTS is a 32-item self-report scale that measures a range of paranoid ideas and evaluates participants' conviction, distress, and preoccupation for each item (Green et al., 2008; Ibáñez-Casas et al., 2015). It consists of two 16-item subscales: One pertains to ideas related to social reference and the other pertains to ideas of persecution (Green et al., 2008). Participants rate whether each item occurred during the past month using a 5-point Likert scale that ranges from 1 ("not at all") to 5 ("totally") (Green et al., 2008). Total scores on the GPTS range from 32 to 160 with higher scores indicating more severe paranoia (Green et al., 2008). A recent review of nine self-report measures of paranoia identified the GPTS as the best assessment tool due to its dimensional conceptualization of paranoia and its robust psychometrics (Statham, Emerson, & Rowse, 2018). The GPTS has demonstrated acceptable reliability and validity (Green et al., 2008; Ibáñez-Casas et al., 2015). For the current study, the GPTS scale showed excellent internal reliability (Cronbach alpha = .97).

**Patient-Reported Outcomes Measurement Information System (PROMIS$^{TM}$) Sleep Disturbance and Sleep-Related Impairment Short Forms (Yu et al., 2012).** These measures assess sleep disturbance and sleep-related impairment over the past seven days (Yu et al., 2012). The Sleep Disturbance Scale is an 8-item questionnaire that inquiries about various sleep disturbances including restlessness, difficulty falling asleep, and trouble staying asleep (Yu et al., 2012). Items on the Sleep Disturbance Scale are rated on a 5-point Likert scale (Yu et al., 2012). The Sleep-Related Impairment Scale inquiries about various challenges that people experience due to sleep disturbance including trouble getting things done, poor concentration, and feeling irritable (Yu et al., 2012). Items on the Sleep-Related

Impairment Scale are rated on a 5-point Likert scale of 1 (“not at all”) to 5 (“very much”) (Yu et al., 2012). Based on item-response analyses, these scales have shown greater precision assessing the severity of sleep disturbance and sleep-related impairment compared to traditional questionnaires like the Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale, which suggests that they are better tools to assess sleep disturbance and sleep-related impairment (Yu et al., 2012). The Sleep Disturbance and Sleep-Related Impairment Scales have shown acceptable convergent, construct, and discriminant validity (Yu et al., 2012). For the current study, the Sleep-Disturbance Scale showed excellent internal reliability (Cronbach alpha = .92), and the Sleep-Related Impairment Scale showed good internal reliability (Cronbach alpha = .89).

**Actigraphy.** An actigraph wristwatch was used to estimate each participant’s sleep patterns. For this study, actigraph watches and software were purchased from Phillips Respironics. Participants wore the watches for seven days on their non-dominant wrist. Consistent with previous studies (Lunsford-Avery et al., 2015), the averages for total sleep time, wake after sleep onset, number of awakenings after sleep onset, and sleep efficiency were used in analyses. Actigraphy is considered a highly reliable and ecologically valid assessment of sleep parameters (Lunsford-Avery et al., 2015; Waters et al., 2011).

Because actigraph watches measure activity level to estimate wake and sleep time intervals (Gordon et al., 2017; Wee et al., 2019), the current study originally intended to confirm participant’s sleep patterns using the empirically validated

Consensus Sleep Diary (Carney et al., 2012; Maich, Lachowski, & Carney, 2018). The sleep diary was administered through a smartphone, as a part of the pilot study. However, following data collection it was discovered that participants had difficulty completing the sleep diary as reflected by a large amount of incomplete and inconsistent data (e.g., missing sleep diary data, mixed dates and times of sleep and wake periods). As a result, we relied on the actigraphy estimated wake and sleep times for purposes of the actigraphy analyses.

**Ambiguous Intentions and Hostility Questionnaire (AIHQ; Combs, Penn, Wicher, & Waldheter, 2007).** The AIHQ measures social-cognitive biases (Combs, Finn, Wohlfahrt, Penn, & Basso, 2013; Combs et al., 2007). It assesses for hostile attribution bias, aggression attribution bias, and the tendency to blame others (Combs et al., 2007; Combs et al., 2013; Pinkham, Penn, et al., 2016). It consists of five vignettes describing negative social situations with ambiguous causes (Buck et al., 2017; Pinkham, Penn, et al., 2016). For each vignette, participants rate how much they believe the other character's actions were purposeful using a scale from 1 ("definitely not") to 6 ("definitely yes"), the amount of anger they feel towards the other character from 1 ("not angry at all") to 5 ("very angry"), and how much they blame the other character from 1 ("not at all") to 5 ("very much") (Buck et al., 2017; Combs et al., 2007; Pinkham, Penn, et al., 2016). These ratings are averaged for each question and then summed to calculate a blame score that ranges from 3 to 16 (Buck et al., 2017; Pinkham, Penn, et al., 2016). Higher scores indicate increased blame towards others (Buck et al., 2017; Pinkham, Penn, et al., 2016).

The AIHQ has been successfully used in samples of persons with schizophrenia spectrum disorders (Buck et al., 2017; Combs et al., 2007; Combs et al., 2013; Pinkham, Penn, et al., 2016). It has also successfully distinguished between persons with high and low levels of paranoia (Combs et al., 2013; Pinkham, Penn et al., 2016). The AIHQ has demonstrated adequate test-retest reliability (Pinkham, Penn, et al., 2016) and validity (Combs et al., 2007). For the current study, the AIHQ showed good internal reliability (Cronbach alpha = .88).

