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The impact of shift work on mental health: Focus on depression

RESEARCH PAPER

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Abstract

Background: Shift work is known to provide both flexibility and a good work-life balance for employees. While it is documented that shift work poses great risk for developing cardiovascular disease , the effects on mental health often remain unspoken. Disturbed sleeping patterns, increased cortisol levels and work related stress are few of the many factors that can lead to the development of depression.

Aim: To examine the relationship between shift work and depression. It is of interest to identify the correlation between a disturbed sleeping pattern, circadian rhythm and shift work, and how it may lead to depression. In addition, it is valuable to study the incidence and prevalence of depression among shift workers compared to the general population. This study is also aimed to identify and evaluate effectiveness of pharmacological and non-pharmacological interventions to reduce depression among shift-working individuals.

Methods: The information in this literature review was taken from several scientific papers which were available on multiple E-databases, including PubMed, ProQuest, UptoDate, ScienceDirect and SageJournals.

Results: Studies reveal that there is a high prevalence of sleep disturbance among shift workers, with poor sleep quality and insomnia, which pose high risks for developing depression. In addition, it is revealed that shift workers can experience difficulties in adapting to shift working schedules. Therapeutic interventions, with pharmacological and non-pharmacological approaches, reveal promising results both in reducing insomnia and depressive symptoms but also in improving sleep quality.

Conclusions: Shift work is proven to have adverse effects on mental health. The interplay between work-related stress, disturbed circadian rhythm combined with neurotransmitter dysregulation and cortisol surge confirms that depression is a multifactorial phenomenon which can be managed effectively with either pharmacological and non-pharmacological approach.

Latvian abstract:

Ievads: Maiņu darbs nodrošina nodarbinātajiem gan elastību, gan labu darba un privātās dzīves līdzsvaru. Lai gan ir dokumentēts, ka maiņu darbs ievērojami palielina sirds un asinsvadu slimību risku, tā ietekme uz garīgo veselību bieži paliek nepietiekami apspriesta. Traucēti miega paradumi, paaugstināts kortizola līmenis un ar darbu saistīts stress ir tikai daži no faktoriem, kas var veicināt depresijas attīstību.

Mērķis: Izpētīt saistību starp maiņu darbu un depresiju. Ir svarīgi noteikt korelāciju starp traucētu miega ritmu, cirkadiāno ritmu un maiņu darbu, kā arī izprast, kā šie faktori var novest pie depresijas attīstības. Papildu uzmanība tiek pievērsta depresijas biežumam un izplatībai maiņu darbinieku vidū, salīdzinot ar vispārējo populāciju. Šī pētījuma mērķis ir arī identificēt un novērtēt farmakoloģisko un nefarmakoloģisko iejaukšanos efektivitāti depresijas mazināšanai maiņu darbinieku vidū.

Metodes: Informācija šajā literatūras apskatā tika iegūta no vairākiem zinātniskiem rakstiem, kas pieejami vairākās elektroniskajās datubāzēs, tostarp *PubMed*, *ProQuest*, *UpToDate*, *ScienceDirect* un *SageJournals*.

Rezultāti: Pētījumi atklāj, ka maiņu darbiniekiem ir augsta miega traucējumu izplatība, ko raksturo slikta miega kvalitāte un bezmiegs, kas ievērojami palielina depresijas attīstības risku. Turklāt atklāts, ka maiņu darbiniekiem bieži ir grūtības pielāgoties maiņu darba grafikam. Terapeitiskās iejaukšanās – gan farmakoloģiskās, gan nefarmakoloģiskās – uzrāda daudzsološus rezultātus, samazinot gan bezmiega, gan depresijas simptomus, kā arī uzlabojot miega kvalitāti.

Secinājumi: Maiņu darbs negatīvi ietekmē garīgo veselību. Savstarpējā mijiedarbība starp ar darbu saistīto stresu, traucētu cirkadiāno ritmu, neirotransmiteru disbalansu un paaugstinātu kortizola līmeni apstiprina, ka depresija ir multifaktoriāls fenomens, ko iespējams efektīvi ārstēt gan ar farmakoloģiskām, gan nefarmakoloģiskām metodēm.

