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Sleep Difficulties and Suicidality in Youth: Current Research and Future Directions

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Abstract

Studies have established a clear relationship between subjective sleep problems and the continuum of suicidality in adolescents. These studies are primarily cross-sectional in nature and conducted with epidemiological and depressed clinical samples. More recent studies focus on prospective data. Herein, we provide an update on current studies on the sleep-suicide association among youth. To further the critical mission of youth suicide prevention, future directions include more nuanced study of sleep employing a sleep health framework, longitudinal studies employing both objective and subjective sleep measures, fine-grained temporal associations between these constructs and their fluctuations over time, as well as enhanced understanding of the mechanisms underlying these associations.

Keywords

adolescent; suicide; sleep

1. Introduction

Youth suicide is the second leading cause of death for young people age 14–24 worldwide [1], and more youth experience suicidal thoughts, plans, and/or attempt than do adults over 25. Indeed, 7% of US high school students made a past-year attempt, 14% made plans to end their own life, and 17% report seriously considered attempting suicide [2]. This increase in suicide risk during adolescence coincides with dramatic changes in sleep-wake and circadian regulation. Sleep duration decreases and sleep timing delays, particularly on weekends. This results from an interaction between biological (i.e., decreasing homeostatic sleep drive and delaying circadian rhythms) and social/environmental factors (i.e., less parental monitoring, substantial screen time and social media use, and early school start times) [3, 4*]. Unfortunately, insufficient sleep on school nights is rampant, with 73% of US high school

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students reporting fewer than 8 hours of sleep and 44% reporting under 6 hours of sleep on school nights [5]. Developmental changes in sleep duration and timing across adolescence have been observed in other countries [6*] and species [7]. Sleep disturbances such as insomnia also emerge during adolescence, with some sex differences noted (9% for boys, 12% for girls [8]). Critically, studies have established a clear relationship between a range of subjective sleep problems (e.g., insomnia, hypersomnia, sleep duration, nightmares) and the continuum of suicidality in adolescents and in adults, leading the American Association of Suicidology to identify sleep difficulties among the consensus set of warning signs for suicide [9]. The co-occurrence of poor sleep and increasing suicide risk during adolescence renders this a unique development period to understand their association toward the aim of enhancing prevention efforts.

2. Review of Studies

To date, the majority of studies examining the association between sleep disturbance and suicidality in adolescents have been in epidemiological samples of youth. In general, sleep disturbances in these studies have been broadly defined, of varied timeframes, and derived from a limited number of sleep items; the data on suicidal outcomes (ideation, plans, attempts) have similar limitations. Nonetheless, these studies overwhelmingly support an association between a range of sleep difficulties and suicidality in youth, with some studies demonstrating the association over and above the effects of depression. To a lesser extent, the sleep-suicide association has been explored in clinical samples, mainly of depressed outpatients and psychiatric inpatients. Data from prospective studies remain limited. We summarize recent findings from the past 2 years below.

2.1 Epidemiological Studies

2.1.1 Total Sleep Time—Arguably the most accumulated evidence from cross-sectional studies of sleep and adolescent suicidality focuses on the association with total sleep time.

Short Total Sleep Time.: Short total sleep time is linked to suicidal ideation and attempt in youth in multiple studies, although the operationalization of “short sleep” varies between studies. To highlight, Lee and colleagues [10] developed a suicide index model using the Youth Risk Behavior Survey (YRBS) of 247,222 middle and high school students in South Korea. Total self-reported sleep duration emerged as one of the most potent risk factors for suicide attempt. Similarly, in 1,037 adolescents age 12–18 in Belgium, Rodelli and colleagues [11] identified a direct association between self-reported short sleep duration and past 6 months suicidal ideation.

Short and Long Total Sleep Time.: To date, several studies have identified a curvilinear relationship between total sleep time and suicide risk. Of late, Guo et al [12] showed self-reported short sleep (<7 hours) was associated with increased risk for ideation and attempts, whereas long sleep (>9 hours) was associated with attempts but not ideation among 20,130 high school students in China. Importantly, depressive symptoms moderated these associations.

Dose Dependent Relationship of Total Sleep Time.: Recent literature has gone beyond short and long total sleep time cutoffs to demonstrate a dose-response relationship. Using the US YRBS data (n=12,974 youth in grades 9–12), Whitmore and Smith [13] reported increased odds of suicidal ideation for youth who reported total sleep time on school nights of 4–5 hours per night (75–80% increased adjusted odds) and 6–7 hours per night (20–40% increased adjusted odds) versus youth who reported 8+ hours per night. In the Korean YRBS sample [14], suicidal ideation, plans and attempts were each associated with a linear dose-response for weekday sleep duration after covarying for depression. Yeo and colleagues [15] also demonstrated a dose-dependent association between both short (<7) and long (>9) sleep on school nights and past week self-reported self-harm/suicidal thoughts among 2,346 adolescents (age 13–19) in Singapore. A recent meta-analysis of 13 cross-sectional studies [16**] specifically focused on sleep duration and suicidality in adolescents supports a strong curvilinear dose-response relationship for both suicidal ideation (n=13 studies,) and attempts (n=11 studies) with greater risk for both shorter and longer sleep durations (though risk was strongest for shorter duration), with the lowest risk around 8–9 hours of sleep, whereas a linear dose-response relationship was found for suicide plans with risk increasing as sleep duration decreased (n=6 studies). Analyses indicated that these findings were not moderated by depression among the studies that statistically adjusted for depression (8 of 13 for suicidal ideation).

