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Insomnia Symptom Severity is
Associated with Increased Suicidality
and Suicide in a Psychiatric Sample

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Science

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ABSTRACT

Insomnia Symptom Severity is Associated with Increased Suicidality and Suicide in a Psychiatric Sample

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Insomnia is a risk factor for suicidal behavior including attempts and suicide. We investigated whether insomnia symptom severity predicted suicidality and suicide in an at-risk sample. The sample included deceased psychiatric patients seen at Weber Human Services since 2008 ($N=180$) who completed the Outpatient Questionnaire-45.2 (OQ) prior to death. Insomnia symptom severity was assessed using item 41 from the OQ. Manner of death was determined by death records and autopsy reports. History of suicidal ideation and prior suicide attempts were determined through review of electronic medical records. Cases were grouped into 4 categories: no history of suicidality ($n = 30$), history of suicidal ideation ($n = 36$), suicide attempt history ($n = 95$), and death by suicide ($n = 19$). Insomnia symptom severity was compared across groups using linear regression. Logistic regression was used to determine whether OQ reported insomnia symptom severity predicted suicide, adjusting for psychiatric disorders. Compared to the non-suicidal group, the suicide attempt and the suicide groups reported significantly higher insomnia symptom severity, $OR=3.52, p=0.001$ and $OR=6.53, p<0.001$, respectively. Greater insomnia symptom severity reported on the OQ was a significant predictor of suicide attempt and suicide, $OR=2.67, p=0.011$ and $OR=5.53, p=0.002$, respectively, even after adjusting psychiatric diagnoses. Results suggest that insomnia symptoms are more strongly associated with suicidal behavior than suicidal ideation. The presence of insomnia symptoms in psychiatric patients may indicate risk for suicidal behavior and is a target for suicide prevention.

Keywords: insomnia, suicidality, suicide, suicidal behavior

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Insomnia Symptom Severity is Associated with Increased Suicidality and Suicide in a Psychiatric Sample

Globally, nearly 800,000 people die from suicide each year (World Health Organization, 2018). Across the United States, suicide is the tenth leading cause of death and rates of suicide have increased by nearly 30% since 1999 (Center for Disease Control and Prevention, 2018). It is estimated that between 60% and 98% of suicides are completed by those who have a psychiatric illness (Bachmann, 2018). Because suicide is preventable, identifying modifiable risk factors of suicidality in these patients is imperative. Insomnia is associated with suicidality, but its potential as a modifiable risk factor for suicide remains untapped. Greater insight into the relationship between insomnia symptoms and suicide risk may have implications for suicide prevention.

Insomnia symptoms, including difficulty initiating and reinitiating sleep, are common among psychiatric patients and have been linked to suicidal ideation (Chakravorty et al., 2015; Chellappa & Araujo, 2007; Chu et al., 2016; Nadorff et al., 2013; Suh et al., 2013), suicide attempt (Bernert et al., 2015; Hall et al., 1999; Kay, Dombrovski, et al., 2016; Lin et al., 2018), and suicide (Goldstein et al., 2008). The association between insomnia and suicidality persists after controlling for depressive symptoms (Krakow et al., 2011; McCall et al., 2010; Pigeon et al., 2012). Few studies have explored how insomnia severity differs across groups with suicidal ideation, previous suicide attempts, and suicides. We previously reported that older adults with depression who attempted suicide had greater insomnia severity than depressed patients with suicidal ideation or no history of suicidality (Kay, Dombrovski, et al., 2016). An earlier study reported that insomnia was a better predictor of suicide attempt than a specific suicide plan (Hall

et al., 1999). These studies suggest that insomnia may be more strongly associated with suicidal behavior than suicidal ideation.

In a sample of deceased psychiatric patients, we predicted that insomnia symptoms prior to death would be more prevalent in patients with a history of suicidal behavior than those who had suicidal ideation absent of suicidal behaviors and those with no suicidality. We also explored whether self-reported symptoms of insomnia predicted suicide independent of self-reported suicidal ideation.

Methods

Sample

Patients ($N = 196$) were seen clinically at Weber Human Services, died between 2008-2018, and had a documented cause of death. Patient deaths were actively documented by routine monitoring of local obituaries, contact with patient family members, review of client reports, reports from community partners, and through case manager home visits. Cause of death was documented by death record. Suicide was determined by death records and/or autopsy reports obtained from the state coroner. In total, 20 patients had a documented suicide. Patient demographics were collected through electronic medical records. Due to missing data, 16 patients were excluded, including one suicide patient, resulting in an analysis sample of 180.