**Brief Psychiatric Rating Scale, Expanded Version (BPRS; Overall & Gorham, 1962; Ventura et al., 1993).** The Brief Psychiatric Rating Scale-Expanded version (BPRS) is a 24-item semi-structured clinical interview that assesses the severity of various psychiatric symptoms (e.g., anxiety, depression, unusual thought content, and suspiciousness) over the previous one week (Overall & Gorham, 1962; Ventura et al., 1993). Each item is rated on a 7-point Likert scale that ranges from 1 (“not present”) to 7 (“extremely severe”) and is accompanied by descriptive anchors to help the interviewer determine the appropriate rating (Thomas, Donnell, & Young, 2004). The BPRS is one of the most frequently utilized measures to assess general psychopathology in clinical and research settings (Dazzi, Shafer, & Lauriola, 2016; Overall & Gorham, 1962; Thomas et al., 2004), and it has been used with various psychiatric groups including individuals with psychotic disorders, major depressive disorder, and anxiety disorders (Dazzi et al., 2016; Kopelowicz, Ventura, Liberman, & Mintz, 2007; Thomas et al., 2004). The BPRS has repeatedly shown acceptable test-retest reliability, internal correlation coefficients, and discriminant validity (Kopelowicz et al., 2007; Thomas et al., 2004). Exploratory and confirmatory factor analyses have reported that the BPRS is best conceptualized as a four-factor model (Dazzi et al., 2016; Kopelowicz et al., 2007; Thomas et al., 2004). The depression-anxiety subscale (i.e., items related to anxiety, depression, guilt, and suicidality) has consistently been found in various factor analyses (Dazzi et al., 2016; Kopelowicz et al., 2007; Thomas et al., 2004). In the current study, the depression-anxiety subscale will be used as a representative measure of negative affect. The depression-anxiety subscale showed acceptable internal reliability in this study (Cronbach alpha = .73).

*Procedure*

Study procedures were approved by the University of Maryland School of Medicine Institutional Review Board. Prior to any new data collection, a research team member obtained informed consent from each participant. During the first study visit, participants completed the clinical interviews and self-report measures. Following the completion of these assessments, participants were given an actigraph watch to wear on their non-dominant wrist for seven days. After the seven days of actigraphy was completed, all participants returned the study equipment and were debriefed during a brief (approximately fifteen minutes) second study visit.

*Data Analytic Plan*

All data analyses were completed using SPSS 23. First, descriptive statistics (e.g., means and standard deviations) pertaining to demographic information and total scores on all study measures were calculated. Second, zero-order correlations were conducted to examine the association between paranoia, actigraph sleep variables, self-reported sleep disturbance and sleep-related impairment, depression-anxiety, and the social cognitive bias of blaming others. Third, partial correlation analyses were planned to assess if associations between paranoia and sleep variables were related independent of depression-anxiety. This analysis was not conducted because our results showed that depression-anxiety was not related to paranoia. Finally, partial correlation analyses were conducted to examine if sleep variables and paranoia were related independent of social cognitive bias.

# Chapter 3: Results

Twenty-seven individuals participated in the study. Most participants were diagnosed with schizophrenia (*n* = 10) or schizoaffective disorder (*n* = 11). Demographic characteristics of the sample are provided in Table 1.

Table 1.
*Demographic Variables*

| | Mean (*SD*) or *n* (percent) |
|---|---|
| Age (years) | 43.59 (12.45) |
| Sex | |
| Male | 15 (56%) |
| Female | 12 (44%) |
| Race | |
| African American | 16 (59%) |
| White | 8 (30%) |
| Asian | 1 (4%) |
| More than one race | 2 (7%) |
| Ethnicity | |
| Non-Hispanic or Latino | 24 (89%) |
| Hispanic or Latino | 3 (11%) |
| Education (years) | 12.78 (2.32) |
| Marital Status | |
| Divorced/separated | 3 (11%) |
| Married | 0 (0%) |
| Never married/single | 24 (89%) |
| Current Employment | |
| Yes | 8 (30%) |
| No | 19 (70%) |
| Diagnosis | |
| Schizophrenia | 10 (37%) |
| Schizoaffective Bipolar Type | 6 (22%) |
| Schizoaffective Depressive Type | 5 (19 %) |
| Bipolar I with psychotic features | 4 (15%) |
| Major Depressive Disorder with psychotic features | 2 (7%) |
| Antipsychotic Medication | |
| Typical | 4 (15%) |
| Atypical | 18 (67%) |
| Combined (typical and atypical) | 2 (7%) |
| None | 2 (7%) |
| Unknown | 1 (4%) |

*Actigraphy Adherence*

Consistent with the actigraphy completion cut-off used in a previous study (Lunsford-Avery et al., 2015), 23 participants completed at least 5 nights (60%) of actigraphy and were included in the actigraphy analyses. Results showed that the current study had an 85% completion rate for a minimum of five nights of actigraphy. Of note, exploratory analyses conducted using all actigraphy data showed similar results as those described below.

*Descriptive Statistics of Measurements*

Symptom and sleep results are provided in Table 2. One participant did not complete the GPTS; consequently, 26 participants were included in analyses pertaining to paranoia. Compared to the clinical sample in the GPTS validation study (Green et al., 2008), participants in the current sample reported less severe symptoms of paranoia ($M$ = 101.9 versus $M$ = 58.12, respectively). Exploratory analysis showed that 74% of our participants were rated as a 2 ("very mild") or 1 ("not present") on the BPRS suspiciousness item, which demonstrates that trained interviewers also rated participants as having low levels of paranoia. The current sample also endorsed mild symptoms of depression-anxiety ($M$ = 8.86, $SD$ = 4.20). Based on Yu et al.'s (2012) $T$-score conversion table, self-reported sleep disturbance and sleep-related impairment scores were within the normal range ($T$-scores = 46.10 and 51.20, respectively). Similarly, mean actigraph total sleep time (TST) was 473.63 minutes (7.89 hours), which suggests that the average amount of sleep for this sample was within the recommended sleep range for adults (e.g., 7 to 9 hours) (Centers for Disease Control and Prevention, 2011).

Table 2.

