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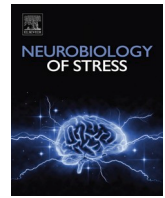
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Sleep disturbance and suicide risk among sexual and gender minority people

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ABSTRACT

Sleep disturbance has emerged as an independent, mechanistic, and modifiable risk factor for suicide. Sexual and gender minority (SGM) people disproportionately experience sleep disturbance and are at higher risk of death by suicide relative to cisgender and/or heterosexual individuals. The present narrative review evaluates nascent research related to sleep disturbance and suicide-related thoughts and behaviors (STBs) among SGM populations, and discusses how experiences of minority stress may explain heightened risk among SGM people. Although there is a growing understanding of the link between sleep disturbance and STBs, most research has not been conducted in SGM populations or has not examined suicide as an outcome. Research is needed to examine whether and how aspects of sleep disturbances relate to STBs among SGM people in order to better tailor sleep treatments for SGM populations.

1. Introduction

Sleep disturbance has been identified as a transdiagnostic risk factor for multiple mental health problems including suicide-related thoughts and behaviors (STBs) such as suicide ideation and suicide attempt (Baglioni et al., 2014, 2016; Bernert and Nadorff, 2015; Dolsen et al., 2014; Harvey, 2008). Sexual and gender minority (SGM) people are among the most vulnerable to suicide risk with rates of STBs, including death by suicide, two to six times higher than the general population (Blosnich et al., 2014a; Clements-Nolle et al., 2006; Haas et al., 2014; King et al., 2008; Knaani and Laur, 2021; Maguen and Shipherd, 2010; Ramchand et al., 2022; Zwickl et al., 2021). Preventing suicide among SGM people requires identifying and treating modifiable contributors to

STBs. One such contributor is sleep disturbance, which we use as an umbrella term to refer to a variety of sleep problems including sleep disorders, insomnia, hypersomnia, poor sleep quality, and inadequate sleep duration. SGM individuals experience more sleep disturbance relative to heterosexual and/or cisgender individuals in part due to experiences of minority stress (Butler et al., 2020; Slopen et al., 2016). Important differences in sleep disturbance have been identified for sexual minority and gender minority subgroups including sexual minority women and transgender people (Butler et al., 2020). Sleep disturbance is a strong candidate for suicide prevention efforts given that sleep treatments have been shown to improve sleep as well as co-occurring STBs in studies that did not specifically recruit SGM people (Manber et al., 2011; McCall et al., 2019; Pigeon et al., 2017; Trockel

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et al., 2015).

The present narrative review will examine evidence that SGM people experience greater risk for STBs as well as sleep disturbance compared with heterosexual and/or cisgender people and evaluate how experiences of minority stress may explain differences in risk. This review also will provide an overview of evidence on the relationship between sleep disturbance and suicide risk as well as the effect of sleep treatments on STBs. Finally, this review will evaluate the small body of literature on the association between sleep and suicide among SGM individuals and provide recommendations for future research.

2. Sexual and gender minority people, mental health, and minority stress

Sexual minority is an umbrella term that includes people with a sexual orientation other than heterosexual such as asexual, bisexual, demisexual, gay, lesbian, pansexual, and other sexual orientations (Alexander et al., 2016). Gender minority people include those whose gender is not congruent with the expectations associated with the sex assigned to them at birth, and includes people who identify as transgender as well as agender, gender expansive, gender fluid, gender nonconforming, non-binary, two-spirit, and other gender identities. By contrast, the term cisgender refers to people whose gender aligns with what is expected of the sex assigned to them at birth. Given that many of the studies reviewed in the current paper do not assess sexual orientation or gender identity, we refer to the participants from studies without these data as presumed heterosexual and/or cisgender. People who identify as SGM comprise 7.1% of the US population, and approximately 21% of Generation Z Americans (i.e., those born between 1997 and 2003) identify as SGM (Jones, 2022). Although some gender minority individuals also identify as sexual minority (e.g., someone who identifies as transgender and pansexual), a study of gender minority adults found that 12.2% identified as heterosexual (Katz-Wise et al., 2016).

Mental health research among SGM individuals is complex given that these identities continue to be pathologized by the medical community (Kronk et al., 2022), which contributes to mistrust of healthcare providers, creates barriers to accessing care, and may lead to under engagement in research. Although sexual minority identities are no longer classified as a mental health disorder, aspects of gender diversity continue to be included in diagnostic classification systems of mental disorders (American Psychiatric Association, 2013). Although having a minoritized sexual orientation or gender identity is not a mental disorder in and of itself, SGM people experience higher rates of mental health problems compared with heterosexual or cisgender people (Alexander et al., 2016; Blossnich et al., 2014b, 2017; Bonvicini, 2017; Valentine and Shipherd, 2018). SGM people are particularly vulnerable to experiencing traumatic events including interpersonal violence and assault compared with cisgender and/or heterosexual people (Flores et al., 2020). Additionally, 48% of sexual minority people and 42% of gender minority people meet criteria for posttraumatic stress disorder (PTSD) compared with approximately 4.7% in the general population (Goldstein et al., 2016; Livingston et al., 2020). However, a precise understanding of the mental health disparities experienced by SGM people is difficult to estimate given that most extant studies did not collect information on sexual orientation or gender identity nor have most studies made efforts to specifically recruit SGM people (Fredriksen-Goldsen and Kim, 2017).

Minority stress theory has been the predominant model for understanding SGM health disparities (Hendricks and Testa, 2012; Meyer, 2003; Valentine and Shipherd, 2018). Minority stress theory was initially developed to explain the mental health consequences of stigma and discrimination experienced by sexual minority individuals, but has been expanded to include experiences of gender minority individuals (Hendricks and Testa, 2012; Valentine and Shipherd, 2018). Minority stress is conceptualized in three categories across a distal-proximal continuum: (1) chronic and/or acute objective experiences such as

discrimination or violence that do not depend on a person's appraisal to be stressful, (2) expectations of rejection and hypervigilance stemming from anticipatory threat, and (3) internal cognitive and emotional processes that reinforce stigma and prejudice regarding a person's minoritized identity such as internalized homophobia or transphobia. Distal and proximal minority stressors interact and overlap. For example, a non-binary person who is misgendered at a doctor appointment (distal minority stressor) may have an increased expectation for rejection (proximal minority stressor) and thus may conceal their gender identity (proximal minority stressor) with future healthcare providers. Similar to heterosexual and/or cisgender people, SGM people experience general social and environmental stressors (e.g., job loss or dissolution of an intimate partner relationship), which interact and overlap with group-specific minority stress processes (Meyer, 2003). For example, an asexual transgender woman who is unstably housed likely experiences minority stressors that are related to and interact with her housing instability. Minority stress theory proposes that these general and minority stress processes contribute to mental health outcomes. The strength of the association is hypothesized to be influenced by factors related to the minoritized identity such as the prominence of the minoritized identity as well as availability of coping resources such as social support.

