

# Suicidality in sleep disorders: prevalence, impact, and management strategies

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**Abstract:** Sleep disturbances are associated with suicide-related thoughts and behaviors, and the incidence of sleep concerns and suicide has increased recently in the US. Most published research exploring the sleep–suicidality relation is focused on select sleep disorders, with few reviews offering a comprehensive overview of the sleep–suicidality literature. This narrative review broadly investigates the growing research literature on sleep disorders and suicidality, noting the prevalence of suicide ideation and nonfatal and fatal suicide attempts, the impact of several sleep disorders on suicide risk, and potential sleep-disorder management strategies for mitigating suicide risk. Aside from insomnia symptoms and nightmares, there exist opportunities to learn more about suicide risk across many sleep conditions, including whether sleep disorders are associated with suicide risk independently of other psychiatric conditions or symptoms. Generally, there is a lack of randomized controlled trials examining the modification of suicide risk via evidence-based sleep interventions for individuals with sleep disorders.

**Keywords:** sleep, suicide, suicidality, insomnia, nightmares, treatment

## Introduction

Globally, approximately 788,000 individuals died by suicide in 2015,<sup>1</sup> and it is estimated that one suicide occurs every 40 seconds somewhere in the world.<sup>2</sup> In the US, the crude suicide rate increased by 19% from 1999 to 2010 (10.5–12.4 per 100,000 individuals).<sup>3</sup> During this same period, there was a 226% increase in outpatient visits related to sleep disorders among adults aged 20 years and older, with the number of sleep-medication prescriptions increasing by 293%.<sup>4</sup> Concerns about sleep problems in other countries have also been noted, with a study of eight countries showing that more than 20% of sampled adults reported poor sleep quality in Bangladesh, South Africa, and Vietnam.<sup>5</sup>

Sleep disturbances have been identified as a risk factor for suicide ideation, nonfatal suicide attempts, and suicide,<sup>6–8</sup> and specific sleep-disorder symptoms (ie, insomnia and nightmares) have demonstrated unique relations to suicide-related thoughts and behaviors.<sup>9</sup> Given the aforementioned concerns regarding the prevalence of suicide and sleep problems, including recent increases in the US suicide rate and outpatient visits for sleep-related complaints, we briefly reviewed the research literature on suicide-related thoughts and behaviors in the varying sleep disorders to provide readers with an updated overview of the current literature. Additionally, we aimed to provide one of the first comprehensive reviews of the growing literature on suicide risk and sleep disorders, since past reviews of sleep disorders and suicidality have focused on a

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circumscribed number of sleep conditions.<sup>6,7,9,10</sup> Finally, this review highlights the available evidence on the prevalence of suicide risk among sleep disorders, the impact of sleep disorders on suicide risk, and potential sleep-disorder management strategies for mitigating suicide risk.

For this narrative review, studies were included if 1) any measure of sleep disturbance and suicide risk was administered in the study, 2) results were published, in press, or currently being considered for publication (ie, under review) in a peer-reviewed journal, and 3) the paper or published conference abstract was written in or translated into the English language. Our search strategy for identifying relevant studies included a search of all EBSCOhost databases, including manual electronic searches of Medline (no start date to May 2017), PsycInfo (no start date to May 2017), and Google Scholar (no start date to May 2017). Examples of general search terms used to identify relevant published work included “sleep”, “sleep disorder”, “sleep disturbance”, “suicide”, “suicidal”, “suicide risk”, “and suicidality”. In addition to the general sleep terms utilized, the first author individually paired the names of the seven major categories of sleep disorders (eg, parasomnias) from the third edition of the *International Classification of Sleep Disorders (ICSD)*<sup>11</sup> with each of the suicide-related search terms noted in the previous sentence. The first author also did this for every sleep-disorder diagnosis (eg, nightmare disorder) listed in the seven major categories to ensure that information was

included for all of the sleep-disorder diagnoses listed in the most recent edition of the ICSD.

## Insomnia symptoms

Along with the increased prevalence of outpatient visits noted previously, outpatient visits due to insomnia symptoms have increased 13% from 1999 to 2010 in the US.<sup>4</sup> Epidemiological studies estimate that up to 30% of the general population may have experienced insomnia symptoms during the past month.<sup>12,13</sup> Prevalence estimates of adults receiving an insomnia diagnosis is substantially lower than prevalence estimates of insomnia symptoms,<sup>13–15</sup> though they have also increased (ie, from 11.9% to 15.5% over a 10-year period).<sup>16</sup>

## Prevalence of suicidality in insomnia

There is a paucity of research estimating the prevalence of suicide-related thoughts and behaviors among individuals with insomnia. Studies examining insomnia and suicide-related variables often do so in samples where a diagnosis of clinical insomnia is not a focal point of sample recruitment. Several studies, though, have provided some perspective on the incidence of insomnia symptoms in samples with at-risk participants (see Table 1). For participants with insomnia symptoms, the prevalence for suicide ideation was 25%–32%,<sup>17,18</sup> 7%–92% for nonfatal attempts,<sup>17,19–22</sup> and 11%–37% among suicide decedents, with higher percentages appearing more closely to the time of death.<sup>23–26</sup>

**Table 1** Research reporting prevalence of suicide ideation in youth and adults with insomnia symptoms and sleep disturbance among youth, adult, and older adult suicide attempters (fatal and nonfatal)