*Descriptive Statistics for Symptom and Sleep Assessments*

| | *N* | Mean (*SD*) | Range |
|---|---|---|---|
| GPTS-Paranoia | 26 | 58.12 (30.42) | 32.00 - 142.00 |
| Sleep Disturbance | 27 | 18.22 (8.34) | 8.00 - 36.00 |
| Sleep-Related Impairment | 27 | 18.74 (7.99) | 8.00 - 31.00 |
| BPRS Depression-Anxiety | 27 | 8.86 (4.20) | 4.00 - 18.00 |
| AIHQ Blame Score | 27 | 7.61 (2.63) | 3.00 - 12.40 |
| Average Total Sleep Time (min) | 23 | 473.65 (89.74) | 315.92 - 642.28 |
| Average Sleep Efficiency (%) | 23 | 82.07 (7.79) | 67.82 - 91.99 |
| Average Wakening After Sleep Onset (min) | 23 | 50.30 (20.44) | 25.71 - 114.17 |
| Average Number of Awakenings | 23 | 35.31 (14.89) | 11.29 - 73.33 |

Note: GPTS = Green Paranoid Thought Scale; BPRS = Brief Psychiatric Rating Scale; AIHQ = Ambiguous Intentions and Hostility Questionnaire.

*Paranoia's Relation to Sleep, Depression-Anxiety and Social Cognitive Bias*

Correlations between paranoia, sleep variables, depression-anxiety, and social cognitive bias are presented in Table 3. Regarding our first hypothesis, paranoia was positively correlated with self-reported sleep-related impairment and reflects a large effect size ($r$ = .50, $p$ = .01) (Cohen, 1988). However, paranoia was not related to self-reported sleep disturbance ($r$ = .11, $p$ = .59) or any actigraphy variables (*ps* > *.05*). While these correlations were non-significant, and must be interpreted with caution, the relation between paranoia and two actigraph variables (i.e., average total sleep time and sleep efficiency) showed medium effect sizes (Cohen, 1988). This suggests that longer and more efficient sleep is linked with greater paranoia.

However, the direction of association between paranoia, total sleep time and sleep efficiency was ultimately opposite of our predictions.

Table 3.

*Correlations of Paranoia, Depression-Anxiety, and Sleep*

| | Paranoia |
|---|---|
| Sleep Disturbance | .11 |
| Sleep-Related Impairment | .50* |
| BPRS Depression-Anxiety | .32 |
| AIHQ Blame Score | .51* |
| Average Total Sleep Time | .39 |
| Average Sleep Efficiency | .34 |
| Average Wakening After Sleep Onset | -.01 |
| Average Number of Awakenings | -.07 |

Note: BPRS = Brief Psychiatric Rating Scale; AIHQ = Ambiguous Intentions and Hostility Questionnaire.
*p < .05

Related to our second hypothesis, greater depression-anxiety was associated with more self-reported sleep disturbance ($r$ = .40, $p$ =.04) and more sleep-related impairment ($r$ = .42, $p$ = .03) with medium effect sizes (see Table 4) (Cohen, 1988). Contrary to our hypothesis, depression-anxiety was not related to paranoia ($r$ = .32, $p$ = .11) or any actigraphy variables (*ps > .05*). Although the correlation between depression-anxiety and paranoia was not significant, the relation between these variables was in the expected direction with a medium effect size (Cohen, 1988), which suggests that higher levels of depression-anxiety was linked with higher levels of paranoia. Given the small sample size, it is possible that our study was statistically underpowered to detect significant associations between depression-anxiety and paranoia. Because the relation between depression-anxiety and paranoia was non-significant, we did not conduct our planned partial correlation analysis to assess the unique associations that sleep variables had on paranoia controlling for depression-anxiety.

Table 4.
*Correlations of Self-Reported Sleep Measures and Other Variables of Interest*

| | Sleep-Disturbance | Sleep-Related Impairment |
|---|---|---|
| BPRS Depression-Anxiety | .40* | .42* |
| AIHQ Blame Score | .25 | .42* |
| Average Total Sleep Time | .04 | .24 |
| Average Sleep Efficiency | -.13 | .01 |
| Average Wakening After Sleep Onset | .05 | .17 |
| Average Number of Awakenings | .09 | .24 |

Note: BPRS = Brief Psychiatric Rating Scale; AIHQ = Ambiguous Intentions and Hostility Questionnaire.
*p < .05

Regarding our third hypothesis, results demonstrated that greater tendency to blame others was related to increased paranoia ($r = .51$, $p = .01$) and more sleep-related impairment ($r = .42$, $p = .03$), which reflects a large and medium effect size, respectively (Cohen, 1988). This hypothesis was only partially supported because results did not show significant associations between tendency to blame others, depression-anxiety ($r = .24$, $p = .23$), self-reported sleep disturbance ($r = .25$, $p = .22$), or any actigraphy variables (*ps* > .05).

Finally, a partial correlation analysis was conducted to evaluate the unique association that sleep-related impairment had on paranoia independent of a tendency to blame others. After controlling for the tendency to blame others, the relation between sleep-related impairment only trended towards significance with increased paranoia ($pr = .39$, $p = .06$). Perhaps the small sample size prevented us from being able to detect a significant association.

# Chapter 4: Discussion

The current study sought to evaluate the relation between paranoia, self-report and actigraph measures of sleep, negative affect, and social cognitive bias in a transdiagnostic sample of persons with psychosis. We aimed to examine whether the relation between paranoia and sleep disturbance (assessed using self-report and actigraph sleep measures) were influenced by negative affect (assessed using a measure of depression-anxiety) and social cognitive bias. To the best of our knowledge, this study was one of the first to examine the relation between sleep, negative affect, social cognitive bias, and paranoia in a transdiagnostic sample with psychosis.

*Main Findings*

Our first hypothesis was partially supported as we found higher levels of paranoia were related to self-reported sleep-related impairment. This finding is similar to previous research that reported that various sleep problems were associated with increased severity of paranoia (Freeman et al., 2009; Kasanova et al., 2019; Mulligan et al., 2016; Reeve, Nickless, et al., 2018). However, inconsistent with our hypotheses, and prior research, we found no relation between paranoia and self-reported sleep disturbance.