Although SGM individuals experience many of the same stressors, there is heterogeneity between and within sexual and gender minority groups. Minority stress theory was developed based on sexual minority people (Meyer, 2003), and did not incorporate important aspects of gender minority people's experiences that differ from sexual minority individuals, which may have important implications for suicide risk. For example, gender dysphoria is experienced by some but not all gender minority people (Ashley, 2021), and has been identified as an important proximal stressor that is absent from the original minority stress theory (Lindley and Galupo, 2020). Additionally, the experience of discrimination and stigma would likely differ, for example, for a bisexual cisgender man and a bisexual transgender man due to having multiple minoritized identities. Minority stress theory has also been extended to other minoritized identities and research has begun to emphasize intersectional minority stress (Sarno et al., 2021). Intersectionality is a theory that explains how multiple marginalized identities (e.g., sexual orientation, gender identity, race, ethnicity, socioeconomic class, etc.) interact with multiple systems of oppression to contribute to health disparities among people with minoritized identities (Crenshaw, 2017).

There has been an interest in understanding how minority stress leads to mental health outcomes. Building on minority stress theory, Hatzenbuehler (2009) proposed that general psychological processes mediate the association between minority stress and psychopathology. Hatzenbuehler's (2009) addition to minority stress theory emphasizes that general psychological processes are overlooked in the original minority stress theory in favor of group-specific processes (i.e., distal and proximal minority stressors), and are important to consider given differences between SGM people and heterosexual and/or cisgender people for psychopathology risk factors such as impaired emotion regulation, lack of social support, and negative cognitive style (Hatzenbuehler, 2009). Sleep may be a similar general process with importance for understanding the association between minority stress and STBs, and potentially provide a point of intervention.

3. Integrated theoretical model

The pathways from SGM identity to suicide are complex and multifactorial. We present an integrated theoretical model (Fig. 1) that illustrates how sleep disturbance functions as a mechanism in the association between SGM identity and suicide risk. This model is informed by theories of minority stress (Hatzenbuehler, 2009; Hendricks and Testa, 2012; Meyer, 2003), sleep disturbance (Perlis et al., 1997; Spielman et al., 1987), and suicide (Joiner, 2005). Specifically, the model proposes that SGM identity (Boxes A and B in Fig. 1) create the

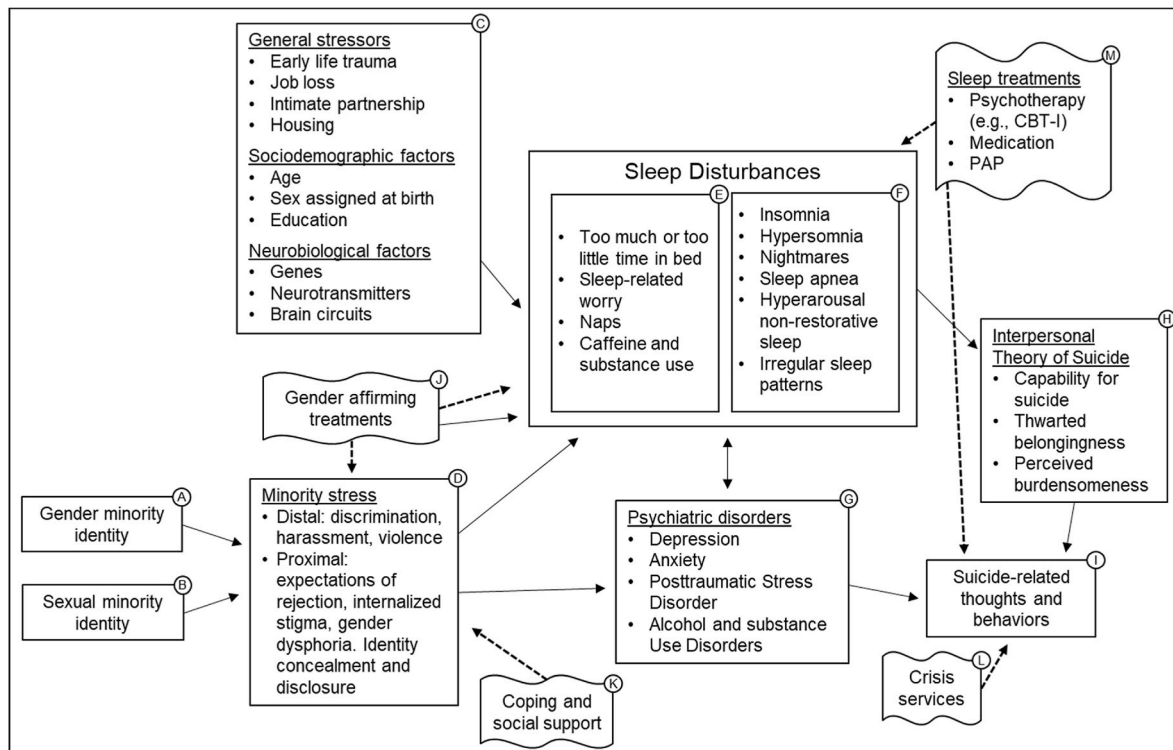


Fig. 1. Integrated theoretical model.

Note. Solid lines indicate that the construct or feature increases risk for an outcome (i.e., positive correlation) and dashed lines indicate that the construct or feature decreases risk for the outcome (i.e., negative correlation).

opportunity for exposure to minority stress (Box D). Minority stress (Box D), as well as general stressors, sociodemographic characteristics, and biological factors (Box C), increases risk for maladaptive sleep behaviors (Box E), which lead to clinical levels of sleep disturbance (Box F). Sleep disturbances (Boxes E and F) are hypothesized to increase risk for suicide-related thoughts and behaviors (Box L) via suicide-specific processes (Box H) such as capability for suicide, thwarted belongingness, perceived burdensomeness. The model also highlights the importance of psychiatric disorders in this model (Box G), which are exacerbated by minority stress (Box D), share a bidirectional risk association with sleep disturbances (Boxes E and F), and confer risk for suicide-related thoughts and behaviors (Box L). Gender-affirming hormone therapy (Box J) is highlighted as potentially reducing minority stress (Box D) and having a variable (i.e., positive or negative) effect on sleep disturbances (Boxes E and F). Potential interventions to alleviate minority stress (Boxes J and K), suicide-related thoughts and behaviors (Box L, Box M), and sleep disturbances (Box M) are also included. The model specifically builds on Spielman et al.'s (1987) 3P model of insomnia, which includes Predisposing (Boxes A, B, C), Precipitating (Boxes D, G, and J), and Perpetuating (Box E) factors in the development of sleep disturbances. Solid lines represent positive correlations between model features (e.g., minority stress is associated with increased sleep disturbances) and dashed lines represent negative associations involving a treatment or intervention (e.g., cognitive behavioral therapy for insomnia is associated with decreased sleep problems).