Abbreviations

ACTH- Adrenocorticotropic Hormone
ANX-Anxiety Scale
CBT-I- Cognitive Behavioral Therapy for Insomnia
CES-D scale-Center for Epidemiologic-Studies Depression Scale
CSF- Cerebrospinal fluid
CTI-Circadian Type Inventory
DASS-21-Depression Anxiety Scale-21
DBAS-16-Dysfunctional Beliefs and Attitudes about Sleep (16 item version)
DEP-Depression Scale
ESE-Epworth Sleepiness Scale
Fixed SWs-Fixed Shift Workers
FR-Flexible and Rigid
GSI-Global Severity Index
HPA-axis-Hypothalamic Pituitary Adrenal axis
HR-Hazard Ratio
ILO-International Labour Organization
ISI-Insomnia Severity Index
LV-Languid and Vigorous
MAO-A-Monoamine Oxidase A
MDD-Major Depressive Disorder
Non-SW- Non Shift Workers
PSQI-Pittsburgh Sleep Quality Index
ROS-Reactive Oxygen Species
SCN-Suprachiasmatic Nucleus
SCL-90-Symptom Checklist-90
SD-Standard Deviation
SE-Sleep Efficiency
SEM-Structural Equation Modeling
SNRIs- Serotonin and Noradrenaline Reuptake Inhibitors
SOL-Sleep Onset Latency
SSRIs-Selective Serotonin Reuptake Inhibitors
SWs-Shift Workers
TIB-Total Time in Bed
True SWs-True Shift Workers
TST-Total Sleep Time
WASO-Wake After Sleep Onset

1. Introduction

In today's society, shift work is a type of work schedule that is prevalent in a number of industries. It is considered as an essential system which has come to dominate several sectors, not solely in healthcare but also in transport and manufacturing industries. While this type of work schedule may appear beneficial and flexible, it should be noted that the adverse effects, particularly on mental health, are an increasing cause of concern. Furthermore, it is well documented that shift work plays a role in developing cardiovascular disease. Apart from cardiovascular disease, it has also been reported that night shift work potentially can have carcinogenic effects to humans [1].

However, mental health effects should not be forgotten. In fact, it is approximated that 332 million people worldwide suffer from depression, a common mental disorder . The complex association between psychological, social as well as biological components is thought to cause this common condition [2] .

While traumatic events are known to trigger depressive episodes, it is yet to be discussed whether daily life duties, such as going to work, play a role in developing depression. In addition, investigating the complex interaction between disturbed sleeping pattern, circadian rhythm and shift work is of interest.

In this literature review, the objective is to examine how shift work can impact prevalence as well as the severity of depression among shift workers compared to those who work daytime. Furthermore it is also of value to determine whether how disturbed sleep patterns can function as mediators between shift work and depression. Finally, the effectiveness of pharmacological as well as non-pharmacological interventions in reducing depression among shift workers will be discussed.

The task of this study is to identify the relationship between shift work and depression, as well as the correlation between disturbed sleep pattern and circadian rhythm, shift work and depression. Also, the task is to evaluate the effectiveness of pharmacological, such as melatonin, and non pharmacological interventions (Cognitive Behavioral therapy and LED light therapy) to reduce depression among shift workers.

This literature review aims to collect and summarize information from a number of relevant sources which could be accessed through Riga Stradins University's E-databases, such as PubMed and Proquest. Other sources, such as ScienceDirect and SageJournals and UpToDate were also used. Articles were found using terms for instance "sleep disturbance and depression", "shift work and depression", "CBT and shift workers", "melatonin".

Inclusion criteria for the literature review resources include:

- Studies conducted from 2000 and onward, in order to ensure the literature review reflects findings which are up-to-date.
- Articles, which focus on correlation between shift work, depression, sleep disturbances and treatment options, are peer-reviewed.
- Studies are published in the English language in order to ensure proper and correct analysis of data and findings.
- Research focuses on shift workers who are adults rather than adolescents.

Exclusion criteria include:

- Articles published in languages other than English .
- Studies where the main focus is on non-shift workers rather than shift workers.
- Studies that include the adolescent population.