	Youth	Adults	Older adults
<b>Suicide ideation</b>	Prevalence of suicide ideation was around 25% for French adolescents reporting insomnia symptoms. <sup>17</sup>	In a longitudinal study of 405 military veterans meeting criteria for insomnia disorder, 32% reported suicide ideation at baseline. <sup>18</sup>	–
<b>Nonfatal suicide attempts</b>	About 7% of French adolescents with insomnia symptoms reported a prior suicide attempt. <sup>17</sup> About 60% of adolescents reporting intentional self-harm or suicide-related behavior at age 15–17 years reported sleeping problems at age 12–14 years. <sup>19</sup> About 81% of adolescent suicide-attempt survivors reported sleep disturbances. <sup>20</sup>	About 46% of adult suicide-attempt survivors reported global insomnia symptoms and 92% reported difficulties with either initial, middle, or terminal insomnia. <sup>21</sup> Around 89% of adult suicide-attempt survivors reported sleep disturbances, which included initial (73%), middle (69%), and terminal insomnia (58%). <sup>22</sup>	–
<b>Suicide</b>	Around 30% of US adolescent suicide decedents experienced insomnia in the week preceding suicide and 32% experienced symptoms around the time of death. <sup>23</sup> About 33% of rural Chinese youth suicide decedents experienced insomnia symptoms in the week preceding suicide. <sup>24</sup>	Between 28 and 37% of Japanese suicide decedents experienced initial, middle, or terminal insomnia. <sup>25</sup> About 60% of US military veteran suicide decedents with psychiatric symptoms reported sleep problems during a VHA visit in the last year of life (40% reported sleep problems at their last VHA visit). About 13% without psychiatric symptoms reported sleep problems (9% at last visit). <sup>192</sup>	About 11% of Taiwanese suicide decedents had a history of insomnia symptoms. <sup>26</sup>

**Notes:** Initial insomnia, sleep-onset difficulty; middle insomnia, sleep-maintenance difficulty; terminal insomnia, early-morning awakening.

**Abbreviation:** VHA, Veterans Health Administration.

## Impact of insomnia on suicidality

Difficulty sleeping and experiencing greater severity of insomnia symptoms have been associated with suicide ideation in youth, adult, and older adult samples across multiple settings and countries.<sup>17,19,27–54</sup> Adolescents and adults reporting insomnia symptoms show an increased suicide risk,<sup>47,55–57</sup> including greater odds of reporting lifetime,<sup>17,58–60</sup> recent,<sup>21</sup> and subsequent<sup>48,58,59</sup> suicide attempts. Further, older adults reporting greater insomnia-symptom severity are also more likely to report a suicide-attempt history.<sup>61</sup> Insomnia symptoms are also associated with fatal suicide attempts in retrospective, prospective, and psychological autopsy studies of youth<sup>23,24</sup> and adults.<sup>24,25,62–67</sup> Research among older adults has shown similar findings regarding fatal suicide attempts,<sup>26</sup> with longitudinal research showing that poor subjective sleep increased the odds of a fatal suicide attempt 1.2-fold<sup>68</sup> and nonrestorative sleep increased risk 2.2-fold.<sup>69</sup>

The odds of suicide were fivefold greater in a sample of adolescents experiencing insomnia symptoms within the week preceding suicide, with suicide decedents more likely than controls to experience a worsening of sleep disturbance in the final week preceding suicide.<sup>23</sup> Additionally, among a sample of veteran suicide decedents, those decedents with documented sleep disturbance (ie, insomnia or hypersomnia) died significantly sooner than decedents without documented sleep disturbances.<sup>64</sup> Longer time frames to suicide have also been observed, as a dated 10-year prospective study of 954 psychiatric inpatients with a major mood disorder showed that global insomnia (presence of onset, maintenance, and terminal insomnia) was one of six variables associated with a fatal suicide attempt within a 1-year time frame.<sup>63</sup> Taken together, these results suggest that insomnia may function

as a distal or proximal risk factor for suicide, with a role in both imminent and long-term suicide risk.

## Insomnia and suicidality inconsistencies

Diverging from the studies reviewed thus far, Pompili et al<sup>70</sup> found no significant differences in suicide ideation or suicide-attempt history between those reporting and denying insomnia symptoms in a sample of 843 patients admitted to an emergency department in Rome. However, they did find that those reporting insomnia symptoms more frequently used a violent suicide-attempt method. Furthermore, a few studies have shown that the presence of a psychiatric illness<sup>24</sup> or depressive symptoms<sup>36,41,52,71</sup> have an indirect effect on the relation between insomnia symptoms and suicide-related variables. However, across numerous studies, associations between insomnia symptoms and suicide-related variables have been independent of depressive symptoms and/or other potential confounders (ie, age, sex, fatigue, chronic health problems, anhedonia, hopelessness, anxiety symptoms, substance use, cognitive ability, or the presence of any psychiatric illness).<sup>19,23,25,30,31,33,34,40,42,46,48,51,57,61,64,66,68,69,72–74</sup>

Additional inconsistencies include the risk conferred by specific insomnia symptoms (see Table 2). Research does not show a clear pattern regarding whether onset, maintenance, or terminal insomnia independently heighten suicide risk, with several studies showing that concurrently reporting two of these three insomnia symptoms may confer greater risk for suicide ideation<sup>40,42,46,57</sup> and attempts,<sup>30,31,75,76</sup> intent to attempt suicide,<sup>72</sup> and death by suicide.<sup>66</sup> This suggests that greater risk may result from the presence of multiple sleep disturbances.<sup>54,66,73</sup>