4. Sexual and gender minority people and suicide-related thoughts and behaviors

Sexual minority individuals are two to six times more likely to attempt suicide compared with heterosexual individuals depending on the population examined (King et al., 2008; Ramchand et al., 2022). In a study examining multiple sexual minority identities among college students, identifying as bisexual or pansexual was found to be among the

strongest risk factors for suicide ideation, and those who identified as pansexual were more likely to report a past suicide attempt compared with other sexual minority people in the study (Horwitz et al., 2020). Rates of death by suicide are even higher among people who hold multiple vulnerable identities. For example, sexual minority veterans die by suicide at a rate 4.5 times higher than the general non-veteran population and 1.5 times higher than the general veteran population (Lynch et al., 2020).

Rates of suicide-related behaviors are substantially higher among gender minority people than the general population with 18–44% attempting suicide (Clements-Nolle et al., 2006; Haas et al., 2014; Maguen and Shepherd, 2010; Zwickl et al., 2021). STBs among gender minority individuals appear to be influenced by minority stress processes. A meta-analysis of 85 cross-sectional studies found that proximal minority stressors including internalized transphobia, expectations of rejection, and identity concealment were associated with modest effect sizes for suicide ideation (Pellicane and Ciesla, 2022). Distal stressors also have been shown to be associated with risk for STBs. In the Virginia Transgender Health Initiative Survey of transgender people, gender-based violence and victimization were associated with a higher likelihood of attempting suicide (Goldblum et al., 2012; Testa et al., 2012). Additionally, in a sample of 515 transgender men and women, gender-based discrimination and victimization were associated with higher risk of suicide attempt. Highlighting the interplay between general and minority stressors for mental health problems, an online survey of 928 transgender adults reported that higher risk of suicide attempt was associated with being unemployed, having depression, desiring gender affirming surgery in the future, experiencing physical assault, and experiencing institutional discrimination related to gender identity (Zwickl et al., 2021).

5. Sexual and gender minority people and sleep

Research on sleep health among SGM people is still in its infancy.

Indeed, a 2020 review reported that only 31 studies have been conducted on sleep among SGM people (Butler et al., 2020). However, there is growing interest in this area of research as 27 (87%) of these studies were published in the preceding 4 years. Across the existing research there is growing recognition for sleep health disparities among SGM people compared to their cisgender and heterosexual peers (Butler et al., 2020; Martin-Storey et al., 2020). Sleep supports physical (Irwin, 2015, 2019; Mullington et al., 2010), emotional (Goldstein and Walker, 2014; Palmer and Alfano, 2017; Walker, 2009), and cognitive functioning (Diekelmann and Born, 2010; Pace-Schott et al., 2015; Stickgold and Walker, 2013; Tononi and Cirelli, 2006). Even a few nights of partial sleep deprivation can result in emotion dysregulation, impaired judgment, and alterations to multiple biological systems.

Evidence suggests that sleep duration differs for SGM people compared with their cisgender and/or heterosexual peers (Butler et al., 2020; Patterson and Potter, 2019). Although short sleep duration is frequently linked to mental and physical health problems (Dong et al., 2022; Itani et al., 2017), long sleep duration is also related to higher mortality, depression, and health problems including diabetes, cardiovascular disease, stroke, coronary heart disease, and obesity (Dong et al., 2022; Jike et al., 2018). Dai and Hao (2019) examined sleep duration in a study of 4,386 SGM people and 142,507 presumed heterosexual and/or cisgender adults. Regarding sexual orientation and short sleep duration (Fig. 3), obtaining ≤ 5 h of sleep was more common for lesbian women (19.7%), bisexual women (19.6%), bisexual men (15.7%), and gay men (13.7%), compared with heterosexual men (12.3%) or heterosexual women (12.1%; Dai and Hao, 2019). Regarding sexual orientation and long sleep duration (Fig. 3), >9 h of sleep was more common for bisexual men (11.1%), gay men (10.6%), bisexual women (9.1%), and lesbian women (8.4%) compared with heterosexual cisgender men (6.8%) or heterosexual cisgender women (7.2%; Dai and Hao, 2019). Although the study by Dai and Hao (2019) collected data on sexual and gender minority identities, participants could only identify as sexual minority or gender minority. Most studies on sleep among SGM people compare sexual minority people with gender minority people rather than comparing, for example, cisgender sexual minority people, heterosexual gender minority people, and people with both sexual minority and gender minority identities. Although this is often done due to practical limitations of sample size, comparing sexual minority people to gender minority people without also including people with both sexual and gender minority identities has the potential to miss important differences in sleep as well as STBs among sexual minority and/or gender minority people, as well as the subgroups within these identities. A major limitation to sleep disturbance among sexual minority people is that existing studies have only focused on lesbian, gay, and bisexual (LGB) identities. To the best of our knowledge, no studies have examined sleep among people with sexual orientations other than LGB including, for example, asexual, demisexual, pansexual, or other sexual orientations.

Bisexual people may be particularly vulnerable to sleep disturbance. For example, bisexual women report worse sleep quality compared with lesbian and heterosexual women (Butler et al., 2020). These findings are consistent with other research demonstrating that bisexual women, compared with lesbian women, have lower health-related quality of life including more frequent mental distress and worse general health (Fredriksen-Goldsen et al., 2010). Data regarding bisexual men are less clear. Although bisexual men were more likely to have short sleep duration (≤ 5 h of sleep) compared with gay men (Dai and Hao, 2019), evidence from the 2013–2015 National Health Interview Survey suggested that bisexual men, compared with gay men, were less likely to have trouble falling asleep, wake unrested, or use sleep medications (Galinsky et al., 2018).

Few studies have been conducted on sleep among gender minority people. A review of sleep among SGM people identified only four studies focused on gender minority sleep (Butler et al., 2020). The study by Dai and Hao (2019) found that gender minority people report both shorter

and longer sleep duration compared with presumed cisgender people. Short sleep duration (≤ 5 h of sleep) was most common for gender nonconforming people (35.5%), transgender women (14.8%), and transgender men (13.2%) compared with cisgender men (12.3%) or cisgender women (12.1%; Dai and Hao, 2019, Fig. 4). Long sleep duration (>9 h of sleep) was more common for transgender men (9.1%) and transgender women (7.9%) compared with cisgender men (6.8%) or cisgender women (7.2%; Dai and Hao, 2019, Fig. 4). Sleep may be a strong determinant of quality of life among transgender people. Sleep quality was found to be an independent predictor of quality of life controlling for gender-affirming hormone therapy or gender-affirming surgeries (Auer et al., 2017). Since the review by Butler et al. (2020) was published, a large-scale study examining sleep, mental health, and suicide reported that transgender college students were more likely than cisgender students to experience inadequate sleep, daytime sleepiness, insomnia symptoms, and sleep disorder diagnosis (Hershner et al., 2021). Additionally, an expanded report from a qualitative study of 40 gender minority people examined associations between sleep quality and mental health, and found that most participants endorsed some difficulties with sleep (Harry-Hernandez et al., 2020). Mental health symptoms as well as factors related to gender identity contributed to worse sleep including gender dysphoria, the effects of gender-affirming treatments (e.g., hormones or surgery), and anticipatory threat (Harry-Hernandez et al., 2020). Minority stressors such as stigma consciousness and gender-related discrimination also have a negative impact on sleep disturbance and adequate sleep duration among gender minority individuals (Caceres et al., 2021).