The research questions in this study are the following:

- How does shift work affect the prevalence and severity of depressive symptoms among shift workers compared to standard daytime schedules?
- To which extent does disrupted sleep pattern and circadian rhythm mediate relationship between shift work and depression?
- Do pharmacological interventions such as melatonin, and non-pharmacological interventions, such as cognitive behavioral therapy for insomnia (CBT-I) reduce depression among shift workers?

2. Literature review

2.1 Definition of shift work, prevalence, types of shift work

2.1.1 Definition of shift work

Usually when discussing the term normal work, it is often referred to as a job schedule in which employees operate from morning hours, typically from 9 am until late afternoon, around 5 pm. Shift work, in contrast to this normal working schedule, refers to a schedule where workers work outside these daylight hours mentioned [3].

Another definition of shift work, according to the International Labour Organization (ILO), follows as "a method of organization of working time in which workers succeed one another at the workplace so that the establishment can operate longer than the hours of work of individual workers"[4].

2.1.2 Prevalence of shift work

It is reported that shift work is similar when comparing different countries around the globe. For instance, the prevalence in European countries such as the United Kingdom, Greece and Czech Republic is estimated to be 22% , 25% and 24% respectively. Moreover, in South American countries such as Chile it is estimated to be 15%, whereas in the Asian continent, China reports 17.5%. Finally, African countries, for instance Senegal, report a prevalence of 20%. Also, the International Labor Organization reported that close to 20% of the overall workforce is made up of shift work [5] .

2.1.3 Types of shift work

In order to understand shift work, it can be subdivided into different types, depending on which time of the day the work occurs. For instance, there are night or evening shifts, rotating shifts, split shifts, on-call shifts, 24-hour shifts and irregular shifts [3]. It should be noted that the time table for night-and evening shifts can vary depending on the industry. For example, night shift can last between 6pm-4am while evening shift between 2pm-6pm.

In addition, a fixed shift schedule may be applied in some cases, which indicates that employee will arrive to work on the same shift on the same day, every week [6]

Split shifts indicate that there are some hours of the schedule in which the employee arrives to work during night. Irregular shifts, on the contrary, signifies that the employee does not have predictable hours and the working schedule is variable [5] .

In contrast, a rotating shift system allows to incorporate both morning, evening and night in the schedule [7] . Thus, shift work can be organized so that employees may alternate between morning, evening and night. Thus, employees will not work on the same hours but the schedule changes regularly.

2.2. Depression- Definition, epidemiology, risk factors and etiology

2.2.1 Depression- definition

The term "depression" is well known among the populations worldwide. However, as it can be utilized in different ways, it is of value to refer to it correctly. Depression may either be referred to as a mood state, where feelings such as anxiety, hopelessness and sadness dominate. In addition, it can refer to a *syndrome* which itself includes depressed mood as a symptom. For instance, it includes conditions such as major depression and dysthymia. Depression can also refer to a mental disorder, which is a recognized clinical condition. For example, the syndrome of major depression is prevalent in several psychiatric disorders, including major depressive disorder, bipolar disorder and other severe conditions e.g schizophrenia.

Major depressive disorder, often referred to as MDD, is a condition in which patients become diagnosed if they have had at least one major depressive episode, in the absence of any history with mania or hypomania [8]. In contrast, the presence of mania or hypomania is rather related to bipolar disorder. Here, mania or hypomania would constitute half of the disease, and depression the other half [9].

A major depressive episode is referred to as a period of at least two consecutive weeks in which patient has experienced at least five of the following: anhedonia, insomnia or hypersomnia, change in appetite, psychomotor agitation, poor ability to concentrate and low energy levels, depressed mood but also thoughts of feeling worthless, guilty and recurrent suicidal thoughts or about death. However, at least one of the symptoms mentioned must include either depressed mood or anhedonia [10].

2.2.2 Epidemiology

Today, depressive disorders are highly prevalent and are a rising cause of concern. Recent statistics reveal that depressive disorders are the 13th most common cause of disability and mortality worldwide, where the lifetime prevalence is approximately 12%. Additionally, major depression usually is recurrent as those who recover from their first episode, around 40%, are prone to a relapse two years after the initial episode (13). In the general adult population, it is estimated that a 1-year prevalence of major depression across countries is approximated to be 5% [8].

