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## Night shift work and the risk of psychiatric symptoms: a comparison between rotating night shifts and day shifts

*O trabalho noturno e o risco de sintomas psiquiátricos: uma comparação entre turnos rotativos noturnos e diurnos*

*El trabajo en turnos de noche y el riesgo de síntomas psiquiátricos: una comparación entre los turnos rotativos de noche y los turnos de día*

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### ABSTRACT

**Introduction:** Sleep is controlled by an interaction between circadian and homeostatic oscillators that dictate wakefulness and sleep state according to the light/dark cycle. Currently, sleeping, and waking times are influenced by social conditions such as school, work hours and work shifts, this disruption of the circadian cycle can negatively influence the physical and mental behavior of the population. Working on shifts is directly associated with psychiatric disorders, such as anxiety, depression, irritability, and nervousness. **Objective and Method:** Given the socioeconomic impacts and impairment of the individual's mental health generated by shift work, this review aimed, based on the analysis of scientific articles published from 2012 to 2022 to evaluate the impact of night work on mental health compared to typical day-to-day shift work. **Results and Conclusion:** Shift work is a significant labor organization employing 10-30% of the workforce, but it disrupts sleep schedules,

leading to a misalignment between the individual's circadian rhythm and the environment. Although it's hard to establish causal links between shift work and health effects, sleep restriction and changes in behavioral rhythms are risk factors for psychiatric disorders. Managing individual exposure is vital to preserving workers' mental health, especially considering age, gender, and chronotype. However, operational constraints may make it difficult to implement in some workplaces.

**Keywords:** night shift work; psychiatric symptoms; sleep, shift work schedule, circadian rhythm disruption, depression, anxiety, bipolar disorder, schizophrenia

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## RESUMO

**Introdução:** O sono é controlado por uma interação entre os osciladores circadianos e homeostáticos que ditam a vigília e o estado de sono de acordo com o ciclo claro/escuro. Atualmente, os horários de dormir e acordar são influenciados pelas condições sociais como escola, horário de trabalho e turnos de trabalho, essa interrupção do ciclo circadiano pode influenciar negativamente no comportamento físico e mental da população.

O trabalho em turnos está diretamente associado a transtornos psiquiátricos, como ansiedade, depressão, irritabilidade e nervosismo.

**Objetivo e Método:** Diante dos impactos socioeconômicos e prejuízos à saúde mental do indivíduo gerados pelo trabalho em turnos, esta revisão teve como objetivo, com base na análise de artigos científicos publicados no período de 2012 a 2022, avaliar o impacto do trabalho noturno na saúde mental em comparação com o típico trabalho em turnos do dia-a-dia.

**Resultados e Conclusão:** O trabalho por turnos é uma organização laboral significativa que emprega 10-30% da força de trabalho, mas perturba os horários de sono, levando a um desalinhamento entre o ritmo circadiano do indivíduo e o ambiente. Embora seja difícil estabelecer relações causais entre o trabalho em turnos e os efeitos na saúde, a restrição do sono e as alterações nos ritmos comportamentais são fatores de risco para transtornos psiquiátricos. O gerenciamento da exposição individual é vital para preservar a saúde mental dos trabalhadores, especialmente considerando idade, sexo e cronotipo. No entanto, restrições operacionais podem dificultar a implementação em alguns locais de trabalho.

**Palavras-chave:** trabalho noturno, sintomas psiquiátricos, sono, jornada de trabalho em turnos, perturbação do ritmo circadiano, depressão, ansiedade, transtorno bipolar, esquizofrenia

## **RESUMEN**

**Introducción:** el sueño está controlado por una interacción entre osciladores circadianos y homeostáticos que dictan el estado de vigilia y sueño de acuerdo con el ciclo de luz/oscuridad. Actualmente, los tiempos de sueño y vigilia están influenciados por las condiciones sociales como la escuela, el horario laboral y los turnos de trabajo, esta interrupción del ciclo circadiano puede influir negativamente en el comportamiento físico y mental de la población. Trabajar por turnos está directamente asociado con trastornos psiquiátricos, como ansiedad, depresión, irritabilidad y nerviosismo. **Objetivo y Método:** Dados los impactos socioeconómicos y el deterioro de la salud mental del individuo generado por el trabajo por turnos, esta revisión tuvo como objetivo, con base en el análisis de artículos científicos publicados entre 2012 y 2022, evaluar el impacto del trabajo nocturno en la salud mental en comparación con el trabajo por turnos típico de la jornada. **Resultados y Conclusión:** El trabajo por turnos es una organización laboral importante que emplea del 10 al 30% de la fuerza laboral, pero interrumpe los horarios de sueño, lo que lleva a una desalineación entre el ritmo circadiano del individuo y el medio ambiente. Aunque es difícil establecer vínculos causales entre el trabajo por turnos y los efectos sobre la salud, la restricción del sueño y los cambios en los ritmos de comportamiento son factores de riesgo para los trastornos psiquiátricos. El manejo de la exposición individual es vital para preservar la salud mental de los trabajadores, especialmente teniendo en cuenta la edad, el género y el cronotipo. Sin embargo, las limitaciones operativas pueden dificultar su implementación en algunos lugares de trabajo.

**Palabras clave:** trabajo nocturno; síntomas psiquiátricos; sueño, horario de trabajo por turnos, alteración del ritmo circadiano, depresión, ansiedad, trastorno bipolar, esquizofrenia

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## Introduction

In humans, sleep time is controlled by an interaction between circadian and homeostatic oscillators that dictate the spontaneous time to go to sleep and wake up in phase with the Earth's light/dark cycle, changes in the body's physiological state that are not in accordance with the cycle allow the adjustment of this cycle, promoting adaptation and survival [1]. The homeostatic oscillator triggers an impulse that corresponds to the physiological need for sleep, known as homeostatic sleep pressure, which increases during wakefulness and dissipates during sleep [2]. Melatonin is an important factor in relaying the light-sleep cycle, favoring its adjustment, and is secreted during the propensity to sleep [2, 3].