Sleep among gender minority people may also be affected by gender-affirming hormone therapy. Feminizing hormone therapy includes receiving estrogen, anti-androgens, and, in some cases, progesterone, and masculinizing hormone therapy consists of receiving testosterone (WPATH, 2012), although not all gender minority people pursue or have access to gender-affirming hormone therapy. Estrogen receptors have been found in areas of the brain associated with sleep regulation and function including the hypothalamus, hippocampus, amygdala, locus coeruleus, midbrain raphe nuclei, basal forebrain, and cerebellum (Hara et al., 2015; McEwen and Alves, 1999). Regarding testosterone, while secretion is influenced by stage of sleep, the effect of testosterone on sleep is less clear (Mong et al., 2011; Mong and Cusmano, 2016). A qualitative study of transgender women suggested that receiving estrogen combined with anti-androgens to suppress testosterone may be related to improved sleep quality compared with receiving anti-androgens to suppress testosterone alone (Wassersug and Gray, 2011). A case study of a transgender woman with a history of obstructive sleep apnea (OSA) reported that her OSA resolved following initiation of feminizing hormone therapy (Robertson et al., 2019). In one of the only studies to evaluate sleep with polysomnography in a sample of SGM people, feminizing hormone therapy (estrogen and the anti-androgen cyproteronacetate) was associated with more stage N1 sleep and increased beta activity during NREM sleep in a sample of seven transgender women (Künzel et al., 2011). Regarding masculinizing hormone therapy and sleep, a case study of two transgender men reported that sleep apnea developed following initiation of testosterone (Robertson et al., 2019).

More research has been conducted on how sleep may be influenced by menopausal hormone therapy and androgen deprivation therapy for prostate cancer, which can have similar pharmacodynamics to feminizing and masculinizing gender-affirming hormone therapy, respectively. Importantly, however, this research has been conducted with presumed cisgender people. Menopausal hormone therapy has been associated with improvements in subjective sleep quality (Polo-Kantola, 2011), which may be in part due to a reduction in menopause symptoms that interfere with sleep such as flushing or night sweats. Menopausal hormone therapy does not appear to be associated with objective sleep changes (Manber et al., 2003). With regard to prostate cancer treatment, androgen deprivation therapy appears to have no effect on sleep

architecture or sleep disordered breathing among presumed cisgender men with sleep apnea (Stewart et al., 1992). However, androgen deprivation therapy has been linked to increased insomnia symptoms (Savard et al., 2013). Of particular relevance to the current review, menopausal hormone therapy has been linked to increased risk of suicide attempt and increased risk of death by suicide in a large-scale sample of midlife and older veterans (Gibson et al., 2021).

Minority stress is the prevailing explanation for differences in sleep disturbance for SGM individuals. Particular features of minority stress such as discrimination have been linked to sleep disturbance as well in presumed heterosexual and/or cisgender samples (see Slopen et al., 2016 for a review). Additionally, the intermediate nucleus, which is the human analog to the ventrolateral preoptic (VLPO) area and major sleep driver in the hypothalamus, has been examined in terms of sexual orientation and gender identity (Saper, 2021). Neuropathology volumetric studies, with small sample sizes, have reported that gay men may have smaller volume intermediate nucleus compared with heterosexual men (LeVay, 1991; Saper, 2021). The morphology of the intermediate nucleus was more strongly differentiated based on gender identity than the sex assigned to them at birth in a sample of transgender and cisgender individuals, and differences were not due to gender-affirming hormone therapy (Garcia-Falgueras and Swaab, 2008; Saper, 2021). Given the role of the intermediate nucleus in promoting sleep, it has been hypothesized that a smaller intermediate nucleus may be an adaptation for increased arousability to attend to threats or children at night (Saper, 2021).

6. Sleep and suicide-related thoughts and behaviors

Sleep disturbance contributes to impairment across multiple domains of functioning including physical, emotional, and cognitive health. Although sleep disturbance has historically been considered a symptom of mental health disorders, there is converging evidence that sleep disturbance is associated with STBs independent of mental health disorders such as depression (Bernert et al., 2005, 2015; Bernert and Nadorff, 2015; Perlis et al., 2015; Pigeon et al., 2012). Research on sleep disturbances and STBs has primarily focused on subjective sleep quality and duration, in part due to the ease of deriving these data from existing epidemiological studies. A meta-analysis of longitudinal studies found that while sleep quality was associated with suicide ideation, there was little evidence that sleep quality was related to suicide attempt or death by suicide (Harris et al., 2020). In the following section, we review evidence that particular types of sleep disturbance are associated with STBs.

6.1. Sleep duration

Multiple large-scale epidemiological studies have reported an association between sleep duration and STBs. Although short sleep duration is frequently linked to mental and physical health problems (Dong et al., 2022; Itani et al., 2017), long sleep duration is also related to higher mortality, depression, and health problems including diabetes, cardiovascular disease, stroke, coronary heart disease, and obesity (Dong et al., 2022; Jike et al., 2018). Regarding STBs, a non-linear association has been described such that both short sleep duration (variously defined as ≤ 4 , ≤ 5 , ≤ 6 , or < 8 h of sleep) and long duration (variously defined as ≥ 9 and ≥ 10 h of sleep) are associated with suicide ideation and attempt (Chakravorty et al., 2015; Dolsen et al., 2021b; Goodwin and Marusic, 2008; Kim et al., 2013; Michaels et al., 2017). However, meta-analytic evidence suggested that sleep duration was not a strong predictor of suicide ideation or attempt, and there were too few studies to evaluate the potential impact of sleep duration on death by suicide (Harris et al., 2020).