2.1.2 Insomnia—Although insomnia has been operationalized variably across studies, the construct has been associated with the range of suicidality in multiple studies. Liu and colleagues' [17**] recent meta-analysis of nine cross-sectional studies concluded that sleep disturbances, broadly defined, were significantly associated with elevated risk for ideation (n=9 studies; OR=2.4), plans (n=3 studies; OR=1.6) and attempts (n=5 studies; OR=1.9). Those studies that examined insomnia, as compared to other sleep difficulties, exhibited a higher risk of suicidal ideation (OR=2.7). Adjustment for depression did not significantly contribute to heterogeneity.

2.1.3 Other Sleep Difficulties—A broad range of sleep difficulties, from poor sleep quality to daytime sleepiness, have been examined in epidemiological studies of youth suicide risk. Two recent studies employing broad definitions include Sami and colleagues' [18*] study of adolescents in Israel (n=631; age 12–18). Those youth with self-reported sleep disturbances had greater rates of past month suicidal ideation. Path analysis demonstrated that the effect of sleep disturbance on suicidal ideation was mediated by sleep effects on depressive symptoms. In the Korean YRBS data (n=370,568 students in grades 5–9), Im and colleagues [19] demonstrated self-reported sleep dissatisfaction was significantly associated with past year suicidal ideation.

Daytime Sleepiness.: Among 538 students (age 16–17) in Korea, Yang and colleagues [20] found significant associations between daytime sleepiness and suicidal ideation; depression mediated this association. Likewise, Tseng and colleagues [21] reported an association between self-reported daytime sleepiness and suicidal ideation (OR=2.25) in a sample of 746 students (grades 5 and 7) in Taiwan.

Use of Technology.: The specific role of technology in the association between sleep disturbance and suicide risk in youth has been of substantial interest of late. Using data from 20,895 students (grades 7–12) in China, Guo and colleagues [22] found an association between self-reported problematic internet use and past year suicidal ideation and attempts. Path models demonstrated that sleep disturbance mediated the relationship between problematic internet use and suicidal ideation and attempt. Similarly, in the Sami and colleagues [18*] study of youth in Israel, path analysis demonstrated that the effect of sleep disturbance on suicidal ideation was moderated by self-reported problems due to internet use.

2.2. Clinical Studies

2.2.1 Outpatient Studies—The following studies include adolescent psychiatric outpatients as study participants. Among outpatients with mood disorders, suicidality and/or non-suicidal self-injury (n=223 adolescents age 11–19), McGlinchey and colleagues [23] found past month late insomnia was associated with suicidal ideation; middle insomnia and circadian reversal were associated with lifetime suicide attempt; and severity of sleep complaints was associated with lifetime non-suicidal self-injury (after controlling for demographics variables). In a secondary analysis of data from the Treatment of Early Age Mania (TEAM) study of 379 youth age 6–15 years with bipolar disorder, Stanley and colleagues [24] found those who met criteria for current nightmare disorder were twice as likely to endorse lifetime suicide risk after controlling for depression, anxiety and trauma history.

2.2.2 Inpatient Studies—Studies among hospitalized adolescents offer the opportunity to gather data during a period of acute suicide risk. Using cross-sectional data from 151 adolescent (age 12–17) psychiatric inpatients, Zullo and colleagues [25] found that self-reported insomnia symptoms in the past 2 weeks were associated with suicide risk; the association was no longer significant after controlling for depressive symptoms and components of the Interpersonal Psychological Theory of Suicide. Path analysis demonstrated only an indirect effect of insomnia on suicide risk via perceived burdensomeness.

2.3 Prospective Studies

Prospective studies are critical to inform the temporal nature of the sleep-suicide association, yet few prospective studies have been conducted with youth. Hill and colleagues [26] applied tree analysis to epidemiological data to identify profiles of youth at-risk for reporting past year suicidal ideation at follow-up. The most sensitive but least specific tree included multiple risk factors as nodes; self-reported hours of sleep emerged as a significant node, with total sleep times of both >10.5 hours and <6.5 hours being significant nodes. In a prospective longitudinal study of 7,072 adolescents (mean age=14.6) in China who were followed up at 1 year, Liu and colleagues [27] found that self-reported baseline daytime sleepiness significantly predicted subsequent risk for onset of suicidal ideation (OR=1.5) and plan (OR=2.6) but not behavior. The Liu and colleagues [17**] recent meta-analysis also examined prospective studies of sleep difficulties and suicidality in adolescents. Findings indicated that sleep disturbances (including difficulty initiating and/or maintaining

sleep) predicted subsequent risk for suicidal ideation (n=4 studies; OR=1.8), the risk for attempt (n=2 studies; OR=2.0) was not statistically significant.