In an attempt to understand the insomnia–suicide relation better and perhaps account for the aforementioned

**Table 2** Inconsistencies in insomnia symptoms and suicidality research

<b>Initial insomnia</b>	Initial insomnia has been associated with current <sup>51</sup> and past 12-month suicide ideation, suicide-attempt planning, and nonfatal suicide attempts, <sup>73</sup> and has been independently associated with youth suicide, <sup>23,24</sup> but was shown to be protective against attempting suicide at age 15–20 years. <sup>193</sup>
<b>Middle insomnia</b>	Middle insomnia has been independently associated with suicide in youth <sup>24</sup> and adult <sup>65</sup> samples, and has been associated with an increased frequency of lifetime suicide attempts, <sup>140</sup> with adolescents reporting middle insomnia showing a four- <sup>179</sup> to sixfold <sup>193</sup> greater likelihood of reporting a past suicide attempt than those without middle insomnia. The relation between middle insomnia and suicide ideation, however, has not been consistent, though it should be noted that the majority of studies have shown an association between these two variables and the few inconsistencies do not appear to depend on whether researchers adjusted for psychiatric illness or other covariates, given that this was done across the majority of studies. <sup>30,31,40,42,46,57,140</sup>
<b>Terminal insomnia</b>	Regarding terminal insomnia, a few studies have shown that terminal insomnia is associated with suicide ideation (independently of mood, anxiety, and substance-use disorders), <sup>140</sup> greater intent to attempt suicide, <sup>128</sup> and recent suicide attempts, <sup>73,76</sup> but not lifetime suicide attempts. <sup>140</sup> A study of Chinese adolescents showed that terminal insomnia did not predict significantly greater odds of suicide ideation when adjusting for age, sex, father's occupation, and depressive symptoms. <sup>117</sup>

**Notes:** Initial insomnia, sleep-onset difficulty; middle insomnia, sleep-maintenance difficulty; terminal insomnia, early-morning awakening.

inconsistencies, researchers have explored several potential mechanisms<sup>77</sup> (see Table 3 for a summary). It is important to note that much of the mediation research thus far has been atemporal, due to the cross-sectional or baseline-follow-up research methods employed, limiting conclusions regarding temporality.<sup>78</sup> More than two time points may be necessary, in order to infer temporal ordering of mediation.<sup>78</sup>

## Management of suicidality and insomnia

Researchers have continuously called for greater empirical focus on the investigation of insomnia-treatment effects on mitigating suicide risk.<sup>33,64,79–83</sup> Although studies examining the efficacy of insomnia treatments on reducing suicide risk have been conducted,<sup>84</sup> there is a significant need for more research (ie, randomized controlled trials). Cognitive

