The Relationship Between Sleep Disturbance, Suicidal Ideation, Suicide Attempts, and Suicide Among Adults: A Systematic Review

Wilfred R. Pigeon, PhD; Todd M. Bishop, PhD; and Caitlin E. Titus, MS

ABSTRACT

Suicide is a significant global health concern; identification of modifiable risk factors can guide future research and prevention efforts. A systematic literature review was undertaken to summarize whether disrupted sleep, which has garnered increased attention as a risk factor for suicidal thoughts and behaviors, has continued to be associated with suicide in recent years. The search resulted in 1,806 abstracts with 188 identified for full text review. Limiting studies to 2012-2015 publications with adult participants and an interpretable relationship between sleep and suicide outcomes left 36 articles for the review. Five new articles focused on suicide decedents, eight on veteran/military populations, but relatively few were longitudinal studies (n = 4) and none assessed sleep apnea. A majority of studies used statistical methods to control for psychopathology, strengthening the overall finding that recent work lends further support for disrupted sleep as an important risk factor, and potential warning sign, for suicide. [Psychiatr Ann. 2016;46(3):177-186.]

Globally, nearly 1 million deaths per year are attributable to suicide.1 In the United States, suicide now represents the 10th leading cause of death and the leading cause

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T. M. B. is supported, in part, by the United States Department of Veterans Affairs Advanced Fellowship Program in Mental Health Illness Research & Treatment, VISN 2 Center of Excellence for Suicide Prevention at the Canandaigua VA Medical Center, which supported this work.

Disclaimer: The authors’ views or opinions do not necessarily represent those of the Department of Veterans Affairs, the National Institutes of Health, or the United States Government.

Disclosure: Wilfred R. Pigeon discloses fees received for non-CME services from Merck & Co. and the Sharpe Dohme Company (a pharmaceutical manufacturer). The remaining authors have no relevant financial relationships to disclose.
doi: 10.3928/00485713-20160128-01
of violent death.\textsuperscript{2,3} In addition, both nonlethal suicide attempts and suicidal ideation (SI) represent additional public health burdens and are each risk factors for suicide.\textsuperscript{4} Modifiable risk factors for suicidal thoughts and behaviors have been identified, including depression and a number of other psychiatric and medical conditions.\textsuperscript{5,6} Despite treatment advances for some of these modifiable conditions, expanded suicide prevention strategies, and a national focus on suicide as a public health imperative,\textsuperscript{7,11} suicide rates have remained relatively unchanged for decades and have even increased in some populations.\textsuperscript{12,13}

In the past decade, important reviews and commentaries have highlighted the probable association of another modifiable risk factor with suicidal thoughts and behaviors—sleep disturbance.\textsuperscript{14-17} In a 2012 meta-analysis that reviewed publications between 1966 and 2011, there were 39 peer-reviewed publications meeting somewhat liberal selection criteria.\textsuperscript{18} Since that time, there has been a second meta-analysis published limited to studies of psychiatric patients.\textsuperscript{19} In both meta-analyses, the presence of sleep disturbance was associated with increased risk of suicidal behaviors. Owing, in part, to high prevalence rates, association with psychiatric and medical conditions that are also associated with suicide, and their apparent capacity to worsen other risk factors (eg, precipitant of relapse to alcohol; blunting of treatment for depression), sleep disturbance in general, and insomnia and nightmares more specifically, have emerged as risk factors of interest.\textsuperscript{20,23}

A recent review that included only studies that prospectively assessed suicide outcomes used validated symptom measures of sleep disturbance and adjusted for the presence or severity of psychopathology corroborated earlier reviews, although the authors commented on the wide variety of methodologic differences apparent in the literature.\textsuperscript{24} Given the increased focus on sleep disturbance as a potentially modifiable risk factor for suicide and the consistent observation that the extant literature is mixed in terms of methodologic rigor, the purpose of this review is to provide an updated and systematic review of the relationship of sleep disturbance to suicidal thoughts and behaviors. Using a chronologic demarcation based on both the first meta-analysis,\textsuperscript{18} which included publications only up to 2011, and the recent review,\textsuperscript{24} which included only one study from 2012, the current review is a systematic review of publications from January 2012 to June 2015.