However, the lifestyle of modern society and artificial light allow living indoors and deprived of natural light, leading to a misalignment of the circadian cycle called social jetlag [2, 4]. Currently, bedtime and wake-up times are influenced by social constraints such as school, work schedule, and work shift, in addition to the individual time dedicated to leisure [4]. Thus, waking up is no longer influenced by daylight, but by the use of electronic alarm clocks [3]. This deregulation of the circadian cycle can negatively influence the physical and mental behavior of the population [4].

Shift work comprises alternative schedules to the typical workday that starts at 9 a.m. and lasts until 5 p.m., and may include teams that work in succession in order to meet the 24 hours of the day. Thus, individuals may

work 12-hour shifts allocated in the morning, afternoon, or evening, on a fixed or rotating basis [1, 5, 6]. The design of shift schedules varies according to the country's legal and institutional framework. According to the International Labor Organization (ILO), 22% of workers in the European Union worked some kind of shift system in 2000 [7].

This circadian disruption is believed to play an important role in the relationship between shift work and poor mental health [8, 9]. Shift work, is directly associated with psychiatric disorders such as anxiety, depression, irritability, nervousness [10, 11] and indirectly associated through the common clinical sleep disorders such as insomnia, obstructive sleep apnea, and restless legs syndrome, which are associated with mental health problems [12].

Although underdiagnosed, these disorders can be seen in all age groups, including the younger ones, where sleep disorders were observed in about 20% of young adult workers that work in a shift system, of which 80% had not been diagnosed yet, and 46% had depression and 30% had anxiety concomitant with sleep disorders [12]. It is also noteworthy that fatigue related to night work reduces performance and job satisfaction in a way that favors absences due to illness and induces psychotropic use [13].

Given the socioeconomic impact of the impairment of the individual's mental health generated by work, the present review aims, through an analysis of the available literature, to evaluate the impact of night shift work on mental health compared to work in typical daily shifts.

## Methods

This article presents a narrative literature review based on the analysis of scientific articles published from 2012 to 2022, in PubMed and Science Direct, about mental health in night shift work. In the application of the first set of criteria, titles that did not mention the theme "night shift work and psychiatric symptoms" were excluded, as well as articles that were not included in the research period from 2012 to 2022 and articles that were not found in English.

The second set of criteria was applied, from which were excluded the abstracts that did not address the theme of mental health in night shift work. In the PubMed database, 545 articles were found through the

keywords (("Mental Health") OR (Depression) OR (Anxiety)) AND ("Shift Work")), from which 30 were selected following the first exclusion criteria.

In the [Science Direct](#) database, 3,207 articles were found through the keywords (("Mental Health") OR (Depression) OR (Anxiety)) AND ("Shift Work")), from which 5 were selected. The second set of criteria was applied, from which were excluded the abstracts that did not address the theme of night shift work and psychiatric symptoms, which led to the exclusion of 11 articles in the [PubMed](#) database and 01 article in the [Science Direct](#) database. Among the remaining articles, 4 were in duplicate, comprising both the [PubMed](#) and [Science Direct](#) databases. In total, 19 articles originally in English remained [[Figure 1](#)].

## **Discussion**

### **Night Shift and Circadian Rhythm Disruption**

Shift work is characterized by workers working outside the normal hours of 7 am to 6 pm. Because shift work includes night work, the normal sleep-wake cycle, the circadian cycle, is interrupted, with possible consequences for the physical and mental health of workers [[10](#)].

Moreover, the potential health effects of shift work are probably related to the misalignment between the light-dark cycle and the human activity-rest cycle. Exposure to light at night causes these effects, including social misalignment and leads to a reversal of activity and rest, which in turn is linked to changes in behaviors [[14](#)].

Given this, the circadian cycle and mental health disorders are closely related to insomnia, depression, and anxiety. A study aimed to evaluate insomnia symptoms in textile industry workers with different working hours and to investigate the association between insomnia, morning-vespertine preference, anxiety, and depression. The prevalence rate of insomnia in textile workers was 16.7%, and 49.8% were shift workers. Among shift workers, 9.5% had difficulty initiating sleep and almost 9.0% had early awakenings, a significantly higher rate than among daytime workers. So the conclusion made by this study evidenced that in order to reduce the symptoms of insomnia, depression, and anxiety among workers, interventions are needed to promote preference in daytime work [[15](#)].



## Night Shift and Depression

The constant flow of shift rotation not only compromises the individuals' own circadian cycle, which does not align with work-related sleep-wake schedules [16, 17], but also reports worsening mental health, mood swings, and depression [16, 18, 19, 20, 21].

Sleep impairment in this scenario may result in a circadian sleep-wake rhythm known as shift work disorder (SWD), characterized by chronic insomnia and/or excessive sleepiness, and there is a strong relationship between sleep disorders associated with SWD and the presence of mental health conditions such as depression [16, 22].

Depression can differ among sectors, varying both in the profession category and in gender. A greater predominance is seen in women [23, 24, 25, 26], since they have stressors beyond work, such as greater responsibility for household duties, social commitments, and family responsibilities [23, 27]. In addition, compared to other jobs, health care professionals experience higher levels of stress in their workplaces because they are exposed to high emotional burdens and traumatic situations [23, 26, 28] and experience depression more often. In addition, unlike other occupations, the health care sector is predominantly female [23].

