

The contribution of sleep deprivation to suicidal behavior

A contribuição da privação do sono para o comportamento suicida

La contribución de la privación del sueño al comportamiento suicida

Received: 10/03/2023 | Revised: 10/14/2023 | Accepted: 10/15/2023 | Published: 10/24/2023

Thais Gomes de Matos Azevedo

ORCID: <https://orcid.org/0009-0009-6803-8121>

Centro Universitário Christus, Brazil

E-mail: thaisgma@hotmail.com

Ana Karoliny Martins Ponceano

ORCID: <https://orcid.org/0009-0005-7399-3300>

Centro Universitário Christus, Brazil

E-mail: anakaroliny122208@gmail.com

Melissa Soares Viana

ORCID: <https://orcid.org/0009-0003-5233-8732>

Centro Universitário Christus, Brazil

E-mail: melissasoaresviana@hotmail.com

Maria Clara Catunda Aguiar

ORCID: <https://orcid.org/0009-0001-1140-6095>

Centro Universitário Christus, Brazil

E-mail: mariaclara19644@gmail.com

Marcéu Veríssimo Ramos dos Santos

ORCID: <https://orcid.org/0000-0003-3039-1340>

Centro Universitário Christus, Brazil

E-mail: marceusantosmedicina@gmail.com

Júlio César Claudino dos Santos

ORCID: <https://orcid.org/0000-0001-6543-481X>

Centro Universitário Christus, Brazil

E-mail: cesar.claudino@unifesp.br

Abstract

Objective: This study has the objective correlate sleep disturbances and mood disorders with suicide behavior, showing that the quality of sleep, when altered, interferes negatively in the individual's daily life, compromising social and labor aspects significantly, leading to a higher incidence of psychiatric disorders, which can incite suicidal behaviors. **Methods:** This article presents a narrative literature review based on the analysis of scientific articles published from 2009 to 2022 in PubMed on sleep deprivation and suicidal behavior. **Results:** The results certainly showed that quality and the minimum amount needed of sleep, when altered, interferes negatively in the individual's daily life, compromising social aspects significantly, leading to a higher incidence of disorders and acute and chronic diseases, such as schizophrenia, depression, anxiety, Alzheimer's and Parkinson's, increasing the risk of infectious diseases, cardiovascular diseases, cancer suggesting that the impact of the sleep-wake cycle on anatomy physiology is significant. **Conclusion:** The study showed that establishing a causal relationship between sleep and mood becomes indispensable to contribute to the development of conventional interventions to promote earlier approaches to sleep and mental health. It was also able to contemplate that sleep disturbance presents itself as a factor, worthy of incorporation into standardized frameworks, for suicide risk assessment and a growing body of research suggests that sleep complaints may be associated with an increased risk of suicidal ideation, suicide attempts and death by suicide, concluding that suicide is largely influenced by changes in the circadian cycle.

Keywords: Sleep deprivation; Sleep disturbances; Suicide.

Resumo

Objetivo: Este estudo tem o objetivo de correlacionar distúrbios do sono e transtornos de humor com comportamento suicida, mostrando que a qualidade do sono, quando alterada, interfere negativamente na vida diária do indivíduo, comprometendo significativamente os aspectos sociais e laborais, levando a uma maior incidência de transtornos psiquiátricos, que podem incitar comportamentos suicidas. **Métodos:** Este artigo apresenta uma revisão narrativa da literatura baseada na análise de artigos científicos publicados de 2009 a 2022 no PubMed sobre privação de sono e comportamento suicida. **Resultados:** Os resultados certamente mostraram que a qualidade e a quantidade mínima necessária de sono, quando alteradas, interferem negativamente na vida diária do indivíduo, comprometendo os aspectos sociais de forma significativa, levando a uma maior incidência de transtornos e doenças agudas e crônicas, como esquizofrenia, depressão, ansiedade, Alzheimer e Parkinson, aumentando o risco de doenças infecciosas e cardiovasculares, sugerindo que o impacto do ciclo sono-vigília na anatomia e fisiologia é significativo. **Conclusão:** O

estudo mostrou que estabelecer uma relação causal entre sono e humor torna-se indispensável para contribuir para o desenvolvimento de intervenções convencionais que promovam abordagens mais precoces para o sono e a saúde mental. Foi também capaz de contemplar que o distúrbio do sono se apresenta como um fator digno de incorporação em estruturas padronizadas para avaliação do risco de suicídio, e um crescente corpo de pesquisa sugere que queixas de sono podem estar associadas a um maior risco de ideação suicida, tentativas de suicídio e morte por suicídio, concluindo que o suicídio é largamente influenciado por alterações no ciclo circadiano.

Palavras-chave: Privação de sono; Distúrbios do sono; Suicídio.