METHODS

A systematic review of the literature was conducted using the PsycINFO and PubMed databases. Boolean search logic and MeSH terms were used to create the following search terms: (1) suicide, suicidal, suicide attempt, suicidal thought, or suicidal ideation; and (2) sleep, sleep disturbance, sleep disorder, nightmare, dream, insomnia, shift work, sleep apnea, sleep disordered breathing, sleep initiation disorder, sleep maintenance disorder, sleep psychology, or sleep epidemiology. The literature search was then supplemented by a hand search of the reference sections of the reviewed articles. Eligible articles contained the following elements: (1) available in English; (2) used people older than age 18 years; (3) original research; (4) published in peer-reviewed journal; (5) reported data on SI, attempts, or deaths; (6) reported data on sleep pathology, pattern, or quality; (7) the association between suicide and sleep outcomes were reported or presented in such a way that the relationship could be interpreted; and (8) published between January 2012 and June 2015.

RESULTS

The literature search yielded a total of 993 abstracts from PubMed and 813 abstracts from PsycINFO. An additional 10 abstracts were identified via hand search of the reference sections. An initial review identified 188 abstracts as potentially relevant for this review. This sample of abstracts was then further reduced to include only those published between January 2012 and June 2015, resulting in 91 abstracts. Of these 91 abstracts, 60 were identified for further full text review. Thirty-six articles met full inclusion criteria and were included in the present review. Studies were largely cross-sectional, were conducted in a wide range of clinical and nonclinical samples, and used a variety of measures to assess sleep disturbances and suicide outcomes. This current review is divided into three broad categories: SI, suicide attempts, and suicide. Some studies report both ideation and attempts and may be reviewed in each respective section.

SUICIDAL IDEATION

A total of 30 publications reported on SI of which four employed longitudinal designs with the remaining 26 being cross-sectional studies (Tables 1-3). In addition, 19 of the 30 studies were conducted in clinical samples, whereas 11 were conducted in either community samples (n = 7) or other nonclinical samples (n = 4). With respect to the relationship of SI to the type of sleep disturbance assessed, the number of studies assessing each of the sleep disturbance categories (with some studies measuring more than one) were as follows: insomnia or insomnia symptoms (n = 16); nightmares (n = 6); circadian rhythm disturbance (n = 2); sleep apnea (n = 0); and other sleep disturbances (n = 16).

Longitudinal Studies

Four studies published since 2012 were identified that assessed the association of sleep disturbance to SI using longitudinal designs. Li et al.\textsuperscript{25} conducted a 4-year follow-up study among 362 psychiatric outpatients in Hong
<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Population</th>
<th>Mean Age (y)</th>
<th>Sleep Construct</th>
<th>Suicide Construct</th>
<th>Sleep-Suicide Association</th>
<th>Association Controlling for Psychopathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li et al.</td>
<td>371</td>
<td>Outpatient (MDD)</td>
<td>44.6</td>
<td>Sleep scale</td>
<td>Nightmare scale</td>
<td>4 items</td>
<td>Insomnia&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Nadorff et al.</td>
<td>1,529</td>
<td>Inpatient</td>
<td>35.6</td>
<td>Sleep item</td>
<td>1 item</td>
<td>No data</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ribeiro et al.</td>
<td>311</td>
<td>Military (SI)</td>
<td>22.2</td>
<td>Insomnia items</td>
<td>Scale</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Suh et al.</td>
<td>1,282</td>
<td>Korean people</td>
<td>52.3</td>
<td>Insomnia items</td>
<td>1 item</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bae et al.</td>
<td>1,000</td>
<td>Korean people</td>
<td>39.6</td>
<td>Sleep duration</td>
<td>Scale</td>
<td>Sleep duration&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Sleep duration&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Betts et al.</td>
<td>2,421</td>
<td>Australian people</td>
<td>No data</td>
<td>Sleep quality scale</td>
<td>1 item</td>
<td>No data</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bishop et al.</td>
<td>654</td>
<td>Outpatient (US veterans)</td>
<td>57.1</td>
<td>Sleep item</td>
<td>Scale</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bryan et al.</td>
<td>158</td>
<td>Outpatient (deployed soldiers with TBI)</td>
<td>25.1</td>
<td>Insomnia scale</td>
<td>Scale</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Calandre et al.</td>
<td>373</td>
<td>Outpatient (fibromyalgia)</td>
<td>49</td>
<td>Sleep quality scale</td>
<td>1 item</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chakravorty et al.</td>
<td>161</td>
<td>Outpatient (US veterans)</td>
<td>51</td>
<td>Sleep continuity items and a sleep quality item</td>
<td>Scale</td>
<td>Sleep duration&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Sleep duration&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chan et al.</td>
<td>253</td>
<td>Outpatient (MDD)</td>
<td>50.8</td>
<td>Chronotype scale</td>
<td>Insomnia scale</td>
<td>4 items</td>
<td>Eveningness&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chiu et al.</td>
<td>263</td>
<td>Older Chinese people</td>
<td>60.7</td>
<td>Insomnia items</td>
<td>1 item</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Davidson et al.</td>
<td>346</td>
<td>Inpatient (PTSD)</td>
<td>45.5</td>
<td>Sleep quality scale</td>
<td>7 items</td>
<td>Sleep quality&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep quality&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Dell’Osso et al.</td>
<td>65</td>
<td>Outpatient and inpatient (PTSD)</td>
<td>45</td>
<td>10 sleep items 6 rhythmicity items</td>
<td>6 items</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Kato et al.</td>
<td>343</td>
<td>White collar workers</td>
<td>43.5</td>
<td>Insomnia items</td>
<td>Scale</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Kim et al.</td>
<td>15,236</td>
<td>Korean people</td>
<td>43</td>
<td>Sleep duration</td>
<td>1 item</td>
<td>Sleep duration&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep duration&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
### TABLE 1. (continued)