**Table 3** Summary of mechanisms examined in the insomnia–suicidality relation

Proposed mediator	Summary of research
<b>Hopelessness</b>	Hopelessness had an indirect effect on the insomnia–suicide ideation relation in a cross-sectional sample of US adults, independently of depressive symptoms. <sup>194</sup> However, other studies have shown that the insomnia symptom–suicide ideation relation remains when adjusting for depressive symptoms and feelings of hopelessness. <sup>48</sup> Additionally, a case study of a 64-year-old male admitted to a psychiatric hospital after a suicide attempt noted that the patient's feelings of hopelessness were secondary to insomnia distress and resolved, along with suicide ideation, following sleep improvements. <sup>195</sup> Finally, in a study of adults with depression, hopelessness did not relate to insomnia symptoms or dysfunctional beliefs and attitudes about sleep, <sup>43</sup> which is notable, given that it has been argued that some of the items on the DBAS measure reflect feelings of hopelessness. <sup>196</sup>
<b>Depression structure</b>	Allan et al <sup>71</sup> suggested that the structure of depression (ie, cognitive/affective symptoms vs somatic) may explain the discrepant depression-mediation results across studies. In their sample of 405 current and former US military personnel, cognitive/affective symptoms of depression had an indirect effect on the relation between insomnia symptoms and baseline and 12-month follow-up suicide-ideation levels.
<b>Insomnia duration</b>	Research has shown that the duration of insomnia symptoms is associated with suicide risk independently of current symptoms of insomnia, depression, anxiety, or PTSD. <sup>177</sup> Furthermore, a random-digit-dial study of US adults showed that insomnia complaints were more strongly associated with suicide ideation than ratings of poor sleep, <sup>197</sup> and other studies have shown higher levels of suicide ideation among participants whose sleep concerns did not improve over the course of the treatment (independently of baseline sleep concerns, depressive symptoms, and suicide ideation) <sup>198</sup> and that sleep dissatisfaction can explain a significant portion of the relation between insomnia and the wish to die. <sup>129</sup>
<b>DBAS</b>	In addition to nightmares, it has been proposed by McCall et al that DBAS may explain part of the relation between insomnia symptoms and suicide ideation due to the indirect effect of DBAS approaching significance in their cross-sectional sample of adults with depression. <sup>43</sup>
<b>Nightmares</b>	Nightmares have received increased attention over the past decade with regard to their potential role as a mediator of the insomnia–suicide relation. Research has shown that nightmares are associated with insomnia symptoms, <sup>43,199</sup> independently predictive of suicide ideation in cross-sectional samples, <sup>38,89,165</sup> and that the relation between insomnia symptoms and suicide ideation becomes nonsignificant when including nightmares <sup>43</sup> and holding symptoms of anxiety, depression, and PTSD constant. <sup>38</sup> Furthermore, coexisting insomnia symptoms and nightmares have been shown to increase the risk for a future suicide attempt in an adult sample of psychiatric outpatients, <sup>58</sup> potentially supporting the supposition that nightmares may be one reason for middle insomnia. <sup>60</sup>
<b>Hyperarousal</b>	Insomnia and PTSD-related nightmares have both been proposed as conditions of hyperarousal, <sup>196</sup> and hyperarousal during sleep has been proposed as a neurobiological correlate of suicide ideation in adults with major depressive disorder. <sup>200</sup> Recent studies have examined the role of hyperarousal in suicide risk, <sup>201</sup> and a study of US military personnel showed a stronger relation between insomnia symptoms and suicide ideation among those with heightened levels of agitation. <sup>35</sup> A dated study of suicide-attempt survivors, however, showed that 89% of attempt survivors denied experiencing agitation in the week prior to their suicide attempt. <sup>21</sup>
<b>Thwarted belongingness</b>	Recent research has examined the indirect effect of thwarted belongingness, a variable included in the suicidal desire component of the IPTS, <sup>202</sup> on the relation between insomnia symptoms, suicide ideation, and suicide risk, showing that the variable accounts for a significant portion of the relation between insomnia and suicide ideation across multiple samples. <sup>39,47,56</sup> However, it should be noted that the indirect effect of thwarted belongingness on the relation between insomnia and suicide risk was not significant when adjusting for depressive symptoms, <sup>47</sup> and prior research has shown that the IPTS or thwarted belongingness alone fail to mediate the relation between insomnia symptoms and past suicide attempts cross-sectionally. <sup>74</sup> Furthermore, the results from Hom et al <sup>47</sup> specifically showed that the indirect effect of thwarted belongingness on the relation between insomnia and suicide ideation was more meaningful for those with lower levels of perceived burdensomeness. This finding potentially conflicts with the IPTS as originally proposed, <sup>202</sup> and suggests that the IPTS may not be able to explain how insomnia symptoms lead to increased suicide risk across all samples, which is consistent with previous research. <sup>74</sup>

**Abbreviations:** DBAS, dysfunctional beliefs and attitudes about sleep; PTSD, posttraumatic stress disorder; IPTS, interpersonal–psychological theory of suicide.

behavioral therapy for insomnia (CBT-I) is one insomnia treatment that appears promising for mitigating suicide risk in insomnia patients. CBT-I is currently recommended as the initial treatment for chronic insomnia in adults,<sup>85</sup> and is associated with significant reductions in suicide-related thoughts from pre- to posttreatment.<sup>18,84,86</sup> Researchers have continuously called for greater empirical focus on investigating the effects of insomnia treatment on mitigating suicide risk.<sup>33,64,79–83</sup> We also argue that such research is needed, especially since there has not been enough research to establish adequate efficacy and because prescription sleep medications (eg, sedative–hypnotics) have been associated with suicide ideation<sup>34</sup> and suicide,<sup>57,87</sup> and were a stronger predictor of past-year suicide ideation and nonfatal suicide attempts than insomnia symptoms in a general US population sample.<sup>88</sup>

### Sleep-related breathing disorders

The number of outpatient visits resulting in a diagnosis of sleep apnea increased 442% from 1999 to 2010,<sup>4</sup> but the prevalence of suicide-related thoughts and behaviors among sleep-apnea patients is currently unknown. Studies have shown mixed findings regarding the relation between sleep apnea and suicide risk. Sleep-related breathing symptoms were not related to suicide ideation in an adult outpatient sample,<sup>89</sup> but have been associated with suicide ideation and suicide-attempt planning in a general population sample of adults<sup>90</sup> and greater depression severity and suicide risk in a sample of female sexual assault survivors (compared to those without sleep-related breathing symptoms).<sup>91</sup> In the latter study, the greatest suicide risk was shown for those participants presenting with concurrent sleep-related breathing symptoms and a sleep-movement disorder. It is unknown if a coexisting psychiatric illness or sleep disorder would explain the discrepant findings between these two studies. For instance, research has shown that 39%–61% of obstructive sleep-apnea patients also have insomnia symptoms.<sup>92–94</sup> It remains to be seen if sleep-related breathing symptoms are associated with suicide-related thoughts and behaviors independently of other sleep or psychiatric disorders.

Results from a case report and a study of adults assessed for obstructive sleep apnea suggest that treatment of sleep-related breathing via nasal continuous positive airway pressure may resolve suicide-related thoughts. The case study<sup>95</sup> focused on a 74-year-old male presenting with severe depression, excessive daytime sleepiness, and suicide ideation with a suicide-attempt plan, and noted that treatment of sleep-apnea symptoms appeared to lead to the resolution of depressive symptoms (a result supported by prior research)<sup>96</sup>

and suicide risk. In the study of adults assessed for obstructive sleep apnea, Edwards et al<sup>97</sup> showed that among the subset of the sample that reported suicide ideation at baseline, none endorsed suicide ideation after 3 months of continuous positive airway-pressure adherence.