Resumen

Objetivo: Este estudio tiene como objetivo correlacionar los trastornos del sueño y los trastornos del estado de ánimo con el comportamiento suicida, mostrando que la calidad del sueño, cuando está alterada, interfiere negativamente en la vida diaria del individuo, comprometiendo significativamente aspectos sociales y laborales, lo que lleva a una mayor incidencia de trastornos psiquiátricos que pueden incitar comportamientos suicidas. Métodos: Este artículo presenta una revisión narrativa de la literatura basada en el análisis de artículos científicos publicados de 2009 a 2022 en PubMed sobre privación del sueño y comportamiento suicida. Resultados: Los resultados ciertamente mostraron que la calidad y la cantidad mínima necesaria de sueño, cuando están alteradas, interfieren negativamente en la vida diaria del individuo, comprometiendo significativamente aspectos sociales, lo que lleva a una mayor incidencia de trastornos y enfermedades agudas y crónicas, como esquizofrenia, depresión, ansiedad, Alzheimer y Parkinson, aumentando el riesgo de enfermedades infecciosas y enfermedades cardiovasculares, cáncer, lo que sugiere que el impacto del ciclo sueño-vigilia en la anatomía y fisiología es significativo. Conclusión: El estudio mostró que establecer una relación causal entre el sueño y el estado de ánimo se vuelve indispensable para contribuir al desarrollo de intervenciones convencionales que promuevan enfoques más tempranos para el sueño y la salud mental. También pudo contemplar que los trastornos del sueño se presentan como un factor digno de incorporación en marcos estandarizados para la evaluación del riesgo de suicidio, y un creciente cuerpo de investigación sugiere que las quejas sobre el sueño pueden estar asociadas con un mayor riesgo de ideación suicida, intentos de suicidio y muerte por suicidio, concluyendo que el suicidio está influenciado en gran medida por cambios en el ciclo circadiano.

Palabras clave: Privación de sueño; Trastornos del sueño; Suicidio.

1. Introduction

Sleep disorders, caused by risk factors such as insomnia, nightmares, excessive daytime sleepiness (EDS) and anxiety, are often associated with a range of psychiatric disorders, which contribute to suicidal thoughts and behaviors (Lopez-Castroman & Jaussent, 2020, p. 211-228). That said, this impact on the reduction of sleep, results in impairments in neurobehavioral and emotional functioning of people, interfering with the performance of daily tasks and personal relationships (Maski & Kothare, 2013, p. 259-264), negatively influencing mental health through the development of pathologies such as depression and substance abuse, which can evolve into suicidal ideation (Owens & Weiss, 2017).

Suicidal behaviors have become common in the general population and, therefore, result in an important public health problem (Benard, Geoffroy, & Bellivier, 2015), which presents vast social, economic and emotional consequences (Rosa et al., 2019), being a complex and multifactorial phenomenon that encompasses biological, social and psychological mechanisms. The characterization and classification of suicidal behaviors, such as suicidal ideation, attempted suicide, and completed suicide, are considered warning signs with potential applicability for the prevention of further emotional disorders. Thus, sleep disorders are strongly associated with different components of suicidal behavior, often constituting a proximal factor that immediately precedes the onset of suicidal behavior. In addition, sleep patterns can be modified through a variety of treatments, such as improved sleep hygiene, psychological interventions, and pharmacological treatments (Lopez-Castroman & Jaussent, 2020, p. 211-228).

As an example, suicide is currently responsible for almost 1 million deaths annually, and approximately one life lost every 40 seconds. Thus, as a way to prevent a more alarming scenario, the Institute of Medicine (IOM) has made suicide prevention a priority and requested proportions in order to investigate the reasons for threat based on evidence, aiming to reduce the number of suicides (Bernert, Kim, Iwata, & Perlis, 2015). Thus, the importance of sleep studies is demonstrated, which lies in its prominent role in the investigation of depression, covering the spheres of diagnosis, the development of treatment strategies,

and the identification of individuals vulnerable to depression (Lopez-Castroman & Jaussent, 2020, p. 211-228; Katherine et al., 2013).

It is important to point out that suicide rates in the medical population are higher than those of the general population (Katherine et al., 2013), and the psychological suffering is related to specific experiences of the profession, such as the heavy workload, which causes constant sleep deprivation, indicated among the main causes in bibliographic studies (Goebert et al., 2009). That said, it is noted that, despite the evolution on the debate of the theme, suicide is still a taboo in society, especially in the medical field, where professionals are taught to see death as their greatest adversary, and should fight it in favor of science and their own competence (Püschel & Schalinski, 2006; Wang, Cheng, & Xu, 2019), which explains the records of underreporting of deaths by suicide in the medical field, understood as a form of protection and to avoid the exposure of suicidal colleagues (Püschel & Schalinski, 2006; Mendoza, 2019).