6.2. Insomnia

Insomnia is characterized by difficulties initiating and maintaining sleep, and has been consistently shown to be related to STBs (Brower et al., 2011; Chakravorty et al., 2015; Li et al., 2010; Pigeon et al., 2012; Pompili et al., 2013). Insomnia was associated with suicide ideation, suicide attempt, and deaths by suicide based on a meta-analysis of longitudinal studies, although effects were strongest for suicide ideation (Harris et al., 2020). Cognitive-behavioral therapy for insomnia (CBT-I) is the first-line treatments for insomnia, and has been shown to improve sleep as well as co-occurring suicide ideation among adults with insomnia and depression symptoms (Manber et al., 2011) and veterans with insomnia (Trockel et al., 2015). A condensed adaptation of CBT-I also decreased suicide ideation among veterans with insomnia and depression symptoms (Pigeon et al., 2017). Additionally, zolpidem in combination with a selective serotonin reuptake inhibitor improved insomnia and reduced SI among adults with major depressive disorder, insomnia, and SI (McCall et al., 2019). However, long-term use of sedative hypnotics are correlated with increased mortality and greater risk of STBs (Hartz and Ross, 2012; McCall et al., 2017), which may be due to impaired judgment and disinhibition, or also may not be causally linked and instead indicate the presence of difficult to treat conditions involving long-term use medications.

6.3. Nightmares

Nightmares are characterized by negatively valenced (e.g., fear, anger, disgust) dreams and frequently result in awakenings from sleep due to physiological arousal such as increased heart rate or sweating. Nightmares are experienced by approximately 2–5% of the population (Sandman et al., 2013), and are a common symptom of PTSD. A meta-analysis of longitudinal studies found that nightmares were associated with suicide attempt, but not suicide ideation or death by suicide (Harris et al., 2020). Frequency of nightmares was associated with death by suicide in a Finland population study, suggesting a dose-response relationship between nightmares and suicide (Sandman et al., 2017). Similarly, chronicity of nightmares was also found to be associated with lifetime STBs (Nadorff et al., 2013), highlighting both frequency and duration in the link between nightmares and risk for STBs. Nightmares may also help explain repeated suicide attempts. A prospective study of 165 patients found that having frequent nightmares, but not difficulties initiating sleep, staying asleep, or waking earlier than planned, was associated with repeated suicide attempts, controlling for mental health disorders and demographic factors (Sjöström et al., 2009). Multiple explanations have been proposed for the connection between nightmares and STBs. As reviewed by Drapeau and Nadorff (2017), proposed mediators include insomnia; negative affect; hopelessness as well as defeat and entrapment; nightmare distress; and components of Joiner's (2005) interpersonal theory of suicide such as thwarted belongingness or perceived burdensomeness.

6.4. Sleep apnea

Few studies have examined the link between sleep apnea and suicide, which is surprising given the established association between sleep apnea and depression (Akashiba et al., 2002; Aloia et al., 2005; Schröder and O'Hara, 2005). Sleep apnea is characterized by hypoxemia and arousal from sleep, often due to collapse of the upper airway. The prevalence of suicide ideation among individuals with sleep apnea is estimated between 10 and 20% of adults (Bishop et al., 2018; Choi et al., 2015). In a large-scale national sample, self-reported sleep apnea was found to be associated with suicide ideation and plans, but not suicide attempts while controlling for depression symptoms, substance use, physical health conditions, and demographic characteristics (Bishop et al., 2018). However, sleep-related breathing disorders as well as insomnia and nightmares were related to suicide attempt after

controlling for age, gender, treatment utilization, and comorbid sleep disorders in a sample of U.S. military veterans (Bishop et al., 2020). In a cross-sectional sample of presumed cisgender women who had a history of sexual or physical assault, a probable sleep-related breathing disorder was associated with suicide ideation (Krakow et al., 2000). Additionally, suicide ideation was positively associated with a composite score of number of apneas, hypopneas and respiratory effort related arousals per hour (Gupta and Jarosz, 2018). Treating sleep apnea can reduce STBs. Depression symptoms, including suicide ideation, were improved in a sample of adults with OSA following continuous positive airway pressure (CPAP) therapy (Edwards et al., 2015).

6.5. Polysomnography

Although sleep is colloquially described as a period of inactivity and dormancy, substantial neurobiological activity occurs across the sleep period. Polysomnography provides information regarding neural and physiological activity that occur during sleep. At the broadest level, sleep can be separated into rapid eye movement (REM) sleep and non-REM (NREM) sleep. NREM sleep is further subdivided into three stages, stage 1 (N1), stage 2 (N2), and stage 3 (N3). REM sleep is characterized by rapid eye movements and muscle atonia. REM sleep most often occurs in the second half of the sleep period. REM sleep appears to be critical for memory consolidation as well as emotional processing (Mander et al., 2011; Walker and van der Helm, 2009). Most of the sleep period is spent during NREM sleep, specifically N2 and N3. NREM sleep, particularly slow-wave sleep occurring during N3, has been implicated in memory consolidation processes via synchrony between neocortical slow oscillations, sharp-wave/ripple complexes in the hippocampus, and thalamo-cortical spindles (Diekelmann and Born, 2010; Tononi and Cirelli, 2014). Slow-wave sleep is also linked to sleep homeostasis and may be responsible for repairing the wear and tear that accumulates throughout the day (Dijk, 2009).

Polysomnography also measures electrophysiological activity, which correlates with underlying brain activity. Power spectral analysis (PSA) is used to process the electrophysiological signal into frequencies, which have functional implications for understanding the phenomenology of

sleep. PSA algorithms commonly provide information about the power (expressed as μV^2) in five frequency bands including beta (16.0–32.0 Hz), sigma (12.0–15.9 Hz), alpha (8.0–11.9 Hz), theta (4.0–7.9 Hz), and delta (0.5–3.9 Hz). Beta activity is most frequently observed during waking periods and occasionally during REM sleep. Alpha activity is associated with restful wakefulness, and often observed during N1 sleep. Delta sleep predominates during N3.

Meta-analytic evidence has found alterations in sleep macroarchitecture and microarchitecture in mental health disorders associated with STBs (Baglioni et al., 2016). Sleep discontinuity was common across most mental disorders, and slow-wave sleep and REM-related measures were related to depressive disorders, anxiety disorders, schizophrenia spectrum disorders, and autism spectrum disorder (Baglioni et al., 2016). Although each mental disorder had a sleep disturbance profile, no single sleep disturbance finding was unique to a single mental disorder (Baglioni et al., 2016). Similarly, STBs were related to sleep discontinuity (including long sleep onset latency, lower sleep efficiency, and increased awakenings), REM sleep disturbance, more N1 and N2 sleep, and less N3 sleep (Agargun and Cartwright, 2003; Ballard et al., 2016; Bernert et al., 2016; Sabo et al., 1991; Singareddy and Balon, 2001; Zeoli et al., 2021). In one of the few studies examining sleep microarchitecture and STBs, greater fast-frequency activity (e.g., beta and alpha frequencies) and lower delta activity differentiated patients with depression with and without suicide ideation (Fig. 2; Dolsen et al., 2017). Polysomnography findings indicate that hyperarousal during sleep may be an important neurobiological mechanism in the association between sleep disturbance and STBs.