2.2.3 Risk factors

Risk factors for major depression are multiple, and include age of onset, income and gender. A number of studies reveal that the average age of onset for major expressive disorder is approximately at 30 years of age. Furthermore, in the United States, it has been concluded by a nationally representative survey, that the 12 month prevalence was greater among people of younger age in comparison to those aged from 65 years and above, with a prevalence estimated 11-13% and 5% respectively [8]

However, depression may affect people of all ages, and it is proven that prevalence in older patients within primary care can be compared to that of younger individuals. In addition, depression can be more prevalent in older individuals with pre-existing conditions which may be both acute or chronic but also require assisted living or even placement in a nursing facility.

Income is another risk factor, where in the United States it is proven that the prevalence is increased among individuals with a lower income. For instance, a nationally representative survey from 2013 revealed the 12-month prevalence in low-income families was higher compared with high-income families with salaries starting from 70.000 USD, with prevalence of 10-14% and 8% respectively [8].

Finally, gender differences are also significant risk factors for major depression. In many countries, including the United States, the prevalence is estimated to be twice as high in females in comparison to males. However, it should be noted that the prevalence rates demonstrate variation as the etiology of depression in male and females is different.

2.2.4 Etiology

Studies suggest that multifactorial factors play a role in the development of depression. These include biological as well as environmental factors. Biological factors refer to genetic vulnerability, as well as the neuroendocrine and neurotransmitter processes. In contrast, environmental factors discuss how the presence of acute life events and chronic stress are connected to development of depression.

Regarding genetic vulnerability to depression, it is discussed that genes, especially related to the serotonin system (5-HT) can dictate the response to stress. Furthermore, a short allele of the serotonin transporter gene (5-HTTLPR) is associated with more depressive symptoms and higher rates of major depressive disorders as a response to stressful events, compared to individuals with the long allele. However, these studies show that the genetic correlation on depression usually is seen only under certain stressful conditions. This further highlights the interaction between genes and the environment [11] .

Serotonin dysfunction is a central role for depression. Neuroendocrine, postmortem as well as cerebrospinal fluid (CSF) studies highlight the reduced serotonergic activity in individuals with depression. In addition, the reduction of serotonin transporter binding sites as well as reduced pre-and postsynaptic receptor subtypes have been demonstrated. Simultaneously low levels of plasma L-tryptophan, a serotonin precursor, has also been revealed in depressed patients. Finally, elevated CNS monoamine oxidase A (MAO-A), which breaks down serotonin, is seen in this group.

Similar to serotonin, norepinephrine dysfunction is also discussed as an important mediator in mood disorders. For instance, stress can activate norepinephrine circuits, which in turn can contribute to higher depression risk. In addition, low metabolite levels of norepinephrine have been found, both in the cerebrospinal fluid as well as urine samples of patients experiencing depression. MAO-A, which breaks down serotonin, also breaks down norepinephrine, and reveals a high activity in brains of depressed individuals.

Finally, dopamine alterations in patients with depression is also a key mediator to be discussed. As documented, alterations in dopaminergic pathways in the brain are significant when discussing the development of schizophrenia. However, the role of dopaminergic circuits has been investigated further as some patients respond poorly to antidepressant treatment with selective serotonin reuptake inhibitors (SSRIs) and serotonin and noradrenaline reuptake inhibitors (SNRIs), which indicates a possible lack of involvement of dopaminergic circuits in the treatment. Furthermore, neuroimaging combined with postmortem studies demonstrate a lower dopamine transporter binding, as well as an increased postsynaptic receptor binding, which combined is indicative of a lower dopaminergic neurotransmission in the brain. In similarity with serotonin and norepinephrine, an increased MAO-A activity was also seen in the CNS of depressed individuals, highlighting the importance of investigating MAO-A further. In addition, CSF analysis of depressive patients revealed reduced dopaminergic metabolites.