#### Studies on Sleep Disturbances and Suicide Ideation

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Population</th>
<th>Mean Age (y)</th>
<th>Sleep Construct</th>
<th>Suicide Construct</th>
<th>Sleep-Suicide Association</th>
<th>Association Controlling for Psychopathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klimkiewicz et al.</td>
<td>304</td>
<td>Outpatient and inpatient</td>
<td></td>
<td>No data</td>
<td>Insomnia scale</td>
<td>1 item</td>
<td>Insomnia^b</td>
</tr>
<tr>
<td>Lai et al.</td>
<td>755</td>
<td>Outpatient (MDD, BD)</td>
<td>41.1</td>
<td>Sleep quality</td>
<td>Nightmare item</td>
<td>Diagnostic interview</td>
<td>Sleep quality^b</td>
</tr>
<tr>
<td>Maniam et al.</td>
<td>20,552</td>
<td>Malaysian community</td>
<td></td>
<td>No data</td>
<td>Insomnia items</td>
<td>1 item</td>
<td>No data</td>
</tr>
<tr>
<td>Marinova et al.</td>
<td>52</td>
<td>Inpatient (MDD, BD)</td>
<td></td>
<td>No data</td>
<td>Dream items</td>
<td>1 item</td>
<td>No data</td>
</tr>
</tbody>
</table>
| Nadorff et al.       | 673         | College students            | 20           | Insomnia scale  | Nightmare scale     | Scale                     | Insomnia^b
| Nadorff et al.       | 1,351       | College students            | 18.9         | Insomnia scale   | Nightmare scale     | Scale                     | Insomnia^b
| Pigeon et al.        | No data     | Community (at large)        | 52.5         | Insomnia scale   | 1 item              | Insomnia^b                                    |
| Pompili et al.       | 843         | ED with psychiatric consult | 45.7         | Insomnia scale   | 4 items             | Insomnia^a                        |
| Racine et al.        | 88          | Outpatient (chronic pain)   | 53.3         | Sleep quality    | 1 item              | Sleep quality^b                       |
| Richardson et al.    | 404         | Outpatient (Canandian veterans) | No data | Insomnia item | Nightmare item     | 1 item                    | Insomnia^a
| Sit et al.           | 628         | Outpatient (postpartum depression) | 28.7    | Sleep disturbance items | 1 item                    | Sleep disturbance^b                              |
| Swinkels et al.      | 1,640       | Outpatient (US veterans)    | 37           | Sleep quality    | Scale               | Sleep quality^b Sleep duration^a |
| Trinanes et al.      | 117         | Outpatient (women with fibromyalgia) | 49.1    | Sleep quality    | 1 item              | Sleep quality^a Daytime dysfunction^b |
| Wigg et al.          | 98          | Outpatient (epilepsy)       | 39.7         | Sleep quality    | Scale and subscales | 1 item                    | Sleep quality^b Sleep quality (scale)^b |

**Abbreviations:** BD, bipolar disorder; ED, emergency department; MDD, major depressive disorder; PTSD, posttraumatic stress disorder; TBI, traumatic brain injury; SI, suicidal ideation; WASO, wake after sleep onset.