2. Methodology

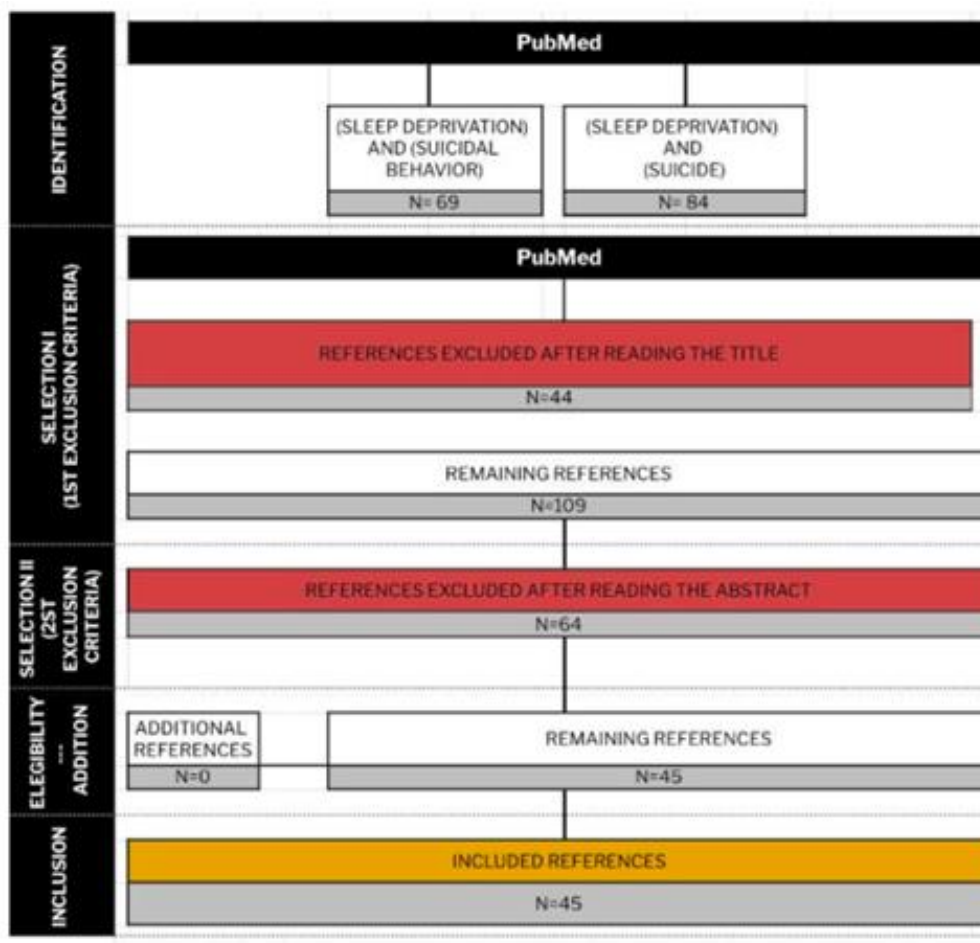
This article presents a narrative review of the literature, aiming to list the main ideas and concepts regarding the exposed theme, based on the analysis of scientific articles published from 2009 to 2022 on PubMed, regarding sleep deprivation and suicidal behavior. The premise is that bibliographic analysis grants us the opportunity to deepen our knowledge through various sources and perspectives, exploring predominant discussions and topics, constructing a comprehensive synthesis that allows us to contemplate the same subject through multiple approaches (Pereira et al., 2018).

In the application of the first set of criteria, titles that did not mention the theme "association between sleep deprivation and suicidal behavior," articles not included in the 2009-2022 research period, and articles not found in English were excluded. In the PubMed database, 69 articles were found using the keywords "SLEEP DEPRIVATION AND SUICIDAL BEHAVIOR," and 84 articles using the keywords "SLEEP DEPRIVATION AND SUICIDAL," of which 109 were selected.

The second set of criteria was applied, excluding abstracts that did not address the theme of sleep deprivation and suicidal behavior, resulting in the exclusion of 64 articles.

Out of the total, 42 originally in English (including book chapters, guidelines, and case reports) remained, as shown in Figure 1, providing a combination of literature data and a more comprehensive understanding.

Figure 1 - literature review: 'relationship between sleep deprivation and suicide.



Source: Authors.

3. Results and Discussion

Sleep Deprivation and Sleep Disturbances

Sleep is a behavioral phenomenon conserved among mammals (Bah, Goodman, & Iliff (2019), essential for the reestablishment of human physiological functions (Aparício & Panin, 2020). Adequate sleep at the appropriate biological time is also critical for homeostasis and maintenance of endogenous chronobiological rhythms, associated with environmental and behavioral stimuli, such as day and night, eating and fasting, and activity and rest (Holmer et al., 2021). However, humans experience an insufficient sleep cycle in a variety of ways, which have acute negative physiological effects and, when experienced chronically, predispose to disease (Holmer et al., 2021).

In this context, the average amount of sleep required for an individual to maintain adequate health is 8 to 10 hours per night. The recommendation is based on the expert panel of the American Academy of Sleep Medicine, which reviewed studies on general health, cardiovascular health, metabolism, mental health, and longevity related to sleep duration, which applies to total sleep over a 24-hour period (Kansagra, 2020). Chronic sleep restriction occurs when an individual gets less sleep than their ideal sleep cycle for days, weeks, months, or even years, and is probably the most prevalent form of sleep deprivation (Wright, Bogan & Wyatt, 2013). As an illustration, insomnia disorder refers to an example of sleep restriction, characterized by the inability to fall asleep or stay asleep and suffering from morning awakening due to anxiety or stress conditions (Sateia, 2014).