Apart from neurotransmitter involvement, the role of the neuroendocrine system is of interest. It is documented that patients with depression secrete cortisol in large portions. Increased secretion of cortisol from the hypothalamic-pituitary-adrenal (HPA) axis is a key factor of pathogenesis. Furthermore, in patients with psychiatric disturbances, the measurement of cortisol concentration is of value. By administration of synthetic glucocorticoid dexamethasone at night, it is possible to measure the plasma concentration the day after. The action of dexamethasone is complex, and is believed to act on the anterior pituitary gland by reducing secretion of adrenocorticotropic hormone (ACTH). As a response, the cortisol synthesis is decreased from the adrenals. In the event of a failed suppression of plasma cortisol post administration of dexamethasone, it indicates a hyperactivity of the HPA axis and an impaired feedback mechanism. Patients with depression tend to fail suppressing cortisol secretion after receiving dexamethasone, and is even believed to be associated with depression severity and the risk of relapse [12]. In short, stress-related biological systems such as the HPA axis thus play a role in depression, and its dysfunction can contribute or even worsen the symptoms of depression itself.

Environmental factors are also important when discussing the etiology of depression. In many cases, depression results from stressful environments, such as acute negative life events with sudden loss or trauma. In most cases, the depressive episodes start shortly after these events, usually within a month. Worth noting that the severity of depression is dependent on the individual's subjective interpretation of the event, not just the trauma itself. Chronic stress is another source for poor mental health. For instance, poor income and unemployment may trigger depression. However, war-related consequences, such as displacement, which leads to immigration and refugee-status, are also known triggers. It has been discussed that several demographic factors play a role in developing depression. For instance, it was found that one depressive episode was linked to being a woman with low income and divorced. Also, unemployment or disability were also associated [11].

2.3 Biological mechanism of shift work, how it affects circadian rhythm

Shift work can affect many parts of our life, including our own biological systems. Circadian rhythm disruption can be due to many reasons, one including shift work. The circadian rhythms refer to changes that we experience over a full 24-hour cycle. These changes are both physical and mental but also behavioral. In addition, the circadian rhythms can affect several functions of our body. For instance, sleep pattern, release of hormones, appetite and temperature include some of the functions influenced by the circadian rhythms [13] .In short, circadian rhythm can be explained as the 24-hour internal clock in the human brain which influences nearly every system in the body [14].

In order to understand how shift work can affect the circadian rhythm, it is important to understand how the circadian rhythm works. The circadian rhythms are coordinated by aid of the suprachiasmatic nucleus (SCN) , which is located in the anterior hypothalamus. It is important to note that circadian rhythm is not exactly corresponding to 24 hours, as there are factors that are needed for maintaining the phase of circadian rhythm to the 24-hour long day. These factors can include light and melatonin. Melatonin, which is produced by the pineal gland, is influenced by the SCN. The melatonin receptors which are located in the SCN, play a crucial role in maintaining phase entrainment. Furthermore, if exogenous melatonin is administered, such as in supplements, it results in a shift in the timing of the internal clock, in the opposite way that light would do. For instance, melatonin administration in the evening would shift the internal clock earlier, causing individuals to feel sleepy earlier than usual [15].

It has been demonstrated that light also can affect the circadian system. One manifestation of the circadian rhythm is the core body temperature. Furthermore, the core body temperature has a minimum , usually referred to as the bathyphase, and a maximum, called acrophase. The minimum core body temperature usually occurs in the morning, approximately 2 hours before waking up. In contrast, the maximum body temperature is reached during the evening instead, also 2 hours prior to falling asleep [16].

An exposure to light in the morning, after the core body temperature reaches its minimum, will cause an advance of the circadian rhythm, meaning individuals will feel sleepy and wake up earlier. However, evening light exposure before the core body temperature reaches its minimum, it will cause a delay in the circadian rhythm, causing individuals to wake up later instead. To summarize, morning light causes the internal clock to move earlier, whereas evening light exposure results in internal clock moving later [15].

Shift work is known to disrupt the circadian rhythm. Studies have revealed that those who work shifts are prone to both disrupted sleep-wake cycles, as well as the changes in the light-darkness pattern. Ultimately, this causes the internal clocks to be desynchronized, both with each other as well as the environment outside. This can be referred to as circadian misalignment [17]. In short, it can manifest as abnormal sleep and wake schedules, e.g. individuals sleep at day and are awake at night. In addition, it also results in changed feeding patterns, meaning the time of food intake is not properly aligned with the normal time of consuming food.