Night work, in general, is associated with depressive conditions. Among the factors that influence the risk of depression in workers are individual variables such as gender, and corporate variables such as the duration of night work, the type of occupation, and the frequency of shift rotation between day and night shifts [29, 30, 31]. When evaluating the relationship between depression and night shift in Chinese workers in the automotive industry [31], a sample composed of about 80% men and 20% women, they observed a strong relationship between the frequency of night shifts, sleep disturbances, and high risk of depression in these workers. With similar objectives and results, the relationship between depression, insomnia, and shift work disorder was evaluated in male shift workers on an oil rig in the Persian Gulf. As observed in the Chinese in the automobile industry, shift work showed a strong relationship with sleep disorders, such as insomnia and daytime sleepiness, and increased risk for depression [32]. Among the possible explanations for such an association, the study cites the effect of environmental stress on the methylation of the serotonin transporter gene promoter (SLC6A4), causing a decrease in the amount of extracellular serotonin in the synaptic cleft and thus increasing

the risk of functional disorders such as depressive mood [29, 33]. The other possible explanation would be that depression may be associated with the disruption of the circadian oscillations of glucocorticoids, which is responsible for balancing synapse formation and "pruning" after learning and during development, where both chronic stress and the night shift disrupt this balance. In addition, disruption of glucocorticoid hormone interacts with signaling in neurons and may contribute to the development of stress-related psychiatric disorders, such as depression, to vulnerable individuals [29, 34].

The common symptoms of depression consist of depressed mood, disinterest in activities, changes in weight and appearance, sleep disturbances, concentration problems, fatigue, and lack of energy, including difficulty in making decisions [35, 36]. In addition to the psychological and social burden on the individual, there is an economic burden involved, with mental health impairment being a major factor in indirect costs regarding sick leave and early retirement. There is a financial burden both on employers and governments, as well as on those who reduce their workload and earnings or are unable to continue working and retire early [35, 37, 38, 39]. This reinforces the negative impacts of night work not only on mental health but also encompassing financial loss.

### **Night Shift and Anxiety**

Occasional anxiety is normal and intrinsic to human beings. However, individuals with anxiety disorders are affected by this sensation routinely, excessively, and persistently, having a debilitating impact on daily activities. Anxiety disorders are highly prevalent in the population and are usually associated with other mental disorders, such as depression [40, 41]. Anxiety disorders are multicausal and these are not yet fully understood. Currently, it is known that anxiety can be triggered by the occurrence of other mental disorders, by specific experiences, such as traumatic events, by genetic aspects, lifestyle, among others. Regarding lifestyle, anxiety disorders have been associated with work activity, such as the type of activity performed, the responsibility of the position held, interpersonal interactions, and work shift [40, 41].

Among the labor characteristics related to anxiety disorders, professions with night shifts are the most affected, in Europe, about 17% of night workers have some degree of anxiety [42]. In this context, health professions are the most studied, with special emphasis on nurses [23, 43]



and paramedics [44]. In a multi-center cross-sectional study, data from nurses with at least six months of experience were collected in 20 hospitals in China. Among the objectives, they investigated the relationship between shift work and the occurrence of anxiety in these professionals. The authors found that the prevalence of anxiety, regardless of work regime, is relatively high among these professionals, where about 55.8% of nurses had some degree of anxiety. When the work regime was considered, they observed that shift-work nurses were 1.36 times more likely to have higher anxiety levels, compared to non-shift nurses. Interestingly, in this population it was also found that the occurrence of anxiety disorders was not influenced by the number of night shifts worked and the length of shifts [43].

In a study carried out in hospitals in Australia, which also included nurses on shift work, the authors, using the General Anxiety Disorder scale (GAD-7), assessed the occurrence of mental disorders, including anxiety. The GAD-7 is a questionnaire with good psychometric properties, useful for large population-based samples, composed of seven items. This questionnaire aims to assess anxiety symptoms, assigning a score from 0 to 24 points, where higher scores indicate higher anxiety level [12, 23]. In this population of nurses in Australia, a strong and positive association between anxiety and night shift work was also found [23]. The literature points out the importance of company policies to prevent the occurrence of disorders related to night shift work [45], which are characterized by sleep and mental disorders secondary to working in night shift systems.

The relationship between anxiety and shift work is not simple; in a meta-analysis of longitudinal studies, conflicting results were found, indicating that shift work increases the risk of anxiety or indicating that shift work improves well-being and mental health in general [10]. This divergence in results may be related to the methodological difference for diagnosing mental disorders, which is often performed through a self-report of the disorder, through a simple and subjective form or through more robust approaches such as the GAD-7.

Amy Reynolds et al. [12], evaluated participants recruited as part of the Raine Study, one of the largest multigenerational prospective cohorts of pregnancy, childhood, adolescence, and adulthood to be conducted in the world. In this study they found that the incidence of anxiety in the shift worker population was not different from that observed in non-shift

workers, in contrast, anxiety levels were significantly higher in individuals with sleep-related disorders. When stratifying these data and adjusting the model to evaluate the interaction of effects, they found that the highest anxiety scores were observed in night shift workers. The authors then concluded that the mental health disorders in the shift worker population are not a consequence of shift work but of some undiagnosed sleep disorder. Additionally, although night shift work is strongly related to sleep disorders, as well as to the use of medications and beverages to aid sleep, it is difficult to trace a cause and consequence relationship, since the secretion of endogenous melatonin is reduced both in situations of anxiety and in sleep-wake cycle disorders, making it difficult to trace a cause and consequence relationship [16, 46].