These symptoms must be in a window of at least three times a week over a period of at least 3 months to be diagnosed as insomnia disorder.

The insomnia-psychosocial stress relationship needs to be conceptualized as bidirectional, since when comparing the etiological and pathophysiological explanations for insomnia and psychological stress, a clear overlap is present, where both conditions have been shown to be triggered by psychophysiological stressors and aggravated by hyperexcitation, reflected in cardiac changes, increased cortisol production, and an increase in fast waves (Riemann et al., 2020). Regardless of how sleep deprivation is experienced, the resulting chronodisruption can impair cardiovascular, cerebral, and hormonal function (Holmer et al., 2021).

Moreover, recent studies have increased interest regarding the role of sleep deprivation in inducing subjective psychosis-like experiences and neurocognitive alterations, such as schizophrenia (Kumari & Ettinger, 2020), depression, anxiety (Riemann et al., 2020), alzheimer's and parkinsonism (Bah, Goodman & Iliff, 2019). In this respect the subjectively reported poorer quality and efficiency of sleep predicts increased severity in many dimensions of symptoms, including auditory hallucinations, paranoia and delusions, in patients with schizophrenia (Mulligan et al., 2016.). Furthermore ,new insights into changes in brain metabolism during the sleep-wake cycle suggest that functional neuroanatomical correlates can be attributed to characteristic psychic changes in depression, of which two main components can be distinguished (Riemann et al., 2020). First, persistent hyperactivity in the ventral emotional system that includes the amygdala and ventral anterior cingulate cortex(ACC) may be related to disturbances in affect, including depressed mood, and to the characteristic sleep enhancement in depression (Nofzinger, 2004).

Second, hypoactivity in the dorsal executive system throughout the sleep-wake cycle, which includes the dorsolateral prefrontal cortex (DLPFC), may be implicated in attenuated executive functions and reduced slow-wave sleep in depression (Chellappa & Araújo, 2007). Furthermore, with advancing age, sleep time becomes shorter and more fragmented, which leads to the development of age-related neurodegenerative diseases such as Alzheimer's and Parkinson's. Furthermore, emerging mechanistic studies suggest that sleep disruption may be causally linked to neurodegenerative anatomy physiology, suggesting that sleep may represent a key therapeutic target in preventing these conditions (Bah, Goodman & Iliff, 2019).

In this circumstance, the most extensive database for sleep disorder therapy in the window of chronomedicine is evidenced by cognitive-behavioral therapy. first-line treatment raises guidelines regarding significant long-term effects beyond the acute phase of treatment, and is in this respect superior to pharmacological treatment. CBT encompasses relaxation techniques, sleep hygiene, stimulus control, sleep restriction, and cognitive techniques to reduce nocturnal ruminations (Nofzinger et al.,2005).

Adding to the processes of sleep-wake regulation and the concept of sleep propensity/sleep pressure (Borbély, 1982), the proposed strategy is derived from the clinical observation that patients with chronic insomnia prolong time in bed to get more sleep, such behavior perpetuating insomnia rather than alleviating it. By shortening the time in bed, as suggested by sleep restriction, the homeostatic drive is stimulated and the quality of subsequent sleep improves (Miller et al., 2014). Considering sleep restriction as a type of partial sleep deprivation, it is notorious that total sleep deprivation alone is a fast treatment modality in psychiatric disorders such as depression (Riemann et al., 2020).

Referring to the cited and substantiated information, it can be stated that sleep is a physiological behavioral pathway essential for the reestablishment of vital human functions, such as homeostasis, maintenance of heart and brain rhythms. However, humans experience an insufficient sleep cycle, with an average amount of sleep below that required for an individual to maintain adequate health. Chronic sleep restriction, such as insomnia disorder, occurs when an individual gets less sleep than their ideal sleep cycle for days, weeks, months, or even years, and is probably the most prevalent form of sleep deprivation. The presented disorders have been shown to be stimulated by psychophysiological stressors and burdened by hyperexcitation, reflected in cardiac changes, increased cortisol production, and an increase in fast waves.

In view of the above, the quality of sleep, when altered, interferes negatively in the individual's daily life, compromising social aspects significantly, leading to a higher incidence of disorders and acute and chronic diseases, such as schizophrenia, depression, anxiety, Alzheimer's and Parkinson's. The most extensive database for therapy, with emphasis on the processes of sleep-wake regulation is evidenced by cognitive-behavioral therapy, which covers the concept of sleep propensity/sleep pressure and techniques of relaxation, sleep hygiene and stimulus control. Therefore, the present study aims to evaluate the relationship of sleep deprivation and sleep disturbance to human behaviors, suggesting that the impact of the sleep-wake cycle on anatomy physiology is significant.