Apart from disrupted sleep-wake cycles and feeding hours, the altered secretion of melatonin and cortisol is also of interest. A 2013 study “Night Shift Work and Levels of 6-sulfatoxymelatonin and Cortisol in Men” revealed that night shift workers, compared to those working daytime, had lower levels of 6-sulfatoxymelatonin during both daytime sleep, nighttime work and nighttime sleep on days off [18]. Normally, plasma melatonin levels should be lower during the day but increase during evening and then peak in the night [19]. As demonstrated, night shift workers had low levels of 6-sulfatoxymelatonin during nighttime sleep when they are not at work. This indicates a circadian disruption with suppression of melatonin secretion. Cortisol levels are also of interest in this study, which revealed that urinary cortisol levels measured higher both during daytime sleep as well as night work. However, they were lower during nighttime sleep on off-nights. In addition, morning serum cortisol was lower in night shift workers compared to those working during the day. Usually, the cortisol levels would be higher during morning and then decrease during nighttime [20].

As demonstrated, shift workers exhibit disrupted cortisol secretion patterns, given a high cortisol level at night, as well as a low morning serum cortisol when it should be elevated rather than decreased. To summarize, circadian disruption from shift work can manifest as altered cortisol and melatonin secretion. The various side effects in the long run may include obesity, diabetes type 2 as well as diseases in the cardiovascular system. In addition, some research also discusses the increased risk of cancer [21].

2.4 Correlation between shift work and prevalence and severity of depressive symptoms among workers compared to standard daytime schedules

In this literature review, it is of interest to investigate how shift work can affect the prevalence as well as severity of depressive symptoms among workers compared to those who work standard daytime schedules.

A study from Samsung Medical Center and Korea University, both based in Seoul, South Korea, discussed the correlation between sleep disturbance and depression among shift workers compared to non-shift workers . In this study, participants were invited to complete a variety of self-report questionnaires. For example, these included Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), Center for Epidemiologic-Studies Depression Scale (CES-D) and Epworth Sleepiness Scale (ESE) [22].

Pittsburgh Sleep Quality Index (PSQI)is a self-questionnaire, consisting of 19 items that allows assessment of factors related to the quality of sleep. It aids in assessing the sleep quality from the previous month. A higher score on the report indicates a worse quality of sleep [23]. Similar to PSQI, Insomnia Severity Index (ISI) also uses the standard recall period of one month. However, it assesses the severity and impact of insomnia rather than sleep quality. It aids to evaluate factors such as severity of sleep onset, maintenance of sleep, issues waking up in the morning, distress related to difficulties sleeping and subjective dissatisfaction of sleep [24].

In addition to PSQI and ISI, the Center for Epidemiologic Studies Depression Scale (CES-D) is also designed to assist in detecting individuals suffering from depression. Unlike the other previously mentioned, this questionnaire utilizes the past week as a reference for assessment rather than the previous month. In addition, it helps address symptoms of depression rather than evaluating sleep disturbance and quality [25] . Finally, Epworth Sleepiness Scale (ESS), developed by Australian Dr. Murray Johns back in 1991, aims to evaluate patients for so-called excessive daytime sleepiness (EDS) [26].

In the Korean study, a total of 6654 individuals participated. Furthermore, were divided into groups of shift workers (SW) and non-shiftworkers (Non-SW). The latter refer to those who work specifically fixed hours within daylight time, from 7am to 6pm. The shift worker groups consisted of 4561 individuals and the remaining 2093 participants were non-shiftworkers.

Notable that shift workers were further subdivided based on the type of shift work. For instance, Fixed shift workers (Fixed SWs) refer to those who work fixed evenings and nights, and True shift workers (True SWs). True SWs is subdivided into either regularly rotating shift workers i.e shifts that change over time, or irregularly rotating shift workers indicating shifts that irregularly change over time.
The number of Fixed SWs was approximated to 375 participants, and True SWs estimated 3823 participants.