Contrary to our hypothesis, greater actigraph total sleep time and sleep efficiency appeared to be associated with greater levels of paranoia with moderate effect sizes (Cohen, 1988). Although these associations have not been reported in previous studies involving clinical samples with paranoia (Mulligan et al., 2016), it suggests that persons with paranoia who demonstrate longer sleep durations and more efficient sleep may experience more severe symptoms. This finding is partially supported by previous studies that found that sleep duration has a U-shaped association with other health outcomes (e.g., sleep complaints, risk of mortality, and mood) in healthy populations (Cappuccio, D'Elia, Strazzullo, & Miller, 2010; Grandner & Kripke, 2004; Konjarski, Murray, Lee, & Jackson, 2018). The results showed that the relation between other actigraph sleep variables (e.g., number of awakenings) and paranoia were not significantly related. Such findings are not consistent with a recent study that found associations between actigraph measures of sleep and paranoia (Mulligan et al., 2016). Such mixed results may have occurred because both studies had small sample sizes and utilized different assessments for sleep and paranoia. Another possibility is that participants in the current study showed relatively normal levels of sleep (mean total sleep time was 7.89 hours), high sleep efficiency (82%), and mild clinical symptoms; thus, our ability to detect associations between sleep parameters and clinical symptoms may have been limited.

Our second hypothesis was partially supported considering that negative affect was related to self-report measures of sleep disturbance and sleep-related impairment with moderate effect sizes (Cohen, 1988). Contrary to our hypothesis, increased negative affect was not associated with increased paranoia. Despite the non-significant association, the relation between these variables reflected a medium effect size. Therefore, it is possible that we failed to find a significant association between negative affect and paranoia because of the small sample size and our study being statistically underpowered. Our results that negative affect was not related to actigraph measures of sleep reflects findings from a recent meta-analysis that found subjective reports of sleep quality were more consistently related to negative affect than objective measures (e.g., actigraphy) of sleep (Konjarski et al., 2018), which suggests that perceptions of sleep may have a strong impact on how individuals assess their affect (Konjarski et al., 2018).

Results showed that the social cognitive bias of blaming others was associated with paranoia; thus, our third hypothesis was partially supported. This finding replicates previous research involving persons with schizophrenia spectrum disorders (Buck et al., 2016; Buck et al., 2017; Pinkham, Harvey et al., 2016; Pinkham, Penn et al., 2016). Our results also indicated that the social cognitive bias to blame others was associated with increased sleep-related impairment, which suggests that social cognitive bias may be associated with some aspects of sleep. To the best of our knowledge, this is the first study that has found an association between social cognitive bias and sleep-related impairment in a clinical sample with paranoia. Regarding the associations between social cognitive bias and other sleep variables, it is possible that we did not detect significant relations between these variables because there was little variation in sleep. Future studies may want to explore the link between social cognitive bias, sleep problems, and paranoia in order to identify possible mechanisms behind this relation.

Although our fourth hypothesis was not supported, the relation between sleep-related impairment, social cognitive bias and paranoia represents a novel finding.

Given that the association between sleep-related impairment and paranoia trended towards significance after controlling for social cognitive bias, this finding suggests that the association between sleep-related impairment and paranoia is partially accounted for by social cognitive bias. Future studies, with larger sample sizes, are needed to fully assess how social cognitive bias contributes to the relation between sleep and paranoia (Davies et al., 2017; Reeve et al., 2015).

*Relation Between Sleep Measures*

The current study intended to evaluate the unique contribution that self-report and actigraph measures of sleep had on paranoia. Although Mulligan and colleagues (2016) found that actigraph results provided unique information about the relation between sleep and paranoia, we were unable to find significant associations between actigraph sleep variables and paranoia (see Table 4). In addition, our results indicated that self-report and actigraph sleep measures were not significantly related in our sample.

To try to understand these findings better, we reviewed previous literature regarding the relation between self-report and actigraph sleep measures. Lunsford and colleagues (2015) have reported positive associations between self-report and actigraph measures of total sleep time in ultra-high risk and healthy control groups, but not other measures of sleep and actigraphy (e.g., sleep efficiency and awakenings after sleep onset). Other studies have reported that there were no significant differences between self-report and actigraph sleep measures (Waters et al., 2011; Wichniak et al., 2011). Alternatively, many studies did not report if they examined the relation between different sleep assessments (Bromundt et al., 2011; Freeman et al., 2015; Ka-Fai et al., 2018; Mulligan et al., 2016). Therefore, future studies should continue to utilize multi-method assessments of sleep due to the potential that self-report and actigraph measures may provide important information about sleep disturbance and clinical symptoms (Mulligan et al., 2016).

*Limitations, Future Directions and Implications*

Findings from the current study must be interpreted cautiously due to several limitations. First, our sample size was small; therefore, our study probably lacked enough power to detect the influences of sleep variables, social cognitive bias, and negative affect on paranoia. Second, our self-report and actigraph measures of sleep indicated that our sample had minimal sleep disturbance and relatively low clinical symptoms, which may have limited our ability to detect significant differences between these constructs. Although we did not screen participants for levels of sleep disturbance or paranoia prior to enrollment, future studies may want to consider including this criterion into their research design to ensure that participants represent the full continuum of sleep disturbance and paranoia. Third, actigraph watches may mistakenly identify events when individuals are awake but inactive as sleep periods (Afonso et al., 2011; Freeman et al., 2015; Gordon et al., 2017; Wee et al., 2019). Unfortunately, we were unable to utilize the self-report sleep diary variables, as described above. Future studies would benefit by reviewing actigraph results with participants the same day the equipment is returned as done in a previous study (Hennig & Lincoln, 2018). Fourth, our findings are limited because we did not include a comparison group. Future studies would benefit from designing studies with larger sample sizes that include non-clinical and clinical populations (Davies et al., 2017; Reeve et al., 2015; Wee et al., 2019). Fifth, the cross-sectional nature of the study prevents us from making any causal claims about the relation between sleep disturbances and paranoia. Because of the cross-sectional nature of the study, our data analyses only incorporated the averages for the actigraph sleep measures. Although this has been conducted in previous studies (Lunsford-Avery et al., 2015), it prevents us from assessing the temporal association between sleep and other constructs. Future longitudinal studies are needed to fully assess the temporal relation between sleep disturbances, social cognitive bias, negative affect, and paranoia (Davies et al., 2017; Freeman et al., 2009; Kasanova et al., 2019; Reeve et al., 2015). Finally, our analyses did not control for pharmacological factors that may influence sleep-wake patterns and sleep quality such as antipsychotic and benzodiazepine medications (Afonso et al., 2014; Cohrs, 2008; Kasanova et al., 2019; Mulligan et al., 2016; Reeve et al., 2015; Wichniak et al., 2011). Future studies need to evaluate the influences of these medications because they may result in increased daytime sleepiness, napping, sleep duration, and sedation (Afonso et al., 2014; Bromundt et al., 2011; Kasanova et al., 2019; Wichniak et al., 2011), which may increase caffeine and nicotine use to remain awake (Wichniak et al., 2011).