Measures

As part of routine medical care, patients included in this study had completed the Outcome Questionnaire (OQ-45.2) (Lambert et al., 1996), a validated 45-item self-report survey designed to assess patient progress across a variety of mental health-related domains throughout therapy. Item 41 on the OQ completed nearest to death (range 16 days to 2.8 years prior to death)

was used to determine patients' insomnia symptom severity (i.e., trouble falling asleep or staying asleep over the previous week). Scoring for this item ranges from "0" (never) to "4" (always).

To document each patient's history of suicidality, we searched for the terms "suicide" or "suicidal" in each patient's medical records including intake assessments and general clinical notes. When those terms did not yield information of suicidal history, we also searched for word roots for ideation ("ideat"), "attempt," "death," and "dying" to determine whether attempts or ideation occurred. Patients with no mention of suicidality in the medical record were categorized as having suicidal ideation if they endorsed >0 on item 8 of the OQ. A subset of participants ($n = 40$) completed the Columbia-Suicide Severity Rating Scale, Lifetime/Recent (C-SSRS), a validated, sensitive, and specific measure of suicidality (Posner et al., 2011). Based on death records, autopsies, medical record review, the OQ, and the C-SSRS, participants were ultimately categorized into 4 groups: no history of suicidality ($n = 30$), history of suicidal ideation ($n = 36$), history of suicide attempt ($n = 95$), and death by suicide ($n = 19$). Those who had evidence of a suicide plan were included in the suicidal ideation group.

Analysis

We performed bivariate statistical tests between severity of suicidality and each variable using linear regression. Ordered logistic regression (*ologit*) was used to model self-reported severity of insomnia and severity of suicidality while controlling for diagnosis of depressive and personality disorders. We also conducted a linear regression analysis to compare patient responses to OQ item 41 (insomnia) across suicide and non-suicide groups (no history of suicidality, history of suicidal ideation, and suicide attempt history groups) in an unadjusted and an adjusted model that accounted for depressive and personality disorders.

We conducted a sensitivity power analysis to determine the minimal correlation detectable given $\alpha = 0.05$ and $\beta = 0.2$, with $N = 180$. A similar study reported 85% power to detect small effects ($N = 552$) (Chu et al., 2016) while another reported $\geq 80\%$ power to detect correlations ≥ 0.4 ($N = 50$) (McCall et al., 2013). Given these studies and our available sample size, our aim was to detect small to medium effect sizes. Results suggested that the sample size of 180 had 80% power to detect population correlations ≥ 0.21 among insomnia and suicidality severity (G*Power 3). Our sample size of 180 was sufficient for the purposes of detecting a medium effect size between insomnia symptom severity and suicidality severity. Analyses were performed with STATA 15 (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC).

Results

Table 1 shows the demographic features across groups. Patients who died by suicide were younger than those who died by other causes, but were otherwise similar in terms of sex, race, education, income, and marital status. Compared to the group with no history of suicidality, the suicidal ideation and suicide attempt groups had more difficulty with headaches and problems sleeping. Those in the suicide attempt and suicide groups also had significantly more history of fatigue when compared to the group with no history of suicidality. We also found that those who had attempted suicide and completed a suicide had significantly more instances of personality disorders and only those who attempt suicide had more instances of depressive disorders compared to those who had no history of suicidality. We also report the median length of time in days between each suicide severity groups' last administration of the OQ and their deaths; the groups did not significantly differ on this variable.

Table 2 reports the odds ratios of each group reporting greater insomnia symptom severity on OQ item 41 as compared to the group with no history of suicidality. In the unadjusted model, the suicide attempt and suicide groups had significantly more frequent insomnia than the group with no history of suicidality. After adjusting for depressive and personality disorders, the suicide attempt and suicide groups remained significantly different from the group with no history of suicidality in insomnia symptom severity; the suicidal ideation group did not have significantly different insomnia symptom severity from the other groups in either model. Figure 1 illustrates differences across the 4 groups in mean self-reported insomnia symptom severity (OQ item 41).

Discussion

Findings suggest that those who exhibit suicidal behavior (attempts or suicide) reported greater insomnia symptom severity than those with no suicidality or only suicidal ideation. This association remained for those exhibiting suicidal behavior after accounting for depressive and personality disorders. These results extend the findings of a previous study that suggested insomnia is associated with suicidal behavior above and beyond its association with suicidal ideation and depression (Kay, Dombrovski, et al., 2016).