Sleep Disturbances, Mood Regulation and Mood Disorder

It is estimated that sleep disorders affect approximately 10% of the adult population and are associated with chronic symptoms of fatigue, impaired sustained attention, poorer working memory and degraded quality of life. In light of this, insomnia is also considered a significant public health problem (Hartescu, Morgan & Stevinson, 2015). Pre-existing correlational work has suggested that negative mood is associated with reduced sleep, that this association may be stronger for anxiety than for depression, and that short sleep is also related to broad mood swings and decreased emotional normalization (Baum et al., 2014).

Significant sleep disturbances have an important relationship with bipolar disorder which in turn is ranked among the 10 major causes of disability worldwide and characterized by mood disturbances, typically spanning manic episodes and depressive episodes (Talbot et al., 2012), as in the course of depression, people typically suffer from insomnia or hypersomnia, while throughout the manic phase, there is a reduced need for sleep (Lo et al., 2016). In this context, there is a proposed bidirectional model, called the sleep-humor cycle in which daytime mood and nighttime sleep interruptions are capable of reinforcing each other, to the extent that despite findings in studies showing that improved sleep leads to better clinical and functional outcomes, it is possible that mood instability and social difficulties causing a consequent generation of stress result in poor sleep (Harvey et al., 2015).

It said, taking into account the prevalence of short sleep and the relevance of mood as a contributor to mental health, it is essential to consider the effects of short sleep on mood (Lunsford-Avery et al., 2012). Therefore, establishing a causal relationship between sleep and mood becomes indispensable to contribute to the development of conventional interventions to promote earlier approaches to sleep and mental health (Paterson et al., 2011).

Studies also show that sleep, as a vital function, when restricted, even in a mild way, leads individuals to experience decreased energy and increased fatigue and confusion, as well as report feeling less alert, less efficient and more helpless, forgetful and exhausted (Talbot et al., 2012). In addition, they report increased feelings of tension, anger, and anxiety, feeling "on edge", anxious, and restless. Decreases in performance, development of pain, negative mood and somatic symptoms are also revealed (Baum et al., 2014).

Sleep Disturbances and Suicide Behaviour

Suicide occurs in the existence of psychiatric pathology and is intrinsically related to biological, psychological and social risk conditions (Bernert & Nadorff, 2015). Sleep disorders, particularly insomnia, nightmares, and excessive daytime sleepiness, are high risk conditions for suicidal ideation and manifestations (Bernert et al., 2015). Thus, in order to prove the relationship between suicide and sleep disorders, a systematic review was conducted with some inclusion criteria, sleep disturbance index, outcome measure for suicidal behavior, and presence of a diagnosis of depression or severity of depression as a covariate, were some of the criteria used. Therefore, the reports that met the inclusion criteria were classified and reviewed according to some parameters: study design and time period, model and sample size, sleep disturbance, suicide risk and outcome

measures for depression covariates, and presence of positive versus negative findings. The study of such reports showed conclusive evidence of sleep-wake cycle disturbances as a major risk factor for suicidal behaviors (Harvey et al., 2021).

Medicine, despite being considered one of the most financially and emotionally rewarding occupations, has some stressors unique to the medical profession, as well as others typical of the pressure caused by highly skilled jobs, such as sleep deprivation, overloaded hours, limitations of medical science, fear of making mistakes, direct contact with patient pain and suffering, and poor prognosis (Bernert & Nadorff, 2015). In continuity, it is important to point out that the sleep deprivation to which medical professionals submit themselves can lead to the deterioration of their intellect and psychological and physical integrity, causing a decrease in their capacity to reason, to retain information, to solve problems and to interpret exams (Lopez-Castroman & Jaussent, 2020, p. 211-228). Nevertheless, this deprivation, despite being interpreted as dedication to the medical profession, increasing, in the short term, the productivity both in the studies and in the care, in the long term causes a drop in productivity, cognitive deficit, demotivation, psychiatric disorders, damage to the general health and quality of life, and may incite suicidal thoughts or even the suicide act itself, as demonstrated by the literature (Harvey et al., 2021).

Accordingly, the literature has been extensive on reports of rising suicide rates among physicians, and this number is even higher when compared to the general population, as revealed by a German study, which shows that the suicide rate in the profession is three to five times higher (Hidalgo & Caumo, 2002). Nevertheless, a research from Oxford University, investigated factors related to suicide in physicians, through psychological autopsy of 38 professionals who committed suicide. Thus, among these, 25 had some type of mental disorder, mainly depression and alcohol abuse, and then these problems were related to work, interpersonal relationships, financial and a set of these factors, which may be related to sleep disorders such as insomnia, nightmares and excessive daytime sleepiness as a trigger (Landrigan et al., 2004). In addition, poor sleep hygiene, circadian rhythm changes, and insomnia can impact human health in other negative ways. The literature supports a multimode of consequences, behavioral changes, changes in mood, and academic decline in young people are some of them. Furthermore, the role of sleep in nocturnal regulation denotes relevance when related to immunity, as it contributes to dynamics of inflammatory biology (Kamski, Frank & Wenzel, 2012). Since the discovery of mutual relations between the central nervous system, sleep, and the immune system has evidenced that sleep elevated immune protections (Hawton, Malmberg & Simkin, 2004). In this way, it is concluded that sleep has a critical role in health promotion, research carried out in the last decade has shown that sleep disturbance has a relevant role in increasing the risk of infectious diseases, cardiovascular diseases, cancer and in the existence of depression, such results explain the need for the maintenance of an adequate circadian cycle, in order to minimize the impacts on human health (Kansagra, 2020).