Analyses of data from longitudinal treatment trials have allowed for additional information regarding trajectories of the sleep-suicide association. In a pilot trial of an adjunctive triple chronotherapy protocol for adolescent inpatients with MDD (n=29, mean age=15.5), Hurd and colleagues [28] showed a decrease in rate of suicidal ideation over the 4 day intervention that remained significant at 1-week and 1-month timepoints.

Another approach is to examine the capacity of biological sleep indices to predict future suicidality. Although sleep electroencephalogram (EEG), cortisol parameters and polysomnography have been examined historically [29], recent studies in this area have been limited.

3. Recommendations for Future Directions

The mechanisms by which sleep leads to suicide remain unknown. However, there are numerous plausible neurobiological and psychological pathways, and it is likely that multiple potential pathways exist. Sleep disturbances are risk factors to the development of psychopathology and worsening of psychopathology, and likewise, sleep disturbances are extraordinarily frequent complaint in most psychiatric disorders [30, 31]. However, many of the above studies controlled for depressive symptoms, suggesting that sleep may have independent effects on suicide. “Sleep”, as quoted by Hobson [32], is “of the brain, by the brain, and for the brain.” From levels of neurotransmitters, metabolism, and activation within neural circuits, to brain plasticity and cleaning out toxic waste proteins, sleep is intricately related to brain functioning. In this way, sleep may have direct effects on neurobiological pathways implicated in suicide (e.g., [33]). In our current treatment study of youth with bipolar disorder (a population that is at high risk for suicide), we are employing a 2-week sleep assessment with actigraphy and diary that culminates in a functional magnetic resonance imaging scan to enhance understanding of neural mechanisms. The prefrontal cortical regions are particularly sensitive to sleep loss [34], which may lead to impaired top-down control of limbic structures such as the amygdala and striatum. Experimental sleep deprivation/restriction studies provide causal evidence that such circuitry [e.g., 35, 36] and other affective processes are impacted by sleep [e.g., 37, 38, 39]. Such alterations may underlie problems like emotion dysregulation, impaired social interactions, anhedonia, impulsivity, and impaired decision making. Given that the development of neural circuitry related to controlling emotions and behaviors continues to develop through adolescence [40], adolescents may be particularly vulnerable to the affective consequences of poor sleep. In this way, sleep disturbances and/or insufficient sleep—common problems experienced by the majority of adolescents—may tip the balance in already vulnerable brains toward suicidal thoughts and behavior.

Insufficient and disturbed sleep likely interacts with other distal and proximal risk factors to culminate in suicidal thoughts and behaviors. Much of the epidemiological research has used variable timeframes, and tends to—erroneously--consider sleep as a static, unchanging predictor. Understanding how sleep serves as a proximal risk factor for suicidal thoughts and

behavior has great importance for guiding prevention efforts. While the number of prospective studies has increased in recent years, the inclusion of daily or weekly measures in prospective studies—including both subjective (e.g., sleep diary) and objective (e.g., wrist actigraphy) methods—is warranted to better understand the temporal relationship between changes in sleep and suicidality. In addition, objective measures such as actigraphy are complementary to self-report data, and may minimize potential biases, such as retrospective biases and underestimating sleep time or overestimating time to fall asleep, that can result from pre-sleep cognitive arousal and post-sleep mood [41]. In another ongoing prospective study of youth at high risk for suicide, participants engage in up to 12 weeks of actigraphy and daily diary while completing daily ratings of suicidal ideation and behavior; meanwhile, data on distal factors including depression and substance use are being collected to better understand temporality as well as inter-relationships between distal and proximal factors.

As is evident from the literature reviewed, many aspects of sleep have been associated with suicide risk. The field would benefit from studies that examine the influence of multiple aspects of sleep simultaneously to determine those that are the most strongly predictive of increasing suicide risk. We assert one promising possibility is the sleep health framework [42]. This approach considers multiple dimensions (regularity, satisfaction/quality, alertness, timing, and efficiency) that together contribute to overall sleep health, which may have additive or interactive effects in leading to emergent suicidality. For example, in a longitudinal sample of older women, there was a dose-response relationship between the number of poor sleep health domains and risk for both concurrent and future depressive symptoms [43].

Many of the past studies have utilized single items of sleep and/or suicide. Future studies would additionally benefit from using reliable sleep and suicide scales. Indeed, in the Liu et al. meta-analysis [17**], those studies that utilized reliable measures of sleep demonstrated higher risk for suicidal ideation (OR=3.1 vs 1.5). Similarly, consistent operationalization of suicide variables, such as the Columbia Classification Algorithm of Suicide Assessment (C-CASA) [44], is also warranted for standardization and comparability across studies.

Although more prospective evidence and examination of potential mechanisms are warranted, the growing body of literature supporting the sleep–suicide association during adolescence suggests that poor sleep health may be an optimal risk factor to target, particularly given that it is modifiable [28, 45, 46]. Better understanding of sleep (and the specific aspects of sleep) as a proximal risk factor for suicide is needed to understand whether and how sleep problems reliably signal near-term risk for suicide. Such evidence is critical for the development of preventive interventions to target the second leading cause of death in young people.

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