More research is needed, especially studies using objective sleep measures, in order to ascertain suicide risk among patients with central or obstructive sleep apnea. Additionally, little is known about the contribution of snoring to suicide risk. One study showed higher suicide risk for South Korean adolescents who reported snoring compared to those who denied snoring,<sup>55</sup> though snoring did not appear independently to contribute to suicide risk when adjusting for other sleep-related variables. Lastly, it is unknown if other sleep-related breathing disorders, such as sleep-related hypoventilation disorders or catathrenia, confer an increased suicide risk.

### Central disorders of hypersomnolence Narcolepsy

When compared to the general population, patients with narcolepsy have an increased mortality risk across all age-groups.<sup>98</sup> Although few studies have examined the prevalence of suicide risk, results from the Burden of Narcolepsy Disease study showed that patients with a narcolepsy diagnosis were at increased risk of suicide-related behavior compared to matched controls, including increased odds of having a depressive or anxiety disorder.<sup>99</sup> Also, Ohayon<sup>98</sup> discussed results from an unpublished longitudinal study of narcolepsy patients<sup>100</sup> showing a sevenfold-greater risk for suicide among those with narcolepsy. More research is needed in order to understand better whether aspects of narcolepsy confer greater suicide risk or if the risk can be explained by a concurrent psychiatric illness (eg, depression). Furthermore, it is unknown if narcolepsy treatment can allay suicide risk.

### Idiopathic and other hypersomnias

Hypersomnia symptoms have been associated with suicide ideation<sup>101</sup> and nonfatal suicide attempts<sup>102</sup> in adolescents. Hypersomnia symptoms have also been associated with increased suicide risk<sup>103</sup> and higher odds of past-year and lifetime nonfatal suicide attempts in a sample of depressed adults.<sup>104</sup> Hypersomnia has also been associated with past-year suicide ideation and suicide-attempt planning when experienced concomitantly with insomnia symptoms.<sup>104</sup> Goldstein et al<sup>23</sup> found a higher prevalence of hypersomnia in adolescent suicide decedents compared to community controls. Based on information from decedent informants,

15% of adolescent suicide decedents experienced hypersomnia in the week preceding suicide and 16% experienced hypersomnia around the time of suicide. Additionally, it was more likely for the suicide decedents' hypersomnia symptoms to worsen in the week preceding suicide (compared to controls).<sup>23</sup> However, a psychological autopsy study of adult suicide decedents showed that the concurrent presence of hypersomnia with other depressive symptoms (ie, fatigue, impaired concentration/indecisiveness, and weight/appetite gain) was associated with decreased risk for suicide.<sup>62</sup> More research is needed to determine if hypersomnia increases suicide risk independently of concurrent psychiatric illness symptoms, and if so, whether management of hypersomnia can mitigate suicide risk.

### Kleine–Levin syndrome

Very few studies have investigated the prevalence of suicide risk in patients with Kleine–Levin syndrome (KLS). One study of 108 KLS patients showed that 3.7% of the sample endorsed thoughts of attempting suicide,<sup>105</sup> but no other studies to our knowledge have examined suicide-specific variables and potential confounders (eg, major mood disorder)<sup>106</sup> in samples of KLS patients. Reviews of the general KLS literature conclude that suicide attempts are rare among those with KLS.<sup>107,108</sup> Even so, Arnulf et al suggested monitoring suicide risk in patients with KLS.<sup>108</sup>

### Insufficient-sleep syndrome

A study of South Korean adolescents with behaviorally induced insufficient-sleep syndrome (BISS) showed that those with BISS had higher scores on measures of depression and suicide risk than adolescents without BISS and with sufficient sleep, adjusting for age and sex.<sup>55</sup> Significant differences in regard to suicide risk remained when adjusting for depressive symptoms, and oversleeping on the weekend were associated with suicide risk independently of depression, insomnia symptoms, snoring, and daytime sleepiness, suggesting that chronic sleep deprivation may be an independent suicide risk factor. These results are consistent with other studies showing that Korean adolescents who slept longer on weekends were at greater risk of reporting a recent suicide attempt or self-injury<sup>109</sup> and Chinese adolescents with greater suicide risk reporting short sleep duration during weekdays, increased sleep compensation and long sleep duration during weekends, and greater frequency of daytime napping.<sup>110</sup> Furthermore, a more recent study of US adults showed that both long and short sleep durations were associated with suicide risk.<sup>111</sup>

Short sleep duration (defined in various studies as  $\leq 4$ ,  $\leq 5$ ,  $\leq 6$ , or  $< 8$  hours of sleep) has been associated with increased odds of suicide risk in samples of Taiwanese adults,<sup>57</sup> US adolescents,<sup>102,112,113</sup> and US Army soldiers following redeployment.<sup>114</sup> Similar findings have been shown in samples of South Korean,<sup>115</sup> Taiwanese,<sup>116</sup> and Chinese adolescents<sup>117</sup> (all were independent of depressive symptoms). Short sleep duration has also been associated with past 12-month suicide ideation and nonfatal suicide attempts in a South Korean adolescent sample (the relation was weaker for depressed adolescents vs nondepressed)<sup>118</sup> and in a community sample of US adults after adjusting for symptoms of depression, bipolar disorder, panic attacks, alcohol and substance dependence, and antisocial personality disorder.<sup>119</sup> Increased risk of suicide ideation has also been shown among rural Chinese adolescents,<sup>120</sup> European adolescents,<sup>121</sup> US adolescents,<sup>122</sup> and South Korean adolescents<sup>123</sup> and adults<sup>124–126</sup> reporting short sleep duration, and one study showed that male Spanish suicide-attempt survivors were more likely to report shorter sleep duration than psychiatric inpatient controls who denied a suicide-attempt history<sup>127</sup> (short sleep duration was also associated with intent to attempt suicide among female attempt survivors, consistent with recent research).<sup>128</sup>