^a Denotes no statistically significant relationship between the sleep construct listed and suicidal ideation.

^b Denotes that a statistically significant relationship has been observed.
Kong who had previously been diagnosed with major depressive disorder (MDD) at baseline. Unfortunately, analyses with respect to SI were only conducted in the subsample \((n = 150)\) of participants with remitted depression, only 13 of which (9%) endorsed SI and only recent, but not baseline sleep was assessed. Here the presence of nightmares, but not insomnia was associated with increased risk for SI in adjusted logistic regression models.

Three additional prospective studies are more informative. Nadorff et al.\(^{26}\) assessed this association across the course of inpatient psychiatric treatment that averaged 6 weeks in 1,529 patients. Sleep variables, SI, and depression severity were all derived from items on the same depression scale and the length between baseline and discharge assessments was relatively modest. Nonetheless, findings revealed a negative association between improvements in sleeping pattern and SI severity at discharge after controlling for baseline depression severity. In another unique sample, among 321 military service members referred to treatment for suicidality, associations of insomnia symptoms to SI were assessed at both baseline and after treatment 1 month later \((n = 239)\).\(^{27}\) Insomnia symptom severity was compiled from the sum of two sleep items on a depression scale and a fatigue item on a suicide scale. Baseline insomnia symptom severity predicted severity of SI 1 month later after controlling for a number of variables including depression. In fact, other than baseline SI, insomnia severity was the only variable to be significantly associated with 1-month SI.

Finally, in a 6-year longitudinal study, Suh et al.\(^{28}\) assessed insomnia, depres-
sion, and SI at four time-points in 1,282 nondepressed participants drawn from a Korean epidemiologic study. In models controlling for a number of factors including depression, the risk of SI posed by the presence of persistent insomnia was upheld. Interestingly, participants with insomnia at only one time-point were at no increased risk for reporting SI compared to those with no insomnia.

**Cross-Sectional Studies**

Twenty-six studies published were identified that assessed the association of SI with sleep disturbance using cross-sectional designs. Sixteen of these studies were conducted in clinical samples, with 5 including inpatients and 11 including outpatients in a variety of settings, and an additional 10 studies were conducted in nonclinical samples.

Four of the five studies among inpatient or emergency department patients requiring psychiatric consults reported an association between some form of sleep disturbance and SI. In one study, an association of sleep quality to SI could be inferred from a structured equation model of veterans in a residential PTSD program. In a smaller sample of both inpatient and outpatient participants, results of patients with PTSD with both a sleep rhythmicity subscale (with higher values indicating greater rhythmicity problems) and a sleep disturbance scale were associated with SI; only rhythmicity remained significant in regression models. Among inpatient and outpatient participants in substance abuse programs in Poland, insomnia severity over a 1-month period followed by a 6-month period was associated with SI; only rhythmicity remained significant in models adjusting for psychopathology.

**TABLE 3.**

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample Size</th>
<th>Population</th>
<th>Mean Age (y)</th>
<th>Sleep Construct</th>
<th>Suicide Construct</th>
<th>Sleep-Suicide Association</th>
<th>Association Controlling for Psychopathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bernert et al.</td>
<td>420</td>
<td>Older adults</td>
<td>74.9</td>
<td>Sleep quality scale</td>
<td>Suicide decedent</td>
<td>Sleep quality&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep quality&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gunnell et al.</td>
<td>393,983</td>
<td>Taiwanese people</td>
<td>~43</td>
<td>Sleep disturbance</td>
<td>Suicide decedent</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Kodaka et al.</td>
<td>194</td>
<td>Japanese people</td>
<td>No data</td>
<td>Sleep disturbance</td>
<td>Suicide decedent</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pigeon et al.</td>
<td>381</td>
<td>US veterans</td>
<td>No data</td>
<td>Sleep disturbance</td>
<td>Time to death by suicide</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sleep disturbance&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Sun et al.</td>
<td>804</td>
<td>Chinese people</td>
<td>26.5</td>
<td>Insomnia items</td>
<td>Suicide decedent</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Insomnia&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Denotes a statistically significant relationship has been observed.
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CME