Despite these limitations, findings from the study support previous arguments that sleep interventions may represent a novel and alternative treatment for clinical symptoms of psychosis including paranoia and negative affect (Freeman et al., 2015; Klingaman et al., 2015). Although few studies have been conducted, there is evidence that sleep interventions, especially cognitive behavioral therapy for insomnia, indirectly reduced psychiatric symptoms including paranoia, hallucinations, and negative affect (Freeman et al., 2015; Myers, Startup, & Freeman, 2011). These new interventions may help to improve psychiatric symptoms without carrying the same level of stigma associated with receiving mental health treatment (Freeman et al., 2017; Oh et al., 2016). However, randomized controlled trials involving persons with psychosis are needed before we can determine the effectiveness of sleep interventions on clinical symptoms (Myers et al., 2011).

### *Conclusion*

In summary, these findings support previous research that some aspects of sleep are related to paranoia. They also support previous research that social cognitive bias is related to paranoia. These findings, if replicated in future studies, would suggest that self-reported sleep problems and social cognitive bias may be important mechanisms in the development and maintenance of paranoia. Further, these results may suggest novel intervention strategies, such as sleep interventions, for paranoia (Freeman et al., 2015; Klingaman et al., 2015).

# Bibliography

Afonso, P., Brissos, S., Cañas, F., Bobes, J., & Bernardo-Fernandez, I. (2014). Treatment adherence and quality of sleep in schizophrenia outpatients. *International Journal of Psychiatry in Clinical Practice*, *18*, 70–76. doi:10.3109/13651501.2013.845219

Afonso, P., Brissos, S., Figueira, M. L., & Paiva, T. (2011). Schizophrenia patients with predominantly positive symptoms have more disturbed sleep-wake cycles measured by actigraphy. *Psychiatry Research*, *189*, 62–66. doi:10.1016/j.psychres.2010.12.031

Andorko, N. D., Mittal, V., Thompson, E., Denenny, D., Epstein, G., Demro, C., … Schiffman, J. (2017). The association between sleep dysfunction and psychosis-like experiences among college students. *Psychiatry Research*, *248*, 6–12. doi:10.1016/j.psychres.2016.12.009

Baandrup, L., & Jennum, P. J. (2015). A validation of wrist actigraphy against polysomnography in patients with schizophrenia or bipolar disorder. *Neuropsychiatric Disease and Treatment*, *11*, 2271–2277. doi:10.2147/NDT.S88236

Bentall, R. P., Rowse, G., Shryane, N., Kinderman, P., Howard, R., Blackwood, N., … Corcoran, R. (2009). The cognitive and affective structure of paranoid delusions: A transdiagnostic investigation of patients with schizophrenia spectrum disorders and depression. *Archives of General Psychiatry*, *66*, 236–247. doi:10.1001/archgenpsychiatry.2009.1

Berry, K., Bucci, S., Kinderman, P., Emsley, R., & Corcoran, R. (2015). An investigation of attributional style, theory of mind and executive functioning in acute paranoia and remission. *Psychiatry Research*, *226*, 84–90. doi:10.1016/j.psychres.2014.12.009

Bromundt, V., Koster, M., Georgiev-Kill, A., Opwis, K., Wirz-Justice, A., Stoppe, G., & Cajochen, C. (2011). Sleep-wake cycles and cognitive functioning in schizophrenia. *The British Journal of Psychiatry*, *198*, 269–276. doi:10.1192/bjp.bp.110.078022

Buck, B., Iwanski, C., Healey, K. M., Green, M. F., Horan, W. P., Kern, R. S., … Penn, D. L. (2017). Improving measurement of attributional style in schizophrenia; A psychometric evaluation of the Ambiguous Intentions Hostility Questionnaire (AIHQ). *Journal of Psychiatric Research*, *89*, 48–54. doi:10.1016/j.jpsychires.2017.01.004

Buck, B., Pinkham, A., Harvey, P., & Penn, D. (2016). Revisiting the validity of measures of social cognitive bias in schizophrenia: Additional results from the Social Cognition Psychometric Evaluation (SCOPE) study. *British Journal of Clinical Psychology*, *55*, 441–454. doi:10.1111/bjc.12113

Cappuccio, F. P., D'Elia, L., Strazzullo, P., & Miller, M. A. (2010). Sleep duration and all-cause mortality: A systematic review and meta-analysis of prospective studies. *Sleep*, *33*, 585–592. doi:10.1093/sleep/33.5.585

Carney, C. E., Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Krystal, A. D., Lichstein, K. L., & Morin, C. M. (2012). The Consensus Sleep Diary: Standardizing prospective sleep self-monitoring. *Sleep*, *35*, 287–302. doi:10.5665/sleep.1642

Centers for Disease Control and Prevention. (2011). Effect of short sleep duration on daily activities--United States, 2005-2008. *MMWR. Morbidity and Mortality Weekly Report*, *60*, 239–242.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Cohrs, S. (2008). Sleep disturbances in patients with schizophrenia: Impact and effect of antipsychotics. *CNS Drugs*, *22*, 939–962. Retrieved from http://10.0.8.117/00023210-200822110-00004

Combs, D. R., Finn, J. A., Wohlfahrt, W., Penn, D. L., & Basso, M. R. (2013). Social cognition and social functioning in nonclinical paranoia. *Cognitive Neuropsychiatry*, *18*, 531–548. doi:10.1080/13546805.2013.766595