As shown in Table 1, it is demonstrated that both True SWs and Fixed SWs reported a higher result in PSQI, ESS, ISI, CES-D questionnaires compared to non-SWs [22] . For instance, the mean score in PSQI was 7.36, 7.30 and 6.25 among True SWs, Fixed SWs and Non SWs respectively. With a p-value <0.001, it indicates a statistically significant difference. In the study it is also mentioned that as part of PSQI, the differences between the True SWs, Fixed SWs and non-SWs were also statistically significant. For instance, the CES-D score among True, Fixed and non-SWs were 8.64, 9.23 and 7.98 respectively. However, note that True and Fixed SWs did not differ to a large extent in terms of PSQI, ISI or CES-D. On the contrary, True SWs reported a higher score in the ESS in comparison to Fixed SWs.

When analyzing the study further, Table 2 also compared the sleep-and depression-related variables between Fixed shift workers (Fixed SWs) that worked either evening or night [22] . Initially it was noted that fixed night SWs scored higher in PSQI and ISI in comparison to fixed evening SWs, with statistically significant ($p=0.03$) PSQI score and ($p=0.05$) ISI score. However, when adding the CES-D i.e depression measure as a covariate in the analysis, it revealed that p-value increased to 0.06 and 0.09 in PSQI and ISI respectively

A Chinese cohort study was conducted in order to evaluate the association between shift work and depression and anxiety, but also to examine the mediating role of lifestyle factors [27]. With a total of 175 543 participants, with 27637 classified as shift workers. The data analysis was done between November 2022 and January 2023. The study provides numbers such as hazard ratios (HRs) and mediation percentages that aids to quantify effects of lifestyle factors that function as mediators. In table 2, a HR value of 1.22 for developing depression ($p<0.001$) demonstrates that there is a 22 % risk of developing depression compared to the non-shift workers. However, it was also demonstrated that there was no significant difference between those who worked night and non-night shifts.

2.5 Disrupted sleep patterns and circadian rhythms as mediators between shift work and depression

Sleep is important to all individuals and is essential in maximizing work performance. A Chinese cross sectional study investigated the effect of circadian rhythm amplitude and stability between work stress and sleep quality in shift working nurses [28]. Furthermore, the study included 379 shift-working nurses from 6 different hospitals around Shanghai, China.

In order to understand the circadian rhythm, it is needed to understand its different components, which consists of phase, amplitude and stability. The phase is defined as the timing of the rhythms peak and trough, whereas the amplitude represents the difference between a peak and through of a rhythm. Lastly, stability is connected with the constancy of an amplitude that we might predict [28].

In the study conducted, the circadian rhythm stability and amplitude were studied and measured by CTI, also known as Circadian Type Inventory. This is a self-questionnaire which helps assess if an individual is content with working shifts and can adapt to it [28]. In order to assess circadian rhythm components such as stability and amplitude, it can be of benefit to clarify the components. The stability can be represented as flexible and rigid (FR) while amplitude as languid and vigorous (LV). In the event there is a high score on the FR, it is suggested that the individual is flexible and may adjust to shift work. On the other hand, a high LV score would suggest an individual is languid and experiences difficulties adapting to shift work, and that he or she may suffer from conditions such as insomnia. For instance, a score >18.75 on stability indicates a flexible worker, whereas scoring >22.5 on the amplitude indicates a languid worker.

In Table 2 of the study, conducted with 379 nurses, in relation to circadian rhythm, the mean score for LV and FR was 22.09 (SD 3.94) and 12.49 (SD 3.97) respectively . In addition, sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). The higher the score, the worse sleep quality. Additionally, sleep was classified as poor if the score was >5. According to the table above , the value representing sleep quality revealed a mean of 6.75 (SD 3.12) [28].

In order to investigate work stress, participants were invited to complete the Chinese Nurses Stressor Scale (CNSS). With 35 items, it included elements concerning nursing speciality and nursing work, time distribution as well as quantity of work, environment and equipment of work, nursing care of patients as well as management and interpersonal relations.
By investigating Table 1, it can be noted that out of 379 nurses, 275 (72.56 %) reported moderate work stress, 76 (20.05 %) with severe stress and only 28 nurses, making up only 7.39%, reported mild stress.

Based on previously mentioned study, it is thus of interest to investigate how disturbed sleep and stress due can precipitate depressive symptoms. In a Japanese study, with 464 Japanese and 185 