The mechanisms of this relationship are unclear and understudied. Kay and colleagues recently found that patients with insomnia had less NREM sleep-wake differences in relative glucose metabolism in the left middle frontal gyrus, left parietal cortex, fusiform/lingual/occipital gyri, posterior cingulate cortex, and precuneus (Kay, Karim, et al., 2016). These are brain regions involved in decision-making and integration of self-referential thought, memory, and affective processes. Previous research has suggested that suicidal patients have decreased activity in the middle and superior frontal gyri when compared to non-suicidal

patients (Cao et al., 2016) and increased activation in the anterior and posterior cingulate cortices (van Heeringen et al., 2014). Other studies have found that suicidal patients have a decreased volume in their right and left orbitofrontal cortices (Monkul et al., 2007), dorsolateral prefrontal cortex (van Heeringen et al., 2011), caudate nucleus, and rectal and superior temporal gyri (van Heeringen et al., 2014), and an increase in right amygdala volumes (Monkul et al., 2007). These brain regions have implications for suicidal behavior as impairments within them have been associated with impulsive behavior (Cao et al., 2016; Monkul et al., 2007; van Heeringen et al., 2014), emotion dysregulation (Jollant et al., 2011), and impaired decision making (Monkul et al., 2007; van Heeringen et al., 2011). It is notable that many abnormalities in brain regions affecting patients with insomnia are also seen in patients who are suicidal. Kay and colleagues have posited that insomnia may represent a form of “localized sleep deprivation” in brain networks involved in executive control, self-referential thinking, and affect (Kay, Dombrovski, et al., 2016). Although highly speculative, the overlap in brain regions altered during sleep in insomnia and the brain regions altered during wakefulness associated with suicidality raises the possibility that insomnia confers risk for suicidal behavior through its impact on brain processes. Future research is needed to test the model that localized sleep disturbance in the brain networks associated with insomnia is a mechanism through which insomnia confers risk for suicidal behavior.

One limitation of our study is our use of a single OQ item to assess insomnia symptom severity. Nevertheless, the robust predictive power of this item in differentiating individuals with suicidal behaviors and those who eventually went on to die by suicide suggest this item has high clinical utility. We also note that sleep problems coded in the medical record followed a similar pattern. As some patients died after receiving care from Weber Human Services, the time

between some patients' last OQ and their death extended beyond the length of a year. However, there was no significant difference between suicidality groups in relation to the time between their last OQ and death. Further research should focus on replicating these results with clinical diagnoses of sleep disorders, valid sleep questionnaires, and physiological sleep measures, including polysomnography. While patient deaths were closely examined and documented by Weber Human Services, it is possible that patients could have moved away and died without the facilities' knowledge. The relatively small number of suicide deaths in a psychiatric sample may also limit the generalizability of these results. Results require follow up in different patient samples known to have high rates of suicide.

Conclusions

Insomnia symptoms may be a valuable indicator of suicide risk in psychiatric patients. Insomnia may be a potent marker of suicidal behavior and potential target for preventing suicide in psychiatric patients. The single insomnia item on the OQ has high clinical utility and feasibility that clinicians may use to help identify suicidality in psychiatric patients. Future research is needed to determine the mechanisms through which insomnia and suicidal behavior are related.