7. Sleep disturbance and suicide-related thoughts and behaviors among sexual and gender minority people

Few studies have examined the association between sleep disturbance and STBs among SGM individuals, and most to date have focused on sexual minority adolescents. The 2015 School-Based Chinese Adolescents Health Survey study found that sleep quality partially mediated the association between sexual minority identity and suicide ideation (Huang et al., 2018). In a study utilizing the 2015/2017 Youth Risk

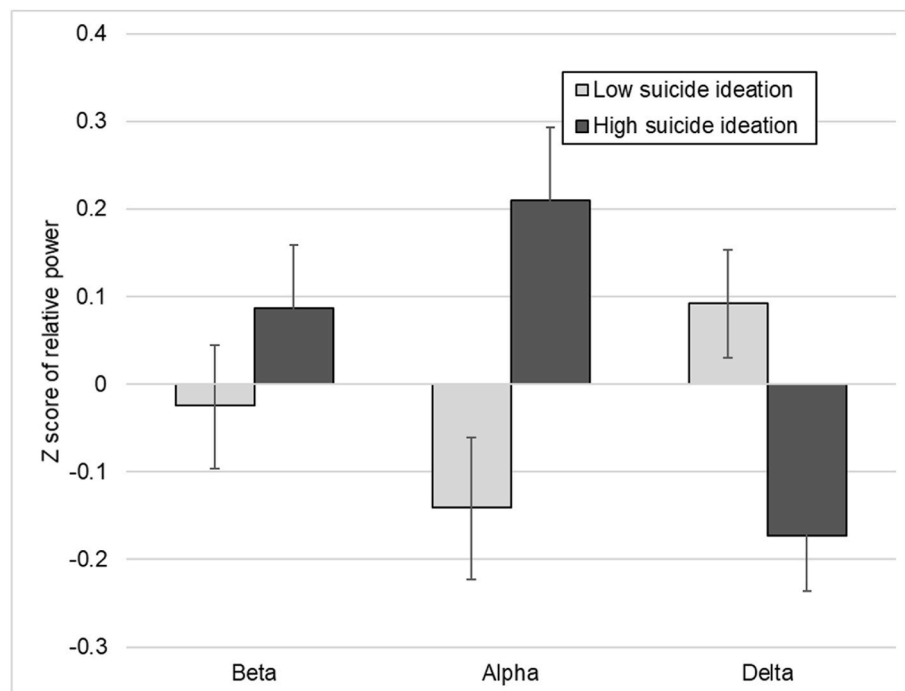


Fig. 2. Differences by high and low suicide ideation for beta, alpha, and delta power in a sample of 84 adults with major depressive disorder. Note: Adapted from Dolsen et al. (2017).

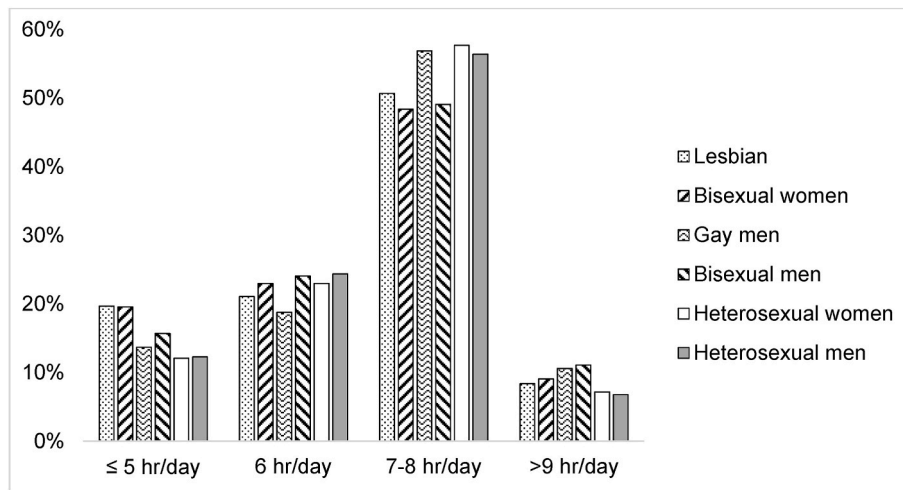


Fig. 3. Comparison of sleep duration by sexual orientation. Note: Data derived from Dai and Hao (2019).

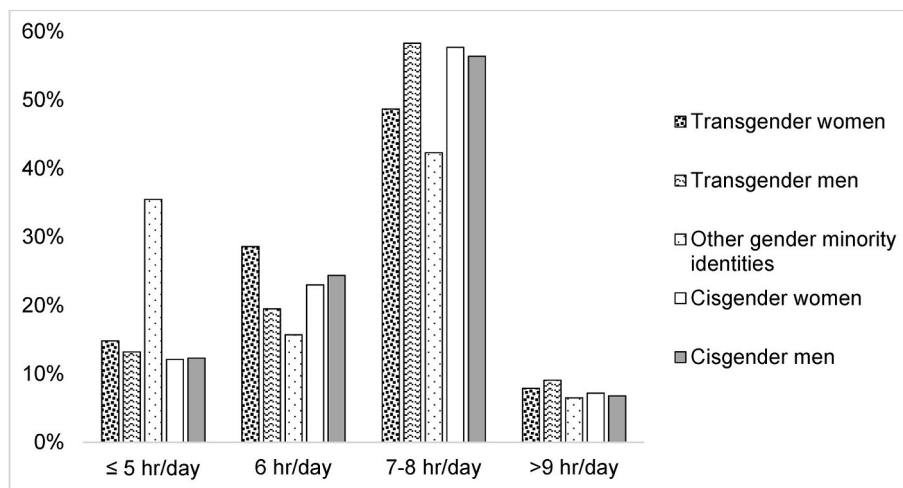


Fig. 4. Comparison of sleep duration by gender identity. Note: Data derived from Dai and Hao (2019).

Behavior Survey data, latent profile analysis was used to identify risk profiles related to suicide attempt (Giano et al., 2020). The highest risk group of LGB youth ranked lowest in hours of sleep, and highest in bullying, alcohol use, academic underachievement, and electronics use (Giano et al., 2020). Additionally, in the single study on sleep and STBs among sexual minority adults, sleep quality was found to be modestly correlated with a composite measure of suicide ideation and attempt (Chu et al., 2019).

Regarding gender minority people, few studies have examined the association between sleep disturbance and STBs. In an analysis of data from the 2016–2017 American College Health Association National College Health Assessment II, transgender college students had higher rates of sleep disturbance including inadequate sleep, daytime sleepiness, insomnia symptoms, and a diagnosis of a sleep disorder as well as 3–4 times increase in the odds of reporting suicide ideation or suicide attempt (Hershner et al., 2021). Although this study did not evaluate whether sleep disturbance functioned as a mechanism in the association between transgender identity and STBs, this study suggests that both sleep disturbance and STBs co-occur at high rates among gender minority people. Nightmares have been consistently linked with STBs in presumed heterosexual and/or cisgender populations, and a sample of transgender individuals found that nightmare frequency but not severity

predicted suicide ideation and suicide attempt (Andrew et al., 2020). Nightmares are among the diagnostic criteria for PTSD (American Psychiatric Association, 2013), and an estimated 1.3–47.6% of sexual minority and 17.8–42.0% for gender minority individuals meet criteria for PTSD compared with 6.8–8.3% in the general population (Livingston et al., 2020).