Sleep disturbance presents itself as a factor, worthy of incorporation into standardized frameworks, for suicide risk assessment. Thus, a growing body of research suggests that sleep complaints may be associated with an increased risk of suicidal ideation, suicide attempts, and death by suicide (Kansagra, 2020; Kamski, Frank & Wenzel, 2012; Hawton, Malmberg & Simkin, 2004; Irwin, 2019). According to a meta-analysis study, this association ranges from a relative risk of 1.95 to 2.95, depending on the type of research and outcome assessed. Consistent with these findings, sleep disturbances are listed among the top 10 warning signs of suicide by the Substance Abuse and Mental Health Services Administration (SAMHSA), highlighting their potential importance in suicide risk assessment and screening (Irwin, 2019).

4. Conclusion

It is undeniable that suicide is one of the leading causes of death worldwide, and allied to this, sleep disorder has gradually gained attention as a possibly high threat motive for suicide. Thus, research indicates that a decrease of just one hour of sleep is associated with a relatively higher chance of these effects. Therefore, in order to improve suicide prevention and

contain suicide mortality, it is indispensable to recognize the reasons for suicide risk more effectively. Seasonality, circadian rhythms and sleep alterations have been related to psychiatric disorders.

Therefore, it can be concluded that suicide is largely influenced by changes in the circadian cycle. Until the current scenario, risk conditions have been exposed, including changeable and unchangeable factors, the changeable reasons include, among other causes, harmful use of alcohol and insomnia symptoms. In view of the above, the quality of sleep, when altered, interferes negatively in the individual's daily life, compromising social and labor aspects significantly, leading to a higher incidence of psychiatric disorders, which can incite suicidal behaviors.