Individual characteristics, not necessarily related to the work aspect, are also very related to the risk of anxiety; nurses on duty who have low sleep quality have a higher risk of anxiety, and nurses who reported easy to regain energy after the shift had a lower risk of anxiety [43]. Corroborating the importance and the need to consider the individual differences between individuals, Jiang et al. [15] observed in Chinese individuals, textile industry workers, that people with morningness preference had a lower incidence of anxiety and insomnia than people with eveningness chronotype, regardless of whether they worked shifts or not.

This variation between individuals also raises a question about whether the night shift itself is the cause of the anxiety or whether the anxiety is a consequence of an individual's genetic, social, or psychological vulnerability. Otherwise, anxiety may not be directly related to shift work, but rather to circadian rhythm disorder, altered social and family relationships, psychological stress during shifts, as well as physical and mental fatigue, which occur in this work system and may likewise culminate in mental health disorders [42, 43, 44, 46].

### **Night Shift and Bipolar Disorder**

Bipolar disorder (BD), formerly called manic depression, is characterized by extreme mood swings. The episodes can last for days or weeks and are characterized by alternating depression and mania. The onset of TB usually occurs between 20 and 30 years of age and has an estimated lifetime prevalence of 2.4% [47] This mental disorder is divided into four categories in descending order of severity: bipolar I, bipolar II, cyclothymic, and other. These extreme mood episodes differ greatly from the person's

typical behavior and occur concomitantly with significant changes in sleep, activity, and energy levels [48]. Studies show a significantly higher prevalence of bipolar disorder in people who have "nocturnal chronotypes," those who have a nighttime preference, than morning types. In addition, there is also an association with earlier development of onset and reduced melatonin peaks during the night [48, 49].

Related to this, abnormal sleep and altered circadian rhythm are found in individuals at high risk of developing TB and are observed in euthymic, prodromal, and syndromic periods, periods that patients with this condition experience. These individuals have abnormal chronobiological rhythms that mainly affect sleep homeostasis and circadian rhythm. Moreover, patients with TB have sleep abnormalities during depressive, manic, and inter-episode periods [49]. However, the pattern of disturbance varies with the mood state; during the manic state, most patients have a reduced need for sleep and the shortening of REM sleep has also been observed, while in the depressive state, a higher incidence of insomnia and hypersomnia has been reported [50]. Thus, workers with night shifts have greater sleep disturbances, such as insomnia, difficulty sleeping, and daytime sleep latency [15]. Disrupted circadian cycles are observed in individuals who subsequently develop bipolar disorder, even before the onset of the illness, and in TB cases during acute episodes and during inter-episode periods [47].

Most of the evidence on the relationship between TB and circadian cycle alterations is from cross-sectional studies, so a cause-and-effect relationship cannot be established. However, this agenda shows promise, since the evidence portrayed in this study directly points out that the modification of the circadian rhythm is a risk factor for bipolar disorder [50].

### **Night Shift and Schizophrenia**

Schizophrenia is a mental disorder that presents as a heterogeneous spectrum, with its main symptoms divided into positive (disorganized behavior and speech, delusions, and hallucinations); and negative (blunted affect, anergy, anhedonia, social isolation, and cognitive impairment) [51]. The disorder results from a multifactorial interaction, in which environmental and developmental risk factors act on a genetically vulnerable individual leading to schizophrenia [52, 53].

From the pathological processes of the disease result stress-induced biomarkers, mitochondrial dysfunction, neuroinflammation, oxidative and nitrosative stress, and circadian rhythm disturbances [51]. Among the symptoms related to circadian rhythm alterations are long sleep onset latency, increased intermittent awakenings, decreased total sleep time, and low sleep efficiency [54]. Such changes constitute sleep phase delay, whose impact on the individual's quality of life is demonstrated by a 2018 study in which only 1 in 10 schizophrenic patients with phase delay were employed [55].

Current literature questions whether circadian alterations represent a symptom or a cause in schizophrenia, and their role in the development of mental illness is still poorly understood [52, 56]. However, it is known that disruptions in the circadian cycle, such as those imposed by shift work, can lead to neurobehavioral disorders, which manifest as mood, affect, or cognitive disorders [52, 57]. Moreover, circadian dysfunction contributes to the onset of the disease, its maintenance, and even to the response to treatment [56].

Alterations in the sleep-wake cycle in schizophrenia can be explained by the impairment of rhythmic glucocorticoid secretion related to the hypothalamic-pituitary-adrenal axis and the consequent imbalance of melatonin, whose function in regulating the circadian cycle is well defined [56]. There is also a relationship between the circadian rhythm of dopamine and melatonin through the postsynaptic 5-hydroxytryptamine 2C receptors, which regulate the release of dopamine and noradrenaline in the prefrontal cortex [56, 58].

Although it needs more studies for its complete understanding, there is an identified relationship between clock genes, circadian cycle alterations, and dopamine dysregulation, a process essential in the pathophysiology of schizophrenia [57, 59]. It is known that increased dopamine is a typical phenomenon of psychosis and acts in a cycle in schizophrenia, since striatal dopaminergic hyperactivity can be a result of circadian abnormalities, just as increased dopamine can induce sleep disruption in the individual [59].

Therefore, it is hypothesized that chronic circadian dysregulation may weaken the individual's neural pathways, making them less resilient to external insults and therefore susceptible to the onset of neuropsychiatric

conditions, especially if previously vulnerable due to genetic factors, neurodevelopmental disorders, or environmental exposures [52].

## Conclusion

In modern society, shift work employs between 10% and 30% of the economically active population, presenting itself as a labor organization of great representativeness. The irregularities imposed by shifts bring about changes in sleep schedules, which lead to a misalignment between the circadian cycle intrinsic to the individual and that of the environment in which he/she is inserted. Although it is difficult to establish causal relationships between shift work and its effects on health, it is known that sleep restriction and changes in behavioral rhythms associated with individual characteristics, such as age, gender, and chronotype, represent risk factors for several psychiatric disorders. Therefore, managing individual exposure seems to be clinically relevant for preserving the worker's mental health, although it may be difficult to implement in some workplaces due to operational constraints.