Combs, D. R., Penn, D. L., Wicher, M., & Waldheter, E. (2007). The Ambiguous Intentions Hostility Questionnaire (AIHQ): A new measure for evaluating hostile social-cognitive biases in paranoia. *Cognitive Neuropsychiatry*, *12*, 128–143. doi:10.1080/13546800600787854

Cuthbert, B. N. (2014). The RDoC framework: Facilitating transition from ICD/DSM to dimensional approaches that integrate neuroscience and psychopathology. *World Psychiatry*, *13*, 28–35. doi:10.1002/wps.20087

Davies, G., Haddock, G., Yung, A. R., Mulligan, L. D., & Kyle, S. D. (2017). A systematic review of the nature and correlates of sleep disturbance in early psychosis. *Sleep Medicine Reviews*, *31*, 25–38. doi:10.1016/j.smrv.2016.01.001

Dazzi, F., Shafer, A., & Lauriola, M. (2016). Meta-analysis of the Brief Psychiatric Rating Scale – Expanded (BPRS-E) structure and arguments for a new version.

*Journal of Psychiatric Research*, *81*, 140–151. doi:10.1016/j.jpsychires.2016.07.001

First, M. B., Williams, J. B. W., Karg, R. S., & Spitzer, R. L. (2015). *Structured clinical interview for DSM-5—research version (SCID-5 for DSM-5, research version; SCID-5-RV)*. Arlington, VA: American Psychiatric Association.

Freeman, D. (2007). Suspicious minds: The psychology of persecutory delusions. *Clinical Psychology Review*, *27*, 425–457. doi:10.1016/j.cpr.2006.10.004

Freeman, D., Dunn, G., Fowler, D., Bebbington, P., Kuipers, E., Emsley, R., … Garety, P. (2013). Current paranoid thinking in patients with delusions: The presence of cognitive-affective biases. *Schizophrenia Bulletin*, *39*, 1281–1287. doi:10.1093/schbul/sbs145

Freeman, D., & Garety, P. (2014). Advances in understanding and treating persecutory delusions: A review. *Social Psychiatry and Psychiatric Epidemiology*, *49*, 1179–1189. doi:10.1007/s00127-014-0928-7

Freeman, D., & Garety, P. A. (2000). Comments on the content of persecutory delusions: Does the definition need clarification? *British Journal of Clinical Psychology*, *39*, 407–414. doi:10.1348/014466500163400

Freeman, D., Garety, P. A., Bebbington, P. E., Smith, B., Rollinson, R., Fowler, D., … Dunn, G. (2005). Psychological investigation of the structure of paranoia in a non-clinical population. *British Journal of Psychiatry*, *186*, 427–435. doi:10.1192/bjp.186.5.427

Freeman, D., Gittins, M., Pugh, K., Antley, A., Slater, M., & Dunn, G. (2008). What makes one person paranoid and another person anxious? The differential prediction of social anxiety and persecutory ideation in an experimental situation. *Psychological Medicine*, *38*, 1121–1132. doi:10.1017/S0033291708003589

Freeman, D., Pugh, K., Vorontsova, N., & Southgate, L. (2009). Insomnia and paranoia. *Schizophrenia Research*, *108*, 280–284. doi:10.1016/j.schres.2008.12.001

Freeman, D., Sheaves, B., Goodwin, G. M., Yu, L. M., Nickless, A., Harrison, P. J., … Espie, C. A. (2017). The effects of improving sleep on mental health (OASIS): A randomised controlled trial with mediation analysis. *The Lancet Psychiatry*, *4*, 749–758. doi:10.1016/S2215-0366(17)30328-0

Freeman, D., Stahl, D., McManus, S., Meltzer, H., Brugha, T., Wiles, N., & Bebbington, P. (2012). Insomnia, worry, anxiety and depression as predictors of the occurrence and persistence of paranoid thinking. *Social Psychiatry and Psychiatric Epidemiology*, *47*, 1195–1203. doi:10.1007/s00127-011-0433-1

Freeman, D., Waite, F., Startup, H., Myers, E., Lister, R., McIntyre, J., … Yu, L.-M. (2015). Efficacy of cognitive behavioural therapy for sleep improvement in patients with persistent delusions and hallucinations (BEST): A prospective, assessor-blind, randomised controlled pilot trial. *The Lancet Psychiatry*, *2*, 975–983. doi:10.1016/S2215-0366(15)00314-4

Gordon, A. M., Mendes, W. B., & Prather, A. A. (2017). The social side of sleep: Elucidating the links between sleep and social processes. *Current Directions in Psychological Science*, *26*, 470–475. doi:10.1177/0963721417712269

Grandner, M. A., & Kripke, D. F. (2004). Self-reported sleep complaints with long and short sleep: A nationally representative sample. *Psychosomatic Medicine*, *66*, 239–241. doi:10.1097/01.psy.0000107881.53228.4d

Green, C. E. L., Freeman, D., Kuipers, E., Bebbington, P., Fowler, D., Dunn, G., & Garety, P. A. (2008). Measuring ideas of persecution and social reference: The Green et al. Paranoid Thought Scales (GPTS). *Psychological Medicine*, *38*, 101–111. doi:10.1017/S0033291707001638

Harvey, A. G., Murray, G., Chandler, R. A., & Soehner, A. (2011). Sleep disturbance as transdiagnostic: Consideration of neurobiological mechanisms. *Clinical Psychology Review*, *31*, 225–235. doi:10.1016/j.cpr.2010.04.003

Hennig, T., & Lincoln, T. M. (2018). Sleeping paranoia away? An actigraphy and experience-sampling study with adolescents. *Child Psychiatry and Human Development*, *49*, 63–72. doi:10.1007/s10578-017-0729-9

Holsten, F. (2011). Sleep disturbances in schizophrenia. *Drug Discovery Today: Therapeutic Strategies*, *8*, 49–52. doi:10.1016/J.DDSTR.2011.10.004

Ibáñez-Casas, I., Femia-Marzo, P., Padilla, J. L., Green, C. E. L., De Portugal, E., & Cervilla, J. A. (2015). Spanish adaptation of the Green Paranoid Thought Scales. *Psicothema*, *27*, 74–81. doi:10.7334/psicothema2014.103

Insel, T., Cuthbert, B., Garvey, M., Heinssen, R., Pine, D. S., Quinn, K., … Wang, P. (2010). Research Domain Criteria (RDoC): Toward a new classification framework for research on mental disorders. *American Journal of Psychiatry*, *167*, 748–751.