The potential importance of sleep duration in the development of suicide risk was emphasized in two longitudinal studies. The first showed that the wish to die among a small sample of French adults 1 month after an index suicidal crisis increased significantly with every lost hour of sleep,<sup>129</sup> which is consistent with cross-sectional adolescent research showing that a 1-hour reduction in weekday sleep was related to an increased risk of hopelessness, suicide ideation, and suicide attempts (risk was higher for males).<sup>130</sup> In a sample of adolescent monozygotic twins, the second study showed that a late bedtime and short sleep duration predicted future development of depressive and anxiety symptoms and suicide and self-injury risk (independently of bedtime regularity and genetic and shared environmental factors).<sup>131</sup>

Though it should be noted that inconsistencies exist, as one study showed that short sleep duration (ie,  $\leq 5$  hours of sleep) and nonrestorative sleep were associated with last-12-month suicide ideation, but not last-12-month suicide attempts in a sample of South Korean adolescents when adjusting for demographics, substance use, and depressive symptoms.<sup>132</sup> More recent research showed depressive symptoms moderating the sleep duration–suicide risk relation among Chinese adolescents,<sup>133</sup> and a study of South Korean adolescents showed that short weekday sleep duration was not associated with last-12-month suicide ideation or suicide

attempts when included in regression models with demographic variables, weekend sleep duration, and depressive symptoms.<sup>109</sup> Furthermore, a dated study showed that risk of death by suicide was not higher among those with short or long sleep duration.<sup>134</sup>

More research is needed on exploring for mechanisms or confounders of the suicide-risk relation that both insufficient-sleep syndromes and sleep duration have demonstrated. Additionally, it is unknown if addressing sleep duration alone can alleviate risk of attempting suicide. Some researchers propose that for adolescents, parents may be able to increase sleep duration and decrease adolescent risk for depression and suicide ideation by setting earlier bedtimes<sup>122</sup> and restricting electronic media access after bedtime.<sup>135</sup>

### Excessive daytime sleepiness

Although excessive daytime sleepiness does not qualify as a sleep disorder, the prevalence of daytime sleepiness (a symptom present across several sleep disorders, eg, insomnia and narcolepsy) was shown to be higher among a sample of adolescent suicide decedents from the US when compared to community controls (13% vs 5%).<sup>23</sup> Cross-sectional research has shown that excessive daytime sleepiness is associated with depression-symptom severity and suicide ideation and attempts in patients with depression,<sup>60</sup> with those reporting more sleepiness showing higher self-reported levels of suicide ideation than those with less daytime sleepiness.<sup>136</sup> However, a follow-up study showed that insomnia symptoms but not excessive daytime sleepiness were associated with suicide ideation when adjusting for demographic factors, depression duration, insomnia symptoms, and antidepressant/hypnotic-medication use.<sup>44</sup> In addition, results of the follow-up study showed that those with insomnia symptoms had significantly higher scores on the suicide-attempt planning and active and passive suicide-ideation components of the Beck Scale for Suicide Ideation<sup>137</sup> than those with excessive daytime sleepiness. Also, no association was shown between excessive daytime sleepiness and suicide risk in a sample of adults admitted to an emergency department who presented with passive or active suicide ideation.<sup>129</sup>

### Circadian rhythm sleep-wake disorders

Circadian rhythm sleep-wake disorders (CRSWDs) have not received much attention in terms of examining the prevalence of suicide-related thoughts and behaviors and identifying how specific sleep-wake disorders may impact one's risk for attempting suicide. The few studies that have been done

have shown mixed results. Adults with bipolar disorder and a CRSWD had a greater likelihood of having a family history of suicide than participants without a CRSWD,<sup>138</sup> though an earlier study of adults with bipolar disorder showed no differences between participants with delayed sleep phase, hypersomnia, insomnia, or no sleep problems with regard to the number of past suicide attempts.<sup>139</sup> Furthermore, the prevalence of circadian reversal was not found to be significantly different in adolescent suicide decedents when compared to community controls.<sup>23</sup> A more recent study of US adolescents showed that circadian reversal was associated with lifetime suicide attempts, but not suicide ideation or nonsuicidal self-injury, when adjusting for age, sex, depressive symptoms, insomnia symptoms, nonrestorative sleep, and hypersomnia.<sup>140</sup>

Research focusing on chronotypes have shown associations between an "eveningness" preference and suicide-related thoughts<sup>141-144</sup> and behaviors (ie, lifetime and violent suicide attempts).<sup>145,146</sup> An eveningness preference has also been associated with elevated scores on measures of depressive symptoms, hopelessness, and defeat.<sup>147</sup> Additionally, an eveningness preference coupled with short sleep duration was associated with greater odds of suicide ideation when adjusting for demographics, hopelessness, and past-month sleep problems due to bad dreams.<sup>141</sup> Although associations have been shown between eveningness and suicide risk (current and lifetime),<sup>110,146</sup> some studies have shown that eveningness was not associated with current (when adjusting for depressive symptoms)<sup>148</sup> or lifetime suicide risk.<sup>147</sup>