8. From general mental health problems to suicide

Minority stress theory has been used to understand why SGM people may be at higher risk for suicide than heterosexual or cisgender people (Hendricks and Testa, 2012; Meyer, 2003). However, minority stress theory explains why SGM people may be at greater risk for mental health problems, in general, but does not predict the development of specific mental health problems such as STBs (Meyer, 2010). As such, minority stress theory may be necessary but not sufficient in explaining the development of STBs. Similarly, sleep disturbance is a transdiagnostic risk factor for multiple mental health disorders (Baglioni et al., 2016; Dolsen et al., 2014), but there does not appear to be a single aspect of sleep disturbance that has high specificity for STBs. Approximately 90% of completed suicide cases occur among individuals with mental health disorders (Cavanagh et al., 2003), and one possibility is that minority

stress interacts with sleep disturbance to increase risk for the development and/or maintenance of mental health disorders, which then lead to STBs and death by suicide. Thus, there may be suicide-specific processes that combine with minority stress and sleep disturbance to lead to suicide-related outcomes instead of, for example, other mental health outcomes such as anxiety or substance use, that might occur if suicide-specific processes were absent.

The interpersonal theory of suicide (Joiner, 2005) is one model of suicide risk that may have particular relevance to how minority stress and sleep disturbance specifically relate to STBs. The interpersonal theory of suicide proposes that one's capability for suicide, in combination with thwarted belongingness and perceived burdensomeness, contribute to thoughts of suicide (Joiner, 2005). A study examining the association between minority stress theory and interpersonal theory of suicide found that minority stress was related to perceived burdensomeness and thwarted belongingness in models predicting suicidal ideation and attempt (Fulginiti et al., 2020). Additionally, minority stress had a direct effect on suicide attempt only and perceived burdensomeness partially mediated the association between minority stress and suicide attempt and suicide ideation (Fulginiti et al., 2020). Additionally, a study compared how minority stress theory related to theories of suicide such as the interpersonal theory of suicide, and found that interpersonal processes (e.g., perceived burdensomeness and thwarted belongingness) and depressive processes interacted with minority stress processes including internalized homophobia, lack of social support, and earlier age of identity disclosure to predict STBs (Plöderl et al., 2014).

The interpersonal theory of suicide has also been applied to understanding the association between sleep disturbance and STBs. Thwarted belongingness was found to mediate the association between insomnia symptoms and suicide ideation in three samples of military servicemembers and veterans (Hom et al., 2017). Thwarted belongingness can be understood as loneliness and social disconnection as well as lack of social support (Van Orden et al., 2010). Nocturnal wakefulness, which is characteristic of insomnia, has been proposed as one explanation for how sleep disturbance increases risk for STBs (Perlis et al., 2015). Social connection and support may be less available at night because friends and family are asleep. Other consequences of nocturnal wakefulness including daytime sleepiness and emotion dysregulation may negatively impact social functioning, which may further contribute to thwarted belongingness. Importantly, thwarted belongingness partially mediated the relationship between insomnia and suicide ideation, but insomnia symptoms did not mediate the association between thwarted belongingness and suicide ideation (Hom et al., 2017). It is less clear how sleep disturbance, perceived burdensomeness, and STBs may be related. However, insomnia symptoms appear to be correlated with perceived burdensomeness in military servicemembers (Bryan, 2011). Additional research is needed regarding interpersonal theory of suicide, sleep disturbance, and STBs, particularly given evidence that insomnia symptoms and nightmares continued to be significantly associated with STBs after controlling for components of the interpersonal theory of suicide (Nadorff et al., 2014).

Thwarted belongingness and perceived burdensomeness may be important to consider in the association between SGM identity, sleep disturbance, and STBs. In the only study to examine sleep and suicide among SGM people, thwarted belongingness and perceived burdensomeness mediated the association between sleep problems and STBs (Chu et al., 2019). Although this study used a single-item measure of sleep quality, a major strength of this study was reporting sexual and/or gender minority identities, with 73.9% of the sample ($n = 245$) identifying as sexual minority, 1.7% as gender minority only ($n = 6$), and 24.4% identifying as both sexual and gender minority ($n = 80$).

9. Conclusions and future directions

Research on sleep health disparities experienced by SGM people continues to grow yet remains an understudied area of research.

Compared with cisgender and/or heterosexual people, there are striking differences in risk for STBs among sexual minority individuals, gender minority individuals, and people who identify as both sexual and gender minorities. In this paper we reviewed evidence that 1) SGM people are at increased risk for STBs, 2) SGM people experience significant sleep problems, and 3) the association between SGM identity, minority stress, and STBs may be partially explained by sleep disturbance. Although previous reviews have highlighted sleep disturbance experienced by SGM people (Butler et al., 2020; Patterson and Potter, 2019), this is the first review to provide a conceptual framework (Fig. 1) for how sleep disturbance may increase risk for STBs among SGM people. This is an important addition to the literature on SGM mental health given the elevated suicide risk in this population. Although this a narrative review rather than a systematic review, it does represent the most recent knowledge base to date, and future systematic reviews should be conducted on this important topic. Research on the mechanisms involved in risk for STBs among SGM people is still growing. The effect sizes for the studies reviewed are low to medium reflecting the well-established difficulty of identifying strong predictors of suicide ideation, suicide attempt, and death by suicide (Franklin et al., 2017). More work is needed to examine sleep disturbance as a potential mechanistic contributor to STBs among SGM people given that nearly all of the existing research has been done with presumed heterosexual and/or cisgender samples. Research on sleep problems among SGM individuals is also still developing. Sleep is not a unitary construct, and research is needed regarding which aspects of sleep may be impacted for SGM people. There are multiple dimensions of sleep health including sleep quality and satisfaction; daytime alertness, sleepiness, and napping; timing and circadian factors; sleep efficiency, sleep latency, wake after sleep onset; and sleep duration (Buysse, 2014). By contrast, most research on sleep among SGM people has used single item assessments of sleep and subjective self-report. Objective measures of sleep such as actigraphy, polysomnography, or clinical interview could help with understanding how particular features of sleep may be disturbed for SGM people in addition to general subjective sleep disturbance. However, whether measuring sleep with multiple methods will provide further insight into the link between sleep disturbance and STBs among SGM people remains an open question. A meta-analysis of longitudinal studies among presumed heterosexual and/or cisgender people found that the association between sleep disturbance and STBs did not depend on whether sleep was assessed with self-report, clinical interview, actigraphy, or polysomnography (Harris et al., 2020). Additionally, a major gap in research is related to sleep disorders such as sleep apnea, particularly among gender minority people (Earl and Brown, 2019). There are known sex differences in rates of sleep apnea with cisgender men being 3–5 times more likely to have sleep apnea compared with cisgender women (Redline et al., 1994; Won et al., 2020). A case series indicated that OSA may be influenced by gender-affirming hormone therapy (Robertson et al., 2019), although larger scale prospective studies should be conducted.