Insel, T. R. (2014). The NIMH Research Domain Criteria (RDoC) Project: Precision medicine for psychiatry. *American Journal of Psychiatry*, *171*, 395–397.

doi:10.1176/appi.ajp.2014.14020138

Ka-Fai, C., Yuan-Ping, P. Y. P., Ting-Kin, N., & Chui-Kwan, K. (2018). Correlates of sleep irregularity in schizophrenia. *Psychiatry Research*, *270*, 705–714. doi:10.1016/j.psychres.2018.10.064

Kasanova, Z., Hajdúk, M., Thewissen, V., & Myin-Germeys, I. (2019). Temporal associations between sleep quality and paranoia across the paranoia continuum: An experience sampling study. *Journal of Abnormal Psychology*. doi:10.1037/abn0000453

Klingaman, E. A., Palmer-Bacon, J., Bennett, M. E., & Rowland, L. M. (2015). Sleep disorders among people with schizophrenia: Emerging research. *Current Psychiatry Reports*, *17*. doi:10.1007/s11920-015-0616-7

Konjarski, M., Murray, G., Lee, V. V., & Jackson, M. L. (2018). Reciprocal relationships between daily sleep and mood: A systematic review of naturalistic prospective studies. *Sleep Medicine Reviews*, *42*, 47–58. doi:10.1016/j.smrv.2018.05.005

Kopelowicz, A., Ventura, J., Liberman, R. P., & Mintz, J. (2007). Consistency of brief psychiatric rating scale factor structure across a broad spectrum of schizophrenia patients. *Psychopathology*, *41*, 77–84. doi:10.1159/000111551

Koyanagi, A., & Stickley, A. (2015). The association between sleep problems and psychotic symptoms in the general population: A global perspective. *Sleep*, *38*, 1875–1885. doi:10.5665/sleep.5232

Laskemoen, J. F., Simonsen, C., Büchmann, C., Barrett, E. A., Bjella, T., Lagerberg, T. V., … Aas, M. (2019). Sleep disturbances in schizophrenia spectrum and bipolar disorders – a transdiagnostic perspective. *Comprehensive Psychiatry*, *91*, 6–12. doi:10.1016/j.comppsych.2019.02.006

Lincoln, T. M., Lange, J., Burau, J., Exner, C., & Moritz, S. (2010). The effect of state anxiety on paranoid ideation and jumping to conclusions. An experimental investigation. *Schizophrenia Bulletin*, *36*, 1140–1148. doi:10.1093/schbul/sbp029

Lowe, C. J., Safati, A., & Hall, P. A. (2017). The neurocognitive consequences of sleep restriction: A meta-analytic review. *Neuroscience and Biobehavioral Reviews*, *80*, 586–604. doi:10.1016/j.neubiorev.2017.07.010

Lüdtke, T., Kriston, L., Schröder, J., Lincoln, T. M., & Moritz, S. (2017). Negative affect and a fluctuating jumping to conclusions bias predict subsequent paranoia in daily life: An online experience sampling study. *Journal of Behavior Therapy and Experimental Psychiatry*, *56*, 106–112. doi:10.1016/j.jbtep.2016.08.014

Lunsford-Avery, J. R., LeBourgeois, M. K., Gupta, T., & Mittal, V. A. (2015). Actigraphic-measured sleep disturbance predicts increased positive symptoms in adolescents at ultra high-risk for psychosis: A longitudinal study. *Schizophrenia Research*, *164*, 15–20. doi:10.1016/j.schres.2015.03.013

Ma, X. R., Song, G. R., Xu, X. B., Tian, T., & Chang, S. H. (2018). The prevalence of sleep disturbance and its socio-demographic and clinical correlates in first-episode individuals with schizophrenia in rural China. *Perspectives in Psychiatric Care*, *54*, 31–38. doi:10.1111/ppc.12197

Maich, K. H. G., Lachowski, A. M., & Carney, C. E. (2018). Psychometric properties of the Consensus Sleep Diary in those with insomnia disorder. *Behavioral Sleep*

*Medicine*, *16*, 117–134. doi:10.1080/15402002.2016.1173556

Meisel, S. F., Garety, P. A., Stahl, D., & Valmaggia, L. R. (2018). Interpersonal processes in paranoia: A systematic review. *Psychological Medicine*, 1–14. doi:10.1017/S0033291718000491

Mulligan, L. D., Haddock, G., Emsley, R., Neil, S. T., & Kyle, S. D. (2016). High resolution examination of the role of sleep disturbance in predicting functioning and psychotic symptoms in schizophrenia: A novel experience sampling study. *Journal of Abnormal Psychology*, *125*, 788–797. doi:10.1037/abn0000180

Myers, E., Startup, H., & Freeman, D. (2011). Cognitive behavioural treatment of insomnia in individuals with persistent persecutory delusions: A pilot trial. *Journal of Behavior Therapy and Experimental Psychiatry*, *42*, 330–336. doi:10.1016/j.jbtep.2011.02.004

Oh, H. Y., Singh, F., Koyanagi, A., Jameson, N., Schiffman, J., & DeVylder, J. (2016). Sleep disturbances are associated with psychotic experiences: Findings from the National Comorbidity Survey Replication. *Schizophrenia Research*, *171*, 74–78. doi:10.1016/j.schres.2016.01.018

Ohayon, M. M. (2011). Epidemiological overview of sleep disorders in the general population. *Sleep Medicine Reviews*, *2*, 1–9. doi:pISSN 2093-9175

Overall, J. E., & Gorham, D. R. (1962). The Brief Psychiatric Rating Scale. *Psychological Reports*, *10*, 799–812.