In the only study with both a relatively large sample size (n = 304) and appropriate statistical controls for psychopathology, insomnia severity over the “past month” as assessed by a validated insomnia scale remained a significant predictor of SI. Eleven cross-sectional studies were conducted in outpatient samples. Two separate studies assessed sleep and SI in veteran patients referred to a telehealth assessment (predominantly for substance misuse, anxiety, or depression). In the larger of the two studies (n = 654) sleep disturbance was associated with SI both before and after controlling for psychopathology. In the smaller study (n = 161) conducted at a different telehealth center and utilizing additional sleep variables, a number of sleep disturbance and insomnia symptom variables were positively associated with the same SI variable as the prior study. Only sleep quality remained significantly associated with SI after controlling for all other sleep variables and a number of demographic and clinical variables. In contrast, among current or recent Canadian military service members referred to a stress injury clinic (n = 404), neither insomnia nor nightmares were associated with SI in logistic
regression models in which the presence of MDD was the only significant predictor of SI.\textsuperscript{50} Finally, among 158 active duty military personnel referred for clinical assessment of traumatic brain injury, insomnia severity was independently associated with SI after age and gender adjustments, but no longer a significant predictor when also controlling for PTSD and depression severity.\textsuperscript{32}

Additional work in outpatient samples includes a study of patients with prior MDD reassessed 1 year later (n = 253).\textsuperscript{35} Rates of “past month SI” were highest among those with eveningness tendencies (49%) compared to morningness (18%) and intermediate (18%) chronotypes, although this particular analysis did not control for depression severity, depression remission, or other psychopathology. In patients with MDD (n = 157) or bipolar disorder (n = 363) completing a number of validated measures, severity of sleep disturbance, poor sleep quality, and frequency of nightmares were each associated with SI in models controlling for demographic, but not clinical factors.\textsuperscript{42} Among 628 women with postpartum depression, sleep disturbance was associated with SI in unadjusted comparisons; whereas in adjusted models this association remained significant for women without a history of childhood sexual abuse, but not in the 21% of the sample with a history of childhood sexual trauma.\textsuperscript{51} In four additional clinical samples with modest sample sizes, poor sleep quality was associated with SI in patients with chronic pain,\textsuperscript{49} fibromyalgia,\textsuperscript{53} and epilepsy,\textsuperscript{53} but not in a smaller sample of patients with fibromyalgia.\textsuperscript{54}

As noted, 10 cross-sectional studies were conducted in nonclinical samples including six in the community or general population and an additional four in more specialized nonclinical samples. Associations with SI were observed for short or long sleep duration in an urban Korean sample (n = 1,000),\textsuperscript{29} sleep disturbance in an urban Australian sample (n = 2,421),\textsuperscript{30} insomnia symptoms in an older, rural Chinese population (n = 263),\textsuperscript{36} insomnia severity in a small US metropolitan area,\textsuperscript{47} both short and long sleep duration in a large Korean sample (n = 15,236),\textsuperscript{31} and insomnia symptoms in a large Malaysian sample (n = 20,552).\textsuperscript{43} All but two of these studies controlled for psychopathology.\textsuperscript{36,43}

In the studies with samples that were nonclinical, but not in the general popula-

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**Findings on the relationship between sleep problems and history of suicide attempts were mixed.**

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**Summary**

Overall, there was a significant association between a sleep measure and SI in 77% of unadjusted comparisons and in 74% of comparisons in which some adjustment for psychopathology was included. A more striking difference between adjusted and unadjusted findings was present for analyses focused on insomnia severity, where 10 of 12 unadjusted comparisons were significant, but only 50% of those adjusting for psychopathology. This was due largely to negative studies conducted in clinical samples. Nightmares, sleep quality, and other sleep disturbances were assessed in a smaller number of cases, but all favored significant associations with SI in both controlled and uncontrolled analyses. Findings were mixed in the small number of studies assessing chronotype or rhythmicity, as well as sleep duration. In studies controlling for psychopathology, sleep duration was significantly associated with SI in only 1 of 4 studies. Finally, no new studies of SI were identified that assessed objective measures of sleep or sleep disordered breathing disorders such as sleep apnea.