Sleep is strongly influenced by the circadian rhythm, and emerging evidence suggests that the circadian rhythm may play a role in risk for STBs (Perlis et al., 2015, 2016; Selvi et al., 2010; Tubbs et al., 2020). Although circadian factors have not been widely researched in SGM populations, circadian misalignment has been linked to substance use in sexual minority men (Millar et al., 2019) as well as depressed mood and lower health-related quality of life among transgender male adolescents (Bowen et al., 2021). Future research should be conducted examining how circadian factors interact with sleep may help further elucidate a potential link between sleep disturbance and suicide risk among SGM people.

Minority stress theory is the primary theoretical basis for the studies reviewed in this paper, yet most studies examining sleep in SGM people have not included validated measures of minority stress such as the Gender Minority Stress and Resilience Measure (Testa et al., 2015). There are advantages to using pre-existing datasets that have collected

data on SGM identity, sleep, and STBs, although these studies have limitations regarding generalizability (Lett and Everhart, 2022). Although no epidemiological studies have directly measured minority stress as well as sleep and STBs, there may be opportunities to use other constructs as a proxy. For example, Dai and Hao (2019) used depression as a proxy for minority stress in a study on sleep duration, but acknowledged that there are important differences between minority stress and depression. Additional research is necessary to elucidate the specific mechanisms involved in the association between minority stress, sleep disturbance, and STBs. There is preliminary evidence that components of the interpersonal theory of suicide may help to explain the association between sleep disturbance and suicide among SGM people (Chu et al., 2019), although evidence is mixed in presumed cisgender and/or heterosexual samples (Hom et al., 2017; Nadorff et al., 2014). Additionally, discrimination has a negative impact on sleep disturbance, but the precise mechanisms have not been established (Slopen et al., 2016).

Sleep is an appealing target for suicide prevention efforts given that sleep problems are modifiable, and existing sleep treatments have high acceptability and are associated with reduced STBs in studies that did not specifically recruit SGM people (Manber et al., 2011; McCall et al., 2019; Pigeon et al., 2017; Trockel et al., 2015). Sexual minority people are more likely to use sleep medications than heterosexual people (Galinsky et al., 2018; Patterson and Potter, 2021). Long-term use of sedative hypnotics have been linked to increased mortality and greater risk of STBs (Hartz and Ross, 2012; McCall et al., 2017), although findings may be confounded by the presence of a sleep disorder diagnosis rather than the sleep treatment. More research is needed to determine whether SGM people are more likely to be prescribed sedative hypnotics for long-term management of sleep problems, which, if true, may represent an important intermediary factor in the association between sleep disturbance and STBs. Regarding psychosocial treatments, no studies have examined receipt of evidence-based treatments such as CBT-I among SGM people. Interventions such as the Transdiagnostic Sleep and Circadian Intervention (Dolsen et al., 2021a; Dong et al., 2020; Harvey et al., 2018, 2021), which is a modular treatment designed to address the particular needs of an individual, may be a good fit for addressing the sleep problems experienced by SGM people. Additionally, research on sleep treatments is particularly needed given that SGM people experience barriers to treatment at the patient, provider, and healthcare system level (Ojeda-Leitner and Lewis, 2021; Whaibeh et al., 2020; Zay Hta et al., 2021). Identifying potential barriers to treatment may be especially important given that number of sleep medicine clinic visits was associated with an 11% reduction in the odds of a suicide attempt in a large sample of veterans (Bishop et al., 2020).

A one-size-fits-all approach to treatment is unlikely to adequately address the mental health problems of diverse populations (Flentje, 2020; Pachankis, 2018). Among those who receive sleep interventions, research is needed to determine whether existing interventions target the particular sleep needs of SGM people such as the impact of minority stress on sleep, or sleep disturbance specifically related to gender dysphoria and/or gender affirming treatments (Harry-Hernandez et al., 2020). Existing interventions have been adapted to address the particular needs of SGM people by changing negative cognitive styles related to internalized stigma, addressing fears related to identity disclosure, applying cognitive restructuring techniques to schemas regarding victimization and empowerment, encouraging behavioral activation within SGM communities, and contextualizing psychopathology as symptomatic of systemic discrimination and oppression (Flentje, 2020; Pachankis, 2018). Similar adaptations could be made to evidenced-based psychotherapies for sleep disturbance. For example, targeting minority stressors may improve sleep. Greater family support has been shown to be related to better sleep quality and lower risk of short sleep duration in sample of sexual minority people (Chum et al., 2021). Notably, support from one's chosen family did not attenuate the negative consequences of lack of family support (Chum et al., 2021),

suggesting that support from one's chosen family does not appear to replace support from one's family.

Few studies acknowledge that people have both a sexual orientation and a gender identity, and that someone may identify as sexual minority, gender minority, or both. This is particularly concerning given that studies that have examined sexual orientation and gender identity separately have found important differences. For example, adolescents who identify as both sexual and gender minority experience greater emotional distress and bullying victimization than those identifying as sexual minority or gender minority (Eisenberg et al., 2019). Further, within these identities, there are important differences that are often conflated. Studies on gender minority individuals often refer to this group as "transgender" despite there being important differences in health risk behaviors between transgender men, transgender women, genderqueer, and nonbinary people (Smalley et al., 2016). Researchers as well as healthcare systems should routinely collect self-reported sexual orientation and gender identity (SOGI) data. This data is particularly important to include in the electronic health record as these data are often used in epidemiological studies examining health disparities. Additionally, research is needed regarding sexual orientation and gender identity across the lifespan to examine potential cohort differences, particularly given that age effects have been observed for SGM identity (Jones, 2022), sleep (Grandner, 2012), and rates of suicide (Ivey-Stephenson et al., 2017).

The present narrative review examined research related to sleep disturbance and STBs among SGM populations, although research in this area is scarce. Our review demonstrates that SGM people disproportionately experience sleep disturbance and are at higher risk of death by suicide relative to cisgender and/or heterosexual individuals. Although sleep disturbance appears to be a mechanistic and modifiable contributor to STBs, most research has not been conducted in SGM populations. Future studies should be conducted with people who identify as sexual minority, gender minority, and both and also assess aspects of sleep disturbance beyond sleep quality and sleep duration. Future research is needed to determine whether sleep may be a potential intervention target to address the high rates of STBs among SGM people.

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CRedit authorship contribution statement

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Declaration of competing interest

None.

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