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## Referências

1. Buijs RM, Soto Tinoco EC, Hurtado Alvarado G, Escobar C. The circadian system: from clocks to physiology. *Handb Clin Neurol.* 2021;179:233-47. <https://doi.org/10.1016/b978-0-12-819975-6.00013-3> PMID:34225965
2. Taillard J, Sagaspe P, Philip P, Bioulac S. Sleep timing, chronotype and social jetlag: impact on cognitive abilities and psychiatric disorders. *Biochem Pharmacol.* 2021;191:114438. <https://doi.org/10.1016/j.bcp.2021.114438> PMID:33545116
3. Crouse JJ, Carpenter JS, Song YJC, Hockey SJ, Naismith SL, Grunstein RR, Scott EM, Merikangas KR, Scott J, Hickie IB. Circadian rhythm sleep-wake disturbances and depression in young people: implications for prevention and early intervention. *Lancet Psychiatry.* 2021;8(9):813-23. [https://doi.org/10.1016/s2215-0366\(21\)00034-1](https://doi.org/10.1016/s2215-0366(21)00034-1) PMID:34419186

4. Fang H, Tu S, Sheng J, Shao A. Depression in sleep disturbance: a review on a bidirectional relationship, mechanisms and treatment. *J Cell Mol Med*. 2019;23(4):2324-32. <https://doi.org/10.1111/jcmm.14170> PMID:30734486 - PMCID:PMC6433686
5. Costa G. The problem: shiftwork. *Chronobiol Int*. 1997;14(2):89-98. <https://doi.org/10.3109/07420529709001147> PMID:9095370
6. Knauth P. The design of shift systems. *Ergonomics*. 1993;36(1-3):15-28. <https://doi.org/10.1080/00140139308967850> PMID:8440212
7. Shift Work. Geneva: International Labour Office; 2004. Information Sheet No. WT-8. [https://www.ilo.org/wcmsp5/groups/public/---ed\\_protect/---protrav/---travail/documents/publication/wcms\\_170713.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---travail/documents/publication/wcms_170713.pdf)
8. Zhao Y, Richardson A, Poyser C, Butterworth P, Strazdins L, Leach LS. Shift work and mental health: a systematic review and meta-analysis. *Int Arch Occup Environ Health*. 2019;92:763-93. <https://doi.org/10.1007/s00420-019-01434-3> PMID:31055776
9. Chellappa SL, Morris CJ, Scheer FAJL. Circadian misalignment increases mood vulnerability in simulated shift work. *Sci Rep*. 2020;10:18614. <https://doi.org/10.1038/s41598-020-75245-9> PMID:33122670 - PMCID:PMC7596056
10. Torquati L, Mielke GI, Brown WJ, Burton NW, Kolbe-Alexander TL. Shift work and poor mental health: a meta-analysis of longitudinal studies. *Am J Public Health*. 2019;109(11):e13-20. <https://doi.org/10.2105/ajph.2019.305278> PMID:31536404 - PMCID:PMC6775929
11. Karatsoreos IN. Effects of circadian disruption on mental and physical health. *Curr Neurol Neurosci Rep*. 2012;12:218-25. <https://doi.org/10.1007/s11910-012-0252-0> PMID:22322663



12. Reynolds AC, Lechat B, Melaku YA, Sansom K, Brown BWJ, Crowther ME, Wanstall S, Maddison KJ, Walsh JH, Straker L, Adams RJT, McArdle N, Eastwood PR. Shift work, clinically significant sleep disorders and mental health in a representative, cross-sectional sample of young working adults. *Sci Rep.* 2022;12:16255. <https://doi.org/10.1038/s41598-022-20308-2> PMID:36171220 - PMCID:PMC9519578
13. Ferri P, Guadi M, Marcheselli L, Balduzzi S, Magnani D, Di Lorenzo R. The impact of shift work on the psychological and physical health of nurses in a general hospital: a comparison between rotating night shifts and day shifts. *Risk Manag Healthc Policy.* 2016;9:203-11. <https://doi.org/10.2147/rmhp.s115326> PMID:27695372 - PMCID:PMC5028173
14. Moreno CRC, Marqueze EC, Sargent C, Wright Jr KP, Ferguson SA, Tucker P. Working time society consensus statements: evidence-based effects of shift work on physical and mental health. *Ind Health.* 2019;57(2):139-57. <https://doi.org/10.2486/indhealth.sw-1> PMID:30700667 - PMCID:PMC6449637
15. Jiang J, Wang D, Scherffius A, Chen D, Ma Z, Chen Z, Zhang Y, Yu Q, Fan F. The association between morningness-eveningness preference, depression, anxiety and insomnia among chinese textile workers with or without shift work. *Front Psychiatry.* 2022;13:915476. <https://doi.org/10.3389/fpsy.2022.915476> PMID:35845469 - PMCID:PMC9279731
16. Kalmbach DA, Pillai V, Cheng P, Arnedt JT, Drake CL. Shift work disorder, depression, and anxiety in the transition to rotating shifts: the role of sleep reactivity. *Sleep Med.* 2015;16(12):1532-8. <https://doi.org/10.1016/j.sleep.2015.09.007> PMID:26611952 - PMCID:PMC4803034
17. Walsh JK, Schweitzer PK, Sugerman JL, Muehlbach MJ. Transient insomnia associated with a 3-hour phase advance of sleep time and treatment with zolpidem. *J Clin Psychopharmacol.* 1990;10(3):184-9. <https://doi.org/10.1097/00004714-199006000-00005> PMID:2198296