**SUICIDE ATTEMPTS**

Interpretable data on the relationship between sleep and suicide attempts or attempters were reported in nine of the reviewed studies. Seven of these studies relied on cross-sectional design,\textsuperscript{32,34,36,38,46,48,55} whereas two employed some form of longitudinal methodology.\textsuperscript{25,27} The participant pools of half of the studies consisted of patients enrolled in either inpatient\textsuperscript{38,48} or outpatient therapy.\textsuperscript{25,27,34,38} The remaining samples consisted of a community sample,\textsuperscript{36} suicide attempters from rural China,\textsuperscript{55} deployed service members of the US military,\textsuperscript{52} or college students.\textsuperscript{46}

Findings on the relationship between sleep problems and history of suicide attempts were mixed. One article reported that short sleep duration was positively associated with a history of attempts among veterans receiving primary care services,\textsuperscript{34} whereas lifetime history of circadian disruption\textsuperscript{18} was not. Presence or history of nightmares was also signifi-
cantly associated with a history of suicide attempt. In one report, two separate analyses involving 1,351 college students found nightmares associated with a greater likelihood of having made a suicide attempt even after controlling for depression and constructs from the Interpersonal-Psychological Theory of Suicide.\textsuperscript{46} Li et al.\textsuperscript{25} suggest that among people with remitted depressive episodes, the presence of nightmares is positively associated with SI, but not suicide attempts.

Insomnia symptoms and generalized sleep disturbance also received mixed support. Of the six articles that examined the association between attempt history and insomnia symptoms, half reported a positive association.\textsuperscript{46,32,27} Support for sleep disturbance as a risk factor for suicide attempts was also split. Two studies explored this relationship among participants in rural China. Chiu et al.\textsuperscript{36} reported that sleep disturbance was associated with increased SI but not a history of attempts, whereas another study found that presence of sleep disturbance was associated with attempter status.\textsuperscript{55}

One longitudinal examination among people with and without remitted depression found both residual insomnia and residual nightmares to be more frequently observed among those with a history of suicide attempt, but the differences were not statistically significant.\textsuperscript{25} In another longitudinal study, Ribeiro et al.\textsuperscript{27} prospectively examined the relationship between insomnia and suicide attempts among service members who were experiencing severe suicidality and who were enrolled as part of a larger suicide intervention trial. The authors reported that insomnia symptoms prospectively predicted suicide attempts at 1-month follow-up when controlling for baseline insomnia, depressive symptoms, and hopelessness. However, insomnia was no longer a significant predictor after PTSD diagnosis, anxiety, and drug and alcohol abuse symptoms were also added to the model. At this time the relationships among various sleep pathology and subsequent suicide attempts remain somewhat unclear. Additional prospective research using validated measures and well-operationalized constructs would add clarity to the existing literature.

SUICIDE

Five publications reported on suicide decedents or risk factors for suicide, of which three employed psychological autopsy or retrospective chart review methodology.\textsuperscript{58-60} Two studies used longitudinal design.\textsuperscript{56,57} Three of the five studies were conducted with Asian populations in rural China,\textsuperscript{60} Japan,\textsuperscript{58} and Taiwan.\textsuperscript{57} Sleep difficulties in relationship to suicide were operationalized in multiple ways. Two articles reported insomnia symptoms,\textsuperscript{56,60} whereas the other three reported more generalized sleep difficulty.\textsuperscript{57,59} In addition, articles reported associations among suicide and self-reported sleep quality,\textsuperscript{56} use of sleep medications,\textsuperscript{57} and duration of sleep.\textsuperscript{57} All five of the articles that reported data on suicide decedents accounted for the presence of comorbid psychopathology either by controlling for it as a covariate or conducting a sensitivity analysis.\textsuperscript{57}

In their longitudinal case-control cohort study of suicide in later life, Bernert et al.\textsuperscript{56} examined risk factors for suicide among a sample of 20 suicide decedents and 400 matched controls drawn from a community sample of adults age 65 years or older (n = 14,456). They reported that at a 10-year follow-up, poor sleep quality at baseline (odds ratio [OR], 1.39; 95% CI, 1.14-1.69), difficulty falling asleep (OR, 2.24; 95% CI, 1.27-3.93), and nonrestorative sleep (OR, 2.17; 95% CI, 1.29-3.67) were all significantly associated with an increase in a participant’s risk of suicide. When controlling for depressive symptoms, only baseline self-reported sleep quality remained significantly associated with suicide (OR, 1.30; 95%; 1.04-1.63).