Table 1 - Demographic, insomnia, and medical features across groups

Characteristic	No S (n = 30)	SI (n = 36)	SA (n = 95)	S (n = 19)	χ^2/F	df	p-value
Sex, female	14(47%)	14(39%)	54(57%)	9(45%)	0.98	1	0.323
Age, y	57(15)	54(14)	51(13) ^A	42(12) ^A	14.46		<0.001***
Race, white	26(87%)	32(89%)	88(93%)	17(89%)	0.61	1	0.437
Education, y	12[11,14]	12[11,12]	12[11,14]	12[11,14]	0.07		0.794
Income, >\$0	25(83%)	30(83%)	74(78%)	17(89%)	0.01	1	0.908
Marital Status					18.95	4	0.090
Married	3(10%)	3(8%)	18(19%)	3(16%)			
Widowed	7(23%)	0(0%)	6(6%)	1(5%)			
Divorced	7(23%)	13(36%)	35(37%)	8(42%)			
Separated	3(10%)	8(22%)	14(15%)	2(11%)			
Never Married	10(33%)	12(33%)	20(21%)	5(26%)			
Medication use							
Benzodiazepine	1(3%)	1(3%)	9(10%)	2(10%)	1.72	1	0.196
Antidepressant	6(20%)	4(11%)	17(18%)	4(21%)	0.17	1	0.681
Antipsychotic	4(13%)	7(19%)	20(21%)	3(16%)	0.01	1	0.939
Other sedative	0(0%)	1(3%)	1(1%)	1(5%)	0.51	1	0.478
Mood stabilizer	1(3%)	1(3%)	2(2%)	0(0%)	0.95	1	0.334
# of total medications	2[1,3]	2[1,3]	3[2,3]	2[2,4]	1.55	1	0.219
Medical problems							
Allergies	9(30%)	9(25%)	35(37%)	7(37%)	1.00	1	0.318
Cancer	2(7%)	7(19%)	14(15%)	1(5%)	0.00	1	0.955
Diabetes	7(23%)	9(25%)	22(23%)	4(22%)	0.05	1	0.826
Dizziness	6(20%)	10(28%)	22(23%)	5(26%)	0.07	1	0.794
Fatigue	8(27%)	18(50%)	53(56%) ^A	12(63%) ^A	8.53	1	0.004**
Headaches	6(20%)	16(44%) ^A	48(51%) ^A	8(42%)	5.28	1	0.023*
Heart Condition	4(13%)	10(28%)	22(23%)	2(11%)	0.00	1	0.968
Immune System Problems	2(7%)	8(22%) ^A	5(5%)	0(0%)	2.96	1	0.087
Kidney Disease	2(7%)	3(8%)	11(12%)	2(11%)	0.56	1	0.454
Liver Disease	4(13%)	2(6%)	11(12%)	2(11%)	0.00	1	0.979
Lung Disease	4(13%)	11(31%)	23(24%)	0(0%)	0.34	1	0.563
Problems Sleeping	7(23%)	17(47%) ^A	56(59%) ^A	13(68%) ^A	14.69	1	<0.001***