18. Axelsson J, Akerstedt T, Kecklund G, Lowden A. Tolerance to shift work-how does it relate to sleep and wakefulness? *Int Arch Occup Environ Health*. 2004;77:121-9. <https://doi.org/10.1007/s00420-003-0482-1> PMID:14610678
19. Bambra C, Whitehead M, Sowden A, Akers J, Petticrew M. "A hard day's night?" The effects of compressed working week interventions on the health and work-life balance of shift workers: a systematic review. *J Epidemiol Community Health*. 2008;62(9):764-77. <https://doi.org/10.1136/jech.2007.067249> PMID:18701725
20. Bjorvatn B, Dale S, Hogstad-Erikstein R, Fiske E, Pallesen S, Waage S. Self-reported sleep and health among Norwegian hospital nurses in intensive care units. *Nurs Crit Care*. 2012;17(4):180-8. <https://doi.org/10.1111/j.1478-5153.2012.00504.x> PMID:22698160
21. Kang MY, Kwon HJ, Choi KH, Kang CW, Kim H. The relationship between shift work and mental health among electronics workers in South Korea: a cross-sectional study. *PLoS One*. 2017;12(11):e0188019. <https://doi.org/10.1371/journal.pone.0188019> PMID:29145440 - PMCID:PMC5690616
22. Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. *Chest*. 2014;146(5):1387-94. <https://doi.org/10.1378/chest.14-0970> PMID:25367475
23. Booker LA, Sletten TL, Alvaro PK, Barnes M, Collins A, Chai-Coetzer CL, Naqvi A, McMahan M, Lockley SW, Rajaratnam SMW, Howard ME. Exploring the associations between shift work disorder, depression, anxiety and sick leave taken amongst nurses. *J Sleep Res*. 2020;29(3):e12872. <https://doi.org/10.1111/jsr.12872> PMID:31144389
24. Kessler RC, Merikangas KR, Wang PS. The prevalence and correlates of workplace depression in the national comorbidity survey replication. *J Occup Environ Med*. 2008;50(4):381-90. <https://doi.org/10.1097/jom.0b013e31816ba9b8> PMID:18404010 - PMCID:PMC2742688

25. Oyane NM, Pallesen S, Moen BE, Akerstedt T, Bjorvatn B. Associations between night work and anxiety, depression, insomnia, sleepiness and fatigue in a sample of Norwegian nurses. *PLoS One*. 2013;8(8):e70228. <https://doi.org/10.1371/journal.pone.0070228> PMID:23950914 - PMID:PMC3737208
26. Jaradat Y, Birkeland Nielsen M, Kristensen P, Bast-Pettersen R. Job satisfaction and mental health of Palestinian nurses with shift work: a cross-sectional study. *Lancet*. 2018;391 Suppl 2:S50. [https://doi.org/10.1016/s0140-6736\(18\)30416-1](https://doi.org/10.1016/s0140-6736(18)30416-1) PMID:29553451
27. Clissold G, Smith P, Acutt B. The impact of unwaged domestic work on the duration and timing of sleep of female nurses working full-time on rotating 3-shift rosters. *J Hum Ergol (Tokyo)*. 2001;30(1-2):345-9. PMID:14564906
28. Adriaenssens J, de Gucht V, Maes S. The impact of traumatic events on emergency room nurses: findings from a questionnaire survey. *Int J Nurs Stud*. 2012;49(11):1411-22. <https://doi.org/10.1016/j.ijnurstu.2012.07.003> PMID:22871313
29. Lee A, Myung SK, Cho JJ, Jung YJ, Yoon JL, Kim MY. Night shift work and risk of depression: meta-analysis of observational studies. *J Korean Med Sci*. 2017;32(7):1091-6. <https://doi.org/10.3346/jkms.2017.32.7.1091> PMID:28581264 - PMID:PMC5461311
30. Hall AL, Franche RL, Koehoorn M. Examining exposure assessment in shift work research: a study on depression among nurses. *Ann Work Expo Health*. 2018;62(2):182-94. <https://doi.org/10.1093/annweh/wxx103> PMID:29340621 - PMID:PMC6788578
31. Zhang G, Shen B, Li P, Wang Y, Liu P, Jiang Y. Night shift work and depression among Chinese workers: the mediating role of sleep disturbances. *Int Arch Occup Environ Health*. 2022;95:1905-12. <https://doi.org/10.1007/s00420-022-01889-x> PMID:35678854

32. Sadeghniaat-Haghighi K, Mehrabinejad MM, Hajighaderi A, Najafi A, Rahimi-Golkhandan A, Zahabi A. Shift work disorder, insomnia, and depression among offshore oil rig workers. *Iran J Psychiatry*. 2021;16(2):162-7. <https://doi.org/10.18502/ijps.v16i2.5817> PMID:34221042 - PMCID:PMC8233558
33. Alasaari JS, Lagus M, Ollila HM, Toivola A, Kivimaki M, Vahtera J, Kronholm E, Harma M, Puttonen S, Paunio T. Environmental stress affects DNA methylation of a CpG rich promoter region of serotonin transporter gene in a nurse cohort. *PLoS One*. 2012;7(9):e45813. <https://doi.org/10.1371/journal.pone.0045813> PMID:23029256 - PMCID:PMC3461019
34. Hall BS, Moda RN, Liston C. Glucocorticoid mechanisms of functional connectivity changes in stress-related neuropsychiatric disorders. *Neurobiol Stress*. 2015;1:174-83. <https://doi.org/10.1016/j.ynstr.2014.10.008> PMID:25729760 - PMCID:PMC4340078
35. Sweeney E, Cui Y, Yu ZM, Dummer TJB, DeClercq V, Forbes C, Grandy SA, Keats MR, Adisesh A. The association between mental health and shift work: findings from the Atlantic PATH study. *Prev Med*. 2021;150:106697. <https://doi.org/10.1016/j.ypmed.2021.106697> PMID:34175348
36. Lopez R, Barateau L, Evangelista E, Dauvilliers Y. Depression and hypersomnia: a complex association. *Sleep Med Clin*. 2017;12(3):395-405. <https://doi.org/10.1016/j.jsmc.2017.03.016> PMID:28778237
37. Driesen K, Jansen NW, Kant I, Mohren DC, van Amelsvoort LG. Depressed mood in the working population: associations with work schedules and working hours. *Chronobiol Int*. 2010;27(5):1062-79. <https://doi.org/10.3109/07420528.2010.489877> PMID:20636216
38. Sobocki P, Lekander I, Borgstrom F, Strom O, Runeson B. The economic burden of depression in Sweden from 1997 to 2005. *Eur Psychiatry*. 2007;22(3):146-52. <https://doi.org/10.1016/j.eurpsy.2006.10.006> PMID:17194573