This work was followed by a study\textsuperscript{57} on longitudinal examination of sleep and suicide among 393,983 Taiwanese adults. Over approximately 7.4 years of follow-up study, 335 deaths by suicide were observed in this sample. Sleep disturbance, short sleep duration (less than 6 hours per night), and use of medications to improve sleep were all positively associated with increased risk of death by suicide. However, these findings should be interpreted with the knowledge that there was a mean gap of 5.6 years between the collection of sleep data and the death of study participants, introducing the possibility that sleep patterns may have significantly improved or worsened during the intervening time.

The three studies that used retrospective chart review and psychologic autopsy methodology all adjusted for comorbid psychopathology.\textsuperscript{58-60} In 2012, Pigeon et al.\textsuperscript{59} performed a retrospective chart review of 423 veteran decedents who were enrolled in Veterans Health Administration (VHA) care. After their last VHA visit, veteran decedents with documented sleep disturbance (45.4%) had a shorter time to death (mean [M] = 75 days) than those who did not have a documented sleep disturbance (M = 174 days) after controlling for the presence of comorbid mental health or substance use symptoms, age, and region. Kodaka et al.\textsuperscript{58} interviewed family members of 49 suicide decedents and 145 matched, living controls. They reported a significantly greater prevalence of sleep disturbances among suicide decedents than controls, even after adjusting for presence of depression and other mental health disorders (OR, 12.7; 95% CI, 4.0-40.3). Lastly, Sun et al.\textsuperscript{60} reported on the findings from a recent psychologic autopsy study of suicide decedents (n = 388) and living community controls (n = 416) in rural China. They report that after controlling for the presence of mental health disorders, difficulty initiating sleep (OR, 12.01; 95% CI, 4.32-33.39), difficulty maintaining sleep (OR, 12.82; 95% CI, 3.67-44.77),
and early morning awakenings (OR, 12.08; 95% CI, 3.87-37.76) were all significantly associated with a greater likelihood of suicide.

In sum, all five of the studies that explored risk factors among suicide decedents that were included in this review reported positive associations among sleep disturbances in some form and increased risk of suicide. Adding to these findings is the fact that all of these studies controlled for co-occurring psychopathology.

**DISCUSSION**

This review identified 36 studies that assessed the relationship of sleep disturbance to SI, suicide attempt and suicide, met inclusion criteria, and were published from 2012 to June 2015. This represents a substantial addition to the extant literature since prior reviews. In general, this newer set of adult studies continues to support sleep disturbance as an independent risk factor for SI, attempts, and suicide.

It is noteworthy, however, that no new studies using objective sleep measures such as polysomnography were identified nor were any studies identified that assessed sleep disordered breathing as a specific form of sleep disturbance. On the other hand, eight studies were identified that assessed sleep-suicide relationships in veteran samples, whereas none were identified in a 2012 meta-analysis. The relationship between sleep problems and suicide among veterans is of particular interest given that this population frequently bears the burden of co-occurring psychopathology, often had a unique work life that lends itself to sleep disturbance, and carries an elevated rate of suicide. Seven of eight studies among veterans reported at least one significant association between a sleep variable and the presence or severity of SI (3 of 4 studies assessing insomnia symptoms). Also noteworthy is the addition to the literature of five new studies that assessed sleep disturbance among suicide decedents. In addition, the majority of studies used some form of statistical control for the presence and/or severity of psychopathology known to increase risk for suicide (eg, depressive episodes or depression severity).

Nonetheless, given the wide variety of clinical samples, nonclinical samples, sleep constructs, validated scales, single item measures, and statistical methodologies across the reviewed studies, it is difficult to draw more than broad conclusions noted above. It is also fair to say that as the operationalization of sleep-related variables become more precise, their robustness as a risk factor for suicide lessens. Although we employed a systematic methodology in selecting articles, this was of course not a meta-analysis. Given the number of studies identified in prior reviews, the addition of the newer studies reviewed here may constitute a critical mass of studies that are similar enough in sample constitution and in methodology to allow one or more narrow meta-analyses that refine our understanding of sleep-suicide relationships. Beyond the value of continuing the trend to use validated measures and appropriate statistical controls for psychopathology, work in the area of sleep disordered breathing in particular is needed. Finally, although not reviewed here, there is a need for controlled trials to assess the effect of sleep treatments on suicidal thoughts and behaviors.

**REFERENCES**