Pinkham, A. E., Harvey, P. D., & Penn, D. L. (2016). Paranoid individuals with schizophrenia show greater social cognitive bias and worse social functioning than non-paranoid individuals with schizophrenia. *Schizophrenia Research:*

*Cognition*, *3*, 33–38. doi:10.1016/j.scog.2015.11.002

Pinkham, A. E., Penn, D. L., Green, M. F., & Harvey, P. D. (2016). Social cognition psychometric evaluation: Results of the initial psychometric study. *Schizophrenia Bulletin*, *42*, 494–504. doi:10.1093/schbul/sbv056

Poe, S. L., Brucato, G., Bruno, N., Arndt, L. Y., Ben-David, S., Gill, K. E., … Girgis, R. R. (2017). Sleep disturbances in individuals at clinical high risk for psychosis. *Psychiatry Research*, *249*, 240–243. doi:10.1016/j.psychres.2016.12.029

Reeve, S., Emsley, R., Sheaves, B., & Freeman, D. (2018). Disrupting sleep: The effects of sleep loss on psychotic experiences tested in an experimental study with mediation analysis. *Schizophrenia Bulletin*, *44*, 662–671. doi:10.1093/schbul/sbx103

Reeve, S., Nickless, A., Sheaves, B., & Freeman, D. (2018). Insomnia, negative affect, and psychotic experiences: Modelling pathways over time in a clinical observational study. *Psychiatry Research*, *269*, 673–680. doi:10.1016/j.psychres.2018.08.090

Reeve, S., Nickless, A., Sheaves, B., Hodgekins, J., Stewart, S. L. K., Gumley, A., … Freeman, D. (2019). Sleep duration and psychotic experiences in patients at risk of psychosis: A secondary analysis of the EDIE-2 trial. *Schizophrenia Research*, *204*, 326–333. doi:10.1016/j.schres.2018.08.006

Reeve, S., Sheaves, B., & Freeman, D. (2015). The role of sleep dysfunction in the occurrence of delusions and hallucinations: A systematic review. *Clinical Psychology Review*, *42*, 96–115. doi:10.1016/j.cpr.2015.09.001

Ritsner, M., Kurs, R., Ponizovsky, A., & Hadjez, J. (2004). Perceived quality of life in schizophrenia: Relationships to sleep quality. *Quality of Life Research*, *13*, 783–791. doi:10.1023/B:QURE.0000021687.18783.d6

Ruhrmann, S., Schultze-Lutter, F., Salokangas, R. K. R., Heinimaa, M., Linszen, D., Dingemans, P., … Klosterkötter, J. (2010). Prediction of psychosis in adolescents and young adults at high risk. *Archives of General Psychiatry*, *67*, 241. doi:10.1001/archgenpsychiatry.2009.206

Sagaspe, P., Sanchez-Ortuno, M., Charles, A., Taillard, J., Valtat, C., Bioulac, B., & Philip, P. (2006). Effects of sleep deprivation on Color-Word, Emotional, and Specific Stroop interference and on self-reported anxiety. *Brain and Cognition*, *60*, 76–87. doi:10.1016/j.bandc.2005.10.001

Statham, V., Emerson, L. M., & Rowse, G. (2018). A systematic seview of self-report measures of paranoia. *Psychological Assessment*. doi:http://dx.doi.org/10.1037/pas0000645

Tahmasian, M., Khazaie, H., Golshani, S., & Avis, K. T. (2013). Clinical application of actigraphy in psychotic disorders: A systematic review. *Current Psychiatry Reports*, *15*, 359-374. doi:10.1007/s11920-013-0359-2

Thomas, A., Donnell, A. J., & Young, T. R. (2004). Factor structure and differential validity of the expanded brief psychiatric rating scale. *Assessment*, *11*, 177–187. doi:10.1177/1073191103262893

Ventura, J., Lukoff, D., Nuechterlein, K., Liberman, R., Green, M., Shaner, A., … Lieberman, R. (1993). Appendix 1: Brief Psychiatric Rating Scale (BPRS) Expanded version (4.0) scales, anchor points and administration manual. *International Journal of Methods in Psychiatric Research*, *3*, 227–243.

Retrieved from https://www.scienceopen.com/document?vid=3dee148c-4a1a-4d64-bc54-6173898bca4b

Waters, F., Sinclair, C., Rock, D., Jablensky, A., Foster, R. G., & Wulff, K. (2011). Daily variations in sleep-wake patterns and severity of psychopathology: A pilot study in community-dwelling individuals with chronic schizophrenia. *Psychiatry Research*, *187*, 304–306. doi:10.1016/j.psychres.2011.01.006

Wee, Z. Y., Yong, S. W. L., Chew, Q. H., Guan, C., Lee, T. S., & Sim, K. (2019). Actigraphy studies and clinical and biobehavioural correlates in schizophrenia: A systematic review. *Journal of Neural Transmission*, *126*, 531–558. doi:10.1007/s00702-019-01993-2

Wichniak, A., Skowerska, A., Chojnacka-Wójtowicz, J., Tafliński, T., Wierzbicka, A., Jernajczyk, W., & Jarema, M. (2011). Actigraphic monitoring of activity and rest in schizophrenic patients treated with olanzapine or risperidone. *Journal of Psychiatric Research*, *45*, 1381–1386. doi:10.1016/j.jpsychires.2011.05.009

Xiang, Y.-T., Weng, Y.-Z., Leung, C.-M., Tang, W.-K., Lai, K. Y. C., & Ungvari, G. S. (2009). Prevalence and correlates of insomnia and its impact on quality of life in Chinese schizophrenia patients. *Sleep: Journal of Sleep and Sleep Disorders Research*, *32*, 105–109.

Yu, L., Buysse, D. J., Germain, A., Moul, D. E., Stover, A., Dodds, N. E., … Pilkonis, P. A. (2012). Development of short forms from the PROMIS$^{TM}$ Sleep Disturbance and Sleep-Related Impairment item banks. *Behavioral Sleep Medicine*, *10*, 6–24. doi:10.1080/15402002.2012.636266