References

- Aparício, C., & Panin, F. (2020). Interventions to improve inpatients' sleep quality in intensive care units and acute wards: a literature review. *British Journal of Nursing (Mark Allen Publishing)*, 29(13), 770–776. <https://doi.org/10.12968/bjon.2020.29.13.770>
- Bah, T. M., Goodman, J., & Iliff, J. J. (2019). Sleep as a therapeutic target in the aging brain. *Neurotherapeutics: The Journal of the American Society for Experimental NeuroTherapeutics*, 16(3), 554–568. <https://doi.org/10.1007/s13311-019-00769-6>
- Baum, K. T., Desai, A., Field, J., Miller, L. E., Rausch, J., & Beebe, D. W. (2014). Sleep restriction worsens mood and emotion regulation in adolescents. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 55(2), 180–190. <https://doi.org/10.1111/jcpp.12125>
- Benard, V., Geoffroy, P. A., & Bellivier, F. (2015). Saisons, rythmes circadiens, sommeil et vulnérabilité aux conduites suicidaires. *L'Encephale*, 41(4), S29–S37. [https://doi.org/10.1016/s0013-7006\(15\)30004-x](https://doi.org/10.1016/s0013-7006(15)30004-x)
- Bernert, R. A., Kim, J. S., Iwata, N. G., & Perlis, M. L. (2015). Sleep disturbances as an evidence-based suicide risk factor. *Current Psychiatry Reports*, 17(3). <https://doi.org/10.1007/s11920-015-0554-4>
- Bernert, R. A., & Nadorff, M. R. (2015). Sleep disturbances and suicide risk. *Sleep Medicine Clinics*, 10(1), 35–39. <https://doi.org/10.1016/j.jsmc.2014.11.004>
- Borbély AA. A two process model of sleep regulation. *Hum Neurobiol*. 1982;1(3):195-204. PMID: 7185792.
- Chellappa, S. L., & Araújo, J. F. (2007). O sono e os transtornos do sono na depressão. *Revista de Psiquiatria Clínica*, 34(6), 285–289. <https://doi.org/10.1590/s0101-60832007000600005>
- Goebert, D., Thompson, D., Takeshita, J., Beach, C., Bryson, P., Ephgrave, K., Kent, A., Kunkel, M., Schechter, J., & Tate, J. (2009). Depressive symptoms in medical students and residents: A multischool study. *Academic Medicine: Journal of the Association of American Medical Colleges*, 84(2), 236–241. <https://doi.org/10.1097/acm.0b013e31819391bb>
- Hartescu, I., Morgan, K., & Stevinson, C. D. (2015). Increased physical activity improves sleep and mood outcomes in inactive people with insomnia: a randomized controlled trial. *Journal of Sleep Research*, 24(5), 526–534. <https://doi.org/10.1111/jsr.12297>
- Harvey, A. G., Soehner, A. M., Kaplan, K. A., Hein, K., Lee, J., Kanady, J., Li, D., Rabe-Hesketh, S., Ketter, T. A., Neylan, T. C., & Buysse, D. J. (2015). Treating insomnia improves mood state, sleep, and functioning in bipolar disorder: A pilot randomized controlled trial. *Journal of Consulting and Clinical Psychology*, 83(3), 564–577. <https://doi.org/10.1037/a0038655>
- Harvey, S. B., Epstein, R. M., Glozier, N., Petrie, K., Strudwick, J., Gayed, A., Dean, K., & Henderson, M. (2021). Mental illness and suicide among physicians. *Lancet*, 398(10303), 920–930. [https://doi.org/10.1016/s0140-6736\(21\)01596-8](https://doi.org/10.1016/s0140-6736(21)01596-8)
- Hawton, K., Malmberg, A., & Simkin, S. (2004). Suicide in doctors. *Journal of Psychosomatic Research*, 57(1), 1–4. [https://doi.org/10.1016/s0022-3999\(03\)00372-6](https://doi.org/10.1016/s0022-3999(03)00372-6)
- Hidalgo, M. P., & Caumo, W. (2002). Sleep disturbances associated with minor psychiatric disorders in medical students. *Neurological Sciences: Official Journal of the Italian Neurological Society and of the Italian Society of Clinical Neurophysiology*, 23(1), 35–39. <https://doi.org/10.1007/s100720200021>
- Holmer, B. J., Lapierre, S. S., Jake-Schoffman, D. E., & Christou, D. D. (2021). Effects of sleep deprivation on endothelial function in adult humans: a systematic review. *GeroScience*, 43(1), 137–158. <https://doi.org/10.1007/s11357-020-00312-y>
- Irwin, M. R., & Opp, M. R. (2017). Sleep health: Reciprocal regulation of sleep and innate immunity. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology*, 42(1), 129–155. <https://doi.org/10.1038/npp.2016.148>
- Irwin, M. R. (2019). Sleep and inflammation: partners in sickness and in health. *Nature Reviews. Immunology*, 19(11), 702–715. <https://doi.org/10.1038/s41577-019-0190-z>
- Kamski, L., Frank, E., & Wenzel, V. (2012). Suizidalität von Medizinstudierenden: Fallserie. *Der Anaesthesist*, 61(11), 984–988. <https://doi.org/10.1007/s00101-012-2094-1>
- Kansagra, S. (2020). Sleep disorders in adolescents. *Pediatrics*, 145(Supplement_2), S204–S209. <https://doi.org/10.1542/peds.2019-2056i>
- Katherine, J., Gold, M. D., Ananda, S., Thomas, L., & Schwenk, M. (2013). Details on suicide among U.S. physicians: Data from the National Violent Death Reporting System. *Gen Hosp Psychiatry*, 35(1), 45–49