Research focused on suicide-related variables has also been fairly absent among samples of participants experiencing jet lag or difficulties due to shift work. One of the few studies that examined shift work and suicide ideation showed an interaction of day shift and depressive symptoms for suicide ideation among female police officers, with female officers reporting higher levels of depression showing an increase in suicide ideation as day-shift hours increased.<sup>149</sup> Among male police officers with higher levels of depression, suicide-ideation levels increased as the frequency of shift changes increased. It is generally unknown if treating CRSWDs can mitigate suicide risk, though one small study of depressed inpatients with suicide ideation showed a significant reduction in suicide risk following triple-chronotherapy treatment.<sup>150</sup>

### Parasomnias

Most of the research published on parasomnias and suicide has focused on parasomnia conditions generally confined to

REM sleep (ie, nightmares). Among the non-REM-related parasomnias, sleep paralysis was suggested as a precipitant to suicide-related behavior in one case study<sup>151</sup> and suicide ideation was more likely to be endorsed among Taiwanese adolescents with concurrent sleep terrors and sleepwalking in a small case-control study.<sup>152</sup> Sleepwalking has been suggested as a possible contributor to accidental nonfatal and fatal suicide attempts,<sup>153–156</sup> but most of the research conducted in this area has been case studies. Similar concerns about accidental self-injurious behavior have been reported for patients with REM sleep-behavior disorder,<sup>157</sup> with a retrospective chart review of sleep-clinic patients showing an increased prevalence of “acting out dreams” in adults with suicide ideation compared to those without ideation.<sup>158</sup> Some researchers have suggested that the use of hypnotics (ie, zolpidem and eszopiclone) could heighten self-injury or suicide risk due to inducing parasomnia behavior that was absent prior to hypnotic use.<sup>159–162</sup>

## Nightmare disorder

Research examining nightmares and suicide risk has focused more on the experience of nightmares versus the presence of a nightmare-disorder diagnosis, and few studies have examined the prevalence of suicide-related variables among those with nightmares (Table 4). The experience of bad dreams and nightmares has been associated with suicide ideation and suicide risk in samples of youth,<sup>117,120,163,164</sup> adults,<sup>22,43,45,58,75,89,165–172</sup> and older adults.<sup>52,173</sup> Moreover, nightmares have been independently associated with lifetime,<sup>58,74,164,169</sup> recent,<sup>58,76,171,174</sup> and subsequent suicide attempts,<sup>58,75</sup> including suicide.<sup>175,176</sup> Importantly, the variance in suicide-related variables explained by nightmares across multiple studies has been independent of several potential confounders, including age, sex, anxiety and depressive symptoms, and the interpersonal-psychological theory of suicide.<sup>22,74,75,117,171,173</sup>

Nightmares have also independently predicted repeated suicide attempts in a sample of suicide-attempt survivors,<sup>75</sup>

**Table 4** Prevalence of suicide-related thoughts and behaviors among participants with nightmares and proposed mechanisms of the nightmare-suicidality relation

	Prevalence
	In a study of adults with a history of trauma, 62% who experienced nightmares during the past month reported suicide ideation, suicide attempt planning, or a nonfatal suicide attempt, <sup>172</sup> and about 96% of adult participants in a separate study who reported melancholic features and a suicide attempt during a current depressive episode reported experiencing nightmares at least twice a week. <sup>76</sup> Among adolescents who often experience nightmares, 40% reported suicide ideation (compared to 13% of those who denied nightmares); the percentage increased to 50% for those who reported experiencing nightmares very often. <sup>28</sup>
<b>Proposed mediator</b>	<b>Summary of research</b>
<b>Insomnia</b>	Some studies have suggested that insomnia symptoms may explain the relation between nightmares and suicide ideation or a suicide-attempt history. An 8-year observational study of adults with schizophrenia-spectrum disorders showed that nightmares were associated with a history of suicide attempts, but only baseline insomnia symptoms were associated with an increased risk of suicide attempt at follow-up, with coexisting insomnia symptoms and nightmares conferring an elevenfold-increased risk for a future suicide attempt. <sup>59</sup> Additionally, among a primary-care clinic sample of older adults, insomnia symptoms had an indirect effect on the association shown between nightmares and suicide ideation, <sup>52</sup> and nightmares and insomnia symptoms predicted suicide ideation after 1 month (independently of baseline suicide ideation) in an online sample of adults, but only insomnia symptoms independently predicted 1 month suicide ideation. <sup>203</sup>
<b>Negative affect</b>	Hochard et al <sup>204</sup> showed in a university sample that nightmares significantly increased the risk for future self-harm ideation and behaviors and that negative affect had an indirect effect on this relation. However, the direct effect of nightmares on self-harm risk was larger than the indirect effect, suggesting that negative affect cannot explain the majority of this relation. <sup>182</sup>
<b>Defeat, entrapment, and hopelessness</b>	Littlewood et al <sup>172</sup> showed that the relation between nightmares and suicide risk is partially mediated by feelings of defeat, entrapment, and hopelessness. Notably, the effects of this multiple-mediation model remained after adjusting for insomnia symptoms and depression diagnosis.
<b>Nightmare distress</b>	A cross-sectional study of undergraduates showed that nightmare frequency had an indirect effect on suicide ideation through nightmare distress, independently of insomnia symptoms. <sup>205</sup> In a moderated mediation analysis with sex as the moderator, results showed that the indirect effect of nightmare distress on the nightmare frequency-suicide ideation relation was significant only for women.
<b>IPTS</b>	Three studies have examined whether the IPTS could explain the nightmare-suicidality relation, with two studies showing that the full IPTS could not fully account for this relation <sup>74,173</sup> and one showing that neither thwarted belongingness nor perceived burdensomeness could fully account for the nightmare distress-suicide ideation relation. <sup>206</sup> However, it should be noted that in the latter study, perceived burdensomeness partially mediated the nightmare distress-suicide ideation relation, with a moderated mediation showing that this effect was significant only for women. <sup>206</sup>