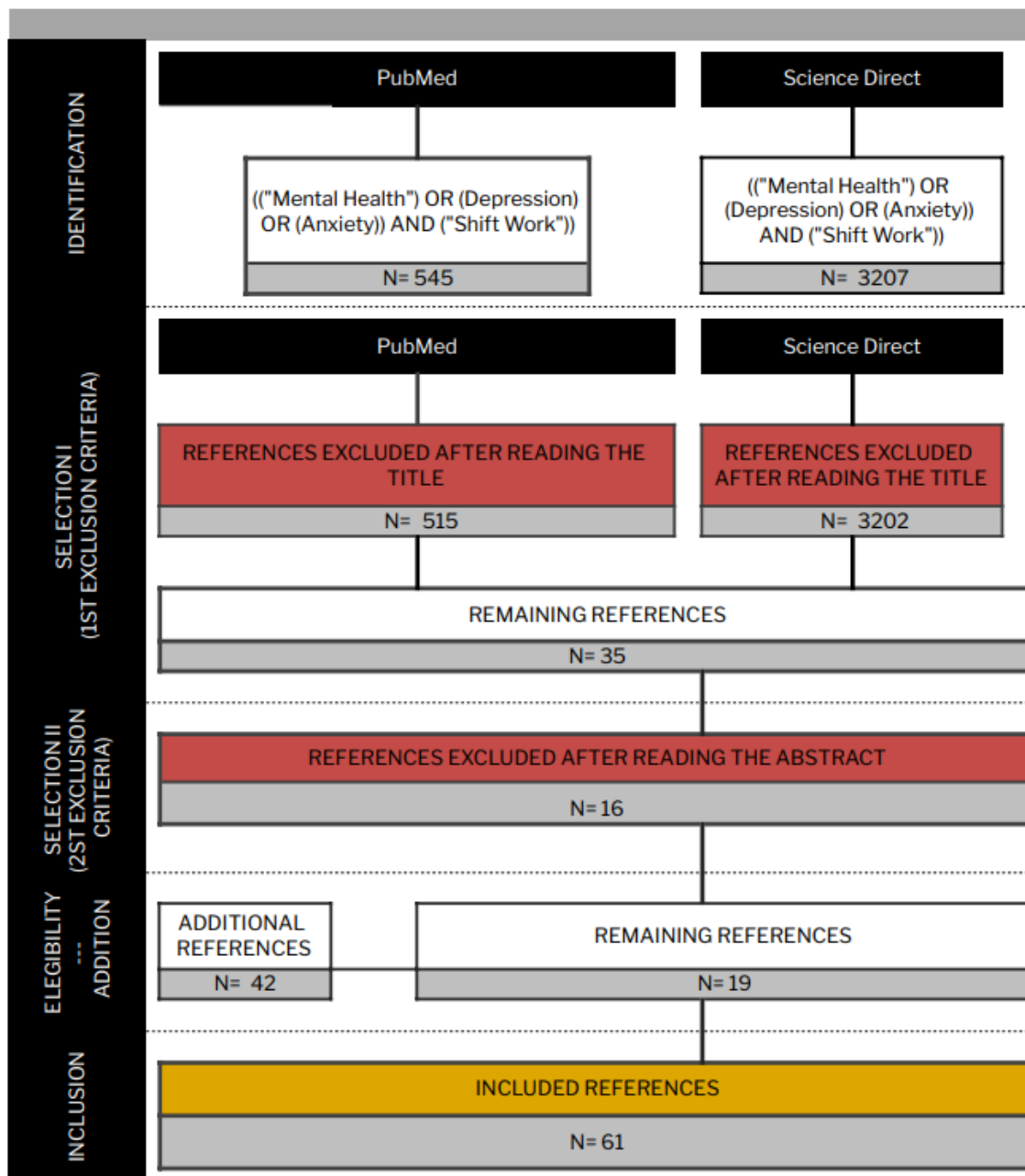
39. de Vries H, Fishta A, Weikert B, Rodriguez Sanchez A, Wegewitz U. Determinants of sickness absence and return to work among employees with common mental disorders: a scoping review. *J Occup Rehabil.* 2018;28:393-417. <https://doi.org/10.1007/s10926-017-9730-1> PMID:28980107 - PMCID:PMC6096498
40. Craske MG, Rauch SL, Ursano R, Prenoveau J, Pine DS, Zinbarg RE. What is an anxiety disorder? *Depress Anxiety.* 2009;26(12):1066-85. <https://doi.org/10.1002/da.20633> PMID:19957279
41. Stein MB, Sareen J. Generalized anxiety disorder. *N Engl J Med.* 2015;373:2059-68. <https://doi.org/10.1056/nejmcp1502514> PMID:26580998
42. Brown JP, Martin D, Nagaria Z, Verceles AC, Jobe SL, Wickwire EM. Mental health consequences of shift work: an updated review. *Curr Psychiatry Rep.* 2020;22:7. <https://doi.org/10.1007/s11920-020-1131-z> PMID:31955278
43. Li Y, Wang Y, Lv X, Li R, Guan X, Li L, Li J, Cao Y. Effects of factors related to shift work on depression and anxiety in nurses. *Front Public Health.* 2022;10:926988. <https://doi.org/10.3389/fpubh.2022.926988> PMID:35910870 - PMCID:PMC9326492
44. Khan WAA, Conduit R, Kennedy GA, Jackson ML. The relationship between shift-work, sleep, and mental health among paramedics in Australia. *Sleep Health.* 2020;6(3):330-7. <https://doi.org/10.1016/j.sleh.2019.12.002> PMID:32223969
45. Norder G, Roelen CA, Bultmann U, van der Klink JJ. Shift work and mental health sickness absence: a 10-year observational cohort study among male production workers. *Scand J Work Environ Health.* 2015;41(4):413-6. <https://doi.org/10.5271/sjweh.3501> PMID:25945780
46. Vogel M, Braungardt T, Meyer W, Schneider W. The effects of shift work on physical and mental health. *J Neural Transm (Vienna).* 2012;119:1121-32. <https://doi.org/10.1007/s00702-012-0800-4> PMID:22488445