- Kumari, V., & Ettinger, U. (2020). Controlled sleep deprivation as an experimental medicine model of schizophrenia: An update. *Schizophrenia Research*, 221, 4–11. <https://doi.org/10.1016/j.schres.2020.03.064>
- Landrigan, C. P., Rothschild, J. M., Cronin, J. W., Kaushal, R., Burdick, E., Katz, J. T., Lilly, C. M., Stone, P. H., Lockley, S. W., Bates, D. W., & Czeisler, C. A. (2004b). Effect of reducing interns' work hours on serious medical errors in intensive care units. *The New England Journal of Medicine*, 351(18), 1838–1848. <https://doi.org/10.1056/nejmoa041406>
- Lo, J. C., Ong, J. L., Leong, R. L. F., Gooley, J. J., & Chee, M. W. L. (2016). Cognitive performance, sleepiness, and mood in partially sleep deprived adolescents: The need for sleep study. *Sleep*, 39(3), 687–698. <https://doi.org/10.5665/sleep.5552>
- Lopez-Castroman, J., & Jaussent, I. (2020). Sleep disturbances and suicidal behavior. In *Behavioral Neurobiology of Suicide and Self Harm* (pp. 211–228). Springer International Publishing
- Liu, R. T., Steele, S. J., Hamilton, J. L., Do, Q. B. P., Furbish, K., Burke, T. A., Martinez, A. P., & Gerlus, N. (2020). Sleep and suicide: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Review*, 81(101895), 101895. <https://doi.org/10.1016/j.cpr.2020.101895>
- Lunsford-Avery, J. R., Judd, C. M., Axelson, D. A., & Miklowitz, D. J. (2012). Sleep impairment, mood symptoms, and psychosocial functioning in adolescent bipolar disorder. *Psychiatry Research*, 200(2–3), 265–271. <https://doi.org/10.1016/j.psychres.2012.07.037>
- Maski, K. P., & Kothare, S. V. (2013). Sleep deprivation and neurobehavioral functioning in children. *International Journal of Psychophysiology: Official Journal of the International Organization of Psychophysiology*, 89(2), 259–264. <https://doi.org/10.1016/j.ijpsycho.2013.06.019>
- Mendoza, J. (2019). Circadian insights into the biology of depression: Symptoms, treatments and animal models. *Behavioural Brain Research*, 376(112186), 112186. <https://doi.org/10.1016/j.bbr.2019.112186>
- Miller, C. B., Espie, C. A., Epstein, D. R., Friedman, L., Morin, C. M., Pigeon, W. R., Spielman, A. J., & Kyle, S. D. (2014). The evidence base of sleep restriction therapy for treating insomnia disorder. *Sleep Medicine Reviews*, 18(5), 415–424. <https://doi.org/10.1016/j.smr.2014.01.006>
- Mulligan, L. D., Haddock, G., Emsley, R., Neil, S. T., & Kyle, S. D. (2016). High resolution examination of the role of sleep disturbance in predicting functioning and psychotic symptoms in schizophrenia: A novel experience sampling study. *Journal of Abnormal Psychology*, 125(6), 788–797. <https://doi.org/10.1037/abn0000180>
- Nofzinger, Eric A., Buysse, D. J., Germain, A., Price, J. C., Meltzer, C. C., Miewald, J. M., & Kupfer, D. J. (2005). Alterations in regional cerebral glucose metabolism across waking and non-rapid eye movement sleep in depression. *Archives of General Psychiatry*, 62(4), 387. <https://doi.org/10.1001/archpsyc.62.4.387>
- Nofzinger, E. A. (2004). Functional neuroimaging evidence for hyperarousal in insomnia. *The American Journal of Psychiatry*, 161(11), 2126–2128. <https://doi.org/10.1176/appi.ajp.161.11.2126>
- Owens, J. A., & Weiss, M. R. (2017). Insufficient sleep in adolescents: causes and consequences. *Minerva Pediatrics*, 69(4). <https://doi.org/10.23736/s0026-4946.17.04914-3>
- Paterson, J. L., Dorrian, J., Ferguson, S. A., Jay, S. M., Lamond, N., Murphy, P. J., Campbell, S. S., & Dawson, D. (2011). Changes in structural aspects of mood during 39–66h of sleep loss using matched controls. *Applied Ergonomics*, 42(2), 196–201. <https://doi.org/10.1016/j.apergo.2010.06.014>
- Pereira, A. S. et al. (2018). Metodologia da pesquisa científica. [e-book]. Santa Maria. Ed. UAB/NTE/UFSM. Disponível em: https://repositorio.ufsm.br/bitstream/handle/1/15824/Lic_Computacao_Metodologia-Pesquisa-Cientifica.pdf?sequence=1.
- Püschel, K., & Schalinski, S. (2006). Zu wenig Hilfe für sich selbst-Arzte in Suizidgefahr [Not enough help for themselves--the risk of physicians to commit suicide. *Arch Kriminol*, 218(3–4), 89–99
- Riemann, D., Krone, L. B., Wulff, K., & Nissen, C. (2020). Sleep, insomnia, and depression. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology*, 45(1), 74–89. <https://doi.org/10.1038/s41386-019-0411-y>
- Rosa, G. S. da, Andrades, G. S., Caye, A., Hidalgo, M. P., Oliveira, M. A. B. de, & Pilz, L. K. (2019). Thirteen Reasons Why: The impact of suicide portrayal on adolescents' mental health. *Journal of Psychiatric Research*, 108, 2–6. <https://doi.org/10.1016/j.jpsychires.2018.10.018>
- Sateia, M. J. (2014). International classification of sleep disorders-third edition. *Chest*, 146(5), 1387–1394. <https://doi.org/10.1378/chest.14-0970>
- Short, M. A., Booth, S. A., Omar, O., Ostlundh, L., & Arora, T. (2020). The relationship between sleep duration and mood in adolescents: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 52(101311), 101311. <https://doi.org/10.1016/j.smr.2020.101311>
- Talbot, L. S., Stone, S., Gruber, J., Hairston, I. S., Eidelman, P., & Harvey, A. G. (2012). A test of the bidirectional association between sleep and mood in bipolar disorder and insomnia. *Journal of Abnormal Psychology*, 121(1), 39–50. <https://doi.org/10.1037/a0024946>
- Wang, X., Cheng, S., & Xu, H. (2019). Systematic review and meta-analysis of the relationship between sleep disorders and suicidal behaviour in patients with depression. *BMC Psychiatry*, 19(1). <https://doi.org/10.1186/s12888-019-2302-5>
- Wright, K. P., Jr, Bogan, R. K., & Wyatt, J. K. (2013). Shift work and the assessment and management of shift work disorder (SWD). *Sleep Medicine Reviews*, 17(1), 41–54. <https://doi.org/10.1016/j.smr.2012.02.002>