**Abbreviation:** IPTS, interpersonal-psychological theory of suicide.



and studies among adults and older adults have shown that the chronicity of nightmares may increase the risk of attempting suicide.<sup>173,177</sup> However, in an online sample of US adults, nightmare frequency differentiated multiple and single suicide attempters independently of nightmare chronicity, nightmare severity/distress, and symptoms of depression, posttraumatic stress disorder, and insomnia in a sample of US adults (Speed et al, under review, 2017), suggesting that the number of nightmares experienced within a specific time frame may have greater relevance to predicting repeat suicide attempts than the length of time nightmares have been experienced.

Additional inconsistencies have been observed. For instance, nightmares were inversely associated with suicide ideation in a sample of Canadian military personnel and veterans<sup>178</sup> and were not more frequent among depressed adolescent outpatients reporting suicide ideation or suicide intent.<sup>54</sup> Also, two separate studies of adolescents failed to show an association between nightmares and suicide-related thoughts and behaviors,<sup>19,179</sup> though one of the adolescent studies showed that parent-reported nightmares were not associated with suicide attempts<sup>179</sup> and recent research showed discrepancies between parent and child reports on measures of distress, with more distressed children showing a greater likelihood of endorsing nightmares and suicide ideation than parents.<sup>180</sup> Research has also shown an absence of suicide-related behavior among treatment-seeking patients with posttraumatic stress disorder and nightmares,<sup>181</sup> and researchers suggest that stronger risk factors may exist that can explain the nightmare–suicide relation.<sup>176</sup>

As noted by Nadorff et al,<sup>182</sup> progress is being made in the search for mechanisms that can explain the process whereby nightmares confer greater risk for suicide (see Table 4 for a review of mediator studies), but the management of suicide risk via nightmare treatment is one area that may deserve greater exploration. Results from an uncontrolled trial<sup>183</sup> showed that imagery rehearsal therapy may resolve both nightmares and suicide ideation, with a case study suggesting that prazosin<sup>184</sup> may also be effective in achieving similar outcomes. Both of these treatments have demonstrated efficacy in treating nightmares.<sup>185</sup>

## Sleep-related movement disorders

Patients with restless-leg syndrome (RLS) appear at risk of developing depression,<sup>167</sup> insomnia, anxiety, and pain disorders,<sup>186,187</sup> conditions that have been associated with suicide risk.<sup>23,188,189</sup> Separate studies showed that 21%<sup>190</sup> and 38%<sup>191</sup> of sampled RLS patients endorsed thoughts of suicide. Depressed RLS patients are also more likely than controls to

blame RLS symptoms entirely for their depressive symptoms, sleep problems, and suicide-related thoughts.<sup>191</sup> Additional research is needed among RLS patients, as it is unknown if concurrent psychiatric illness or insomnia symptoms can explain the increased prevalence of suicide ideation noted. There also is a paucity of research focused on investigating suicide risk among other sleep-related movement disorders. This includes periodic limb-movement disorder, sleep-related leg cramps, sleep-related bruxism, sleep-related rhythmic movement disorder, propriospinal myoclonus at sleep onset, and sleep-related movement disorder due to a medical disorder or medication/substance use.

## Conclusion

This narrative review has revealed multiple research avenues with regard to sleep disorders and suicide risk. Although the impact of some sleep-disorder symptoms on suicide risk has been investigated extensively (ie, insomnia), we still know very little about the prevalence of suicide risk across sleep disorders and the impact these disorders have on suicidality independently of known risk factors (eg, depression). We also know little about whether managing sleep problems via evidence-based treatments can mitigate risk for suicide, and if effective, what populations seem to benefit most from such management. At this point, we can make the argument that sleep disturbances may be a marker of distress and suicide risk<sup>127</sup> and that multiple concurrent sleep problems may confer greater risk for suicide than single sleep problems.<sup>66,141</sup> Mechanisms explaining the relation between sleep disorders and suicide remain needed, including more research rigorously examining the efficacy of sleep-disorder treatments on assuaging suicide risk. Research examining the impact of sleep disorders on suicide risk has been circumscribed to a few sleep-disorder symptoms, with much less known about the prevalence and management of suicide risk across all sleep disorders. Therefore, opportunities abound for current and prospective sleep and suicide researchers.

## Disclosure

The authors report no conflicts of interest in this work.

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