47. Walker WH 2nd, Walton JC, Nelson RJ. Disrupted circadian rhythms and mental health. *Handb Clin Neurol*. 2021;179:259-70. <https://doi.org/10.1016/b978-0-12-819975-6.00016-9> PMID:34225967
48. Bellivier F, Geoffroy PA, Etain B, Scott J. Sleep- and circadian rhythm-associated pathways as therapeutic targets in bipolar disorder. *Expert Opin Ther Targets*. 2015;19(6):747-63. <https://doi.org/10.1517/14728222.2015.1018822> PMID:25726988
49. Melo MCA, Abreu RLC, Linhares Neto VB, de Bruin PFC, de Bruin VMS. Chronotype and circadian rhythm in bipolar disorder: a systematic review. *Sleep Med Rev*. 2017;34:46-58. <https://doi.org/10.1016/j.smrv.2016.06.007> PMID:27524206
50. Takaesu Y. Circadian rhythm in bipolar disorder: a review of the literature. *Psychiatry Clin Neurosci*. 2018;72(9):673-82. <https://doi.org/10.1111/pcn.12688> PMID:29869403
51. Fisar Z. Biological hypotheses, risk factors, and biomarkers of schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry*. 2023;120:110626. <https://doi.org/10.1016/j.pnpbp.2022.110626> PMID:36055561
52. Karatsoreos IN. Links between circadian rhythms and psychiatric disease. *Front Behav Neurosci*. 2014;8:162. <https://doi.org/10.3389/fnbeh.2014.00162> PMID:24834040 - PMCID:PMC4018537
53. Davis J, Eyre H, Jacka FN, Dodd S, Dean O, McEwen S, Debnath M, McGrath J, Maes M, Amminger P, McGorry PD, Pantelis C, Berk M. A review of vulnerability and risks for schizophrenia: beyond the two hit hypothesis. *Neurosci Biobehav Rev*. 2016;65:185-94. <https://doi.org/10.1016/j.neubiorev.2016.03.017> PMID:27073049 - PMCID:PMC4876729



54. Sasidharan A, Kumar S, Nair AK, Lukose A, Marigowda V, John JP, Kutty BM. Further evidences for sleep instability and impaired spindle-delta dynamics in schizophrenia: a whole-night polysomnography study with neuroloop-gain and sleep-cycle analysis. *Sleep Med.* 2017;38:1-13. <https://doi.org/10.1016/j.sleep.2017.02.009> PMID:29031741
55. Poon YPY, Kan CK, Yeung WF, Chung KF. Delayed sleep-wake phase disorder and delayed sleep-wake phase in schizophrenia: clinical and functional correlates. *Schizophr Res.* 2018;202:412-3. <https://doi.org/10.1016/j.schres.2018.06.057> PMID:30539774
56. Kirlioglu SS, Balcioglu YH. Chronobiology revisited in psychiatric disorders: from a translational perspective. *Psychiatry Investig.* 2020;17(8):725-43. <https://doi.org/10.30773/pi.2020.0129> PMID:32750762 - PMCID:PMC7449842
57. Zhao Y, Richardson A, Poyser C, Butterworth P, Strazdins L, Leach LS. Shift work and mental health: a systematic review and meta-analysis. *Int Arch Occup Environ Health.* 2019;92(6):763-93. <https://doi.org/10.1007/s00420-019-01434-3> PMID:31055776
58. Su Q, Li T, Liu GW, Zhang YL, Guo JH, Wang ZJ, Wu MN, Qi JS. Agomelatine: a potential novel approach for the treatment of memory disorder in neurodegenerative disease. *Neural Regen Res.* 2023;18(4):727-33. <https://doi.org/10.4103/1673-5374.353479> PMID:36204828 - PMCID:PMC9700086
59. Yates NJ. Schizophrenia: the role of sleep and circadian rhythms in regulating dopamine and psychosis. *Rev Neurosci.* 2016;27(7):669-87. <https://doi.org/10.1515/revneuro-2016-0030> PMID:27343471



🏠 **Figure 1.** Articles addressing to Shift Work and Mental Health