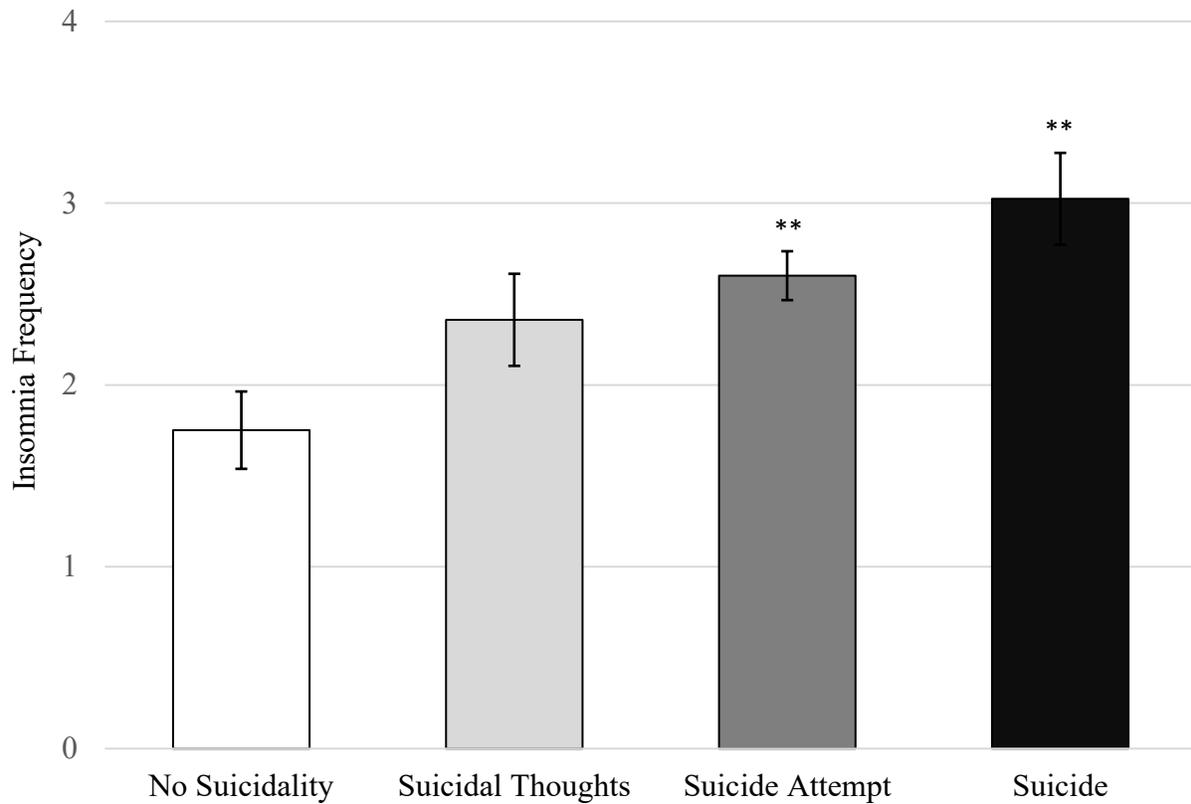
Seizures	3(10%)	6(17%)	11(12%)	4(21%)	0.30	1	0.582
Stomach Aches/Pains	5(17%)	10(28%)	32(34%)	6(32%)	2.56	1	0.111
Tuberculosis	0(0%)	0(0%)	1(1%)	0(0%)	0.23	1	0.631
Ulcer or Stomach Disease	3(10%)	4(11%)	16(17%)	2(11%)	0.42	1	0.519
# of medical conditions	2[1,3]	3[2,6] ^A	4[2,6] ^A	3[2,5]	5.49	1	0.020*
Mental Disorders							
Depressive Disorders	7(23%)	12(33%)	46(48%) ^A	7(37%)	4.25	1	0.041*
Psychotic Disorders	12(40%)	17(47%)	26(27%)	5(26%)	3.31	1	0.071
Anxiety Disorders	7(23%)	9(25%)	36(38%)	5(26%)	1.38	1	0.242
Personality Disorders	1(3%)	4(11%)	30(32%) ^A	8(42%) ^A	17.64	1	<0.001***
Substance Use Disorders	6(20%)	8(22%)	26(27%)	7(37%)	1.90	1	0.170
Bipolar Disorders	3(10%)	4(11%)	16(17%)	4(21%)	1.73	1	0.190
Neurodevelopmental Disorders	1(3%)	0(0%)	0(0%) ^A	0(0%)	5.96	1	0.078
Neurocognitive Disorders	3(10%)	0(0%) ^A	3(3%)	0(0%)	2.55	1	0.112
Trauma-Related Disorders	1(3%)	3(8%)	13(14%)	4(21%)	4.45	1	0.036*
Obsessive-Compulsive Disorders	0(0%)	0(0%)	2(2%)	1(5%)	2.25	1	0.136
Somatic Disorders	0(0%)	0(0%)	1(1%)	0(0%)	0.23	1	0.630
# of mental disorders	1[1,2]	2[1,2]	2[2,3] ^A	2[2,3] ^A	18.34	1	<0.001***
Insomnia symptom severity, OQ	1.4(1.2)	2.1(1.5) ^A	2.4(1.3) ^A	2.9(1.1) ^A	18.42		<0.001***
Time between death and last OQ, days	151[40,1008]	158[51,731]	73[28,224]	20[16,106]	1.81	1	0.180

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. No S=no suicidality, SI=suicidal ideation, SA=suicide attempt, S=suicide, $M(SD)$, $Mdn[IQR]$, $n(\%)$, ^ASignificantly different than No S using post-hoc linear regression.

Table 2 - Self-reported insomnia symptom severity of suicidal groups compared to the no suicidality group

Group	Unadjusted Model			Adjusted Model		
	Odds Ratio	95% CI	<i>p</i>	Odds Ratio	95% CI	<i>p</i>
Suicidal ideation (<i>n</i> = 36)	2.32	0.96-5.57	0.061	2.05	0.86-4.91	0.108
Suicide attempt (<i>n</i> = 94) [†]	3.52	1.70-7.31	0.001**	2.67	1.25-5.72	0.011*
Suicide (<i>n</i> = 19)	6.53	2.30-18.52	<0.001***	5.53	1.89-16.17	0.002**

Note. Odds ratios of a group reporting greater insomnia symptom severity per OQ item 41 as compared to the no suicidality group. **p*<0.05, ***p*<.01, ****p*<.001. The adjusted model controls for depressive and personality disorders. [†]One participant was removed from the analysis due to missing data on mental disorder diagnosis.

Figure 1. Self-reported symptom severity of insomnia across varying levels of suicidality

Note. Comparisons of patients' mean self-reported insomnia frequencies on OQ (0 "never" to 4 "almost always") across levels of suicidality. Self-reported insomnia symptom severity was significantly higher in groups with greater suicidality than the non-suicidal group. ** $p \leq 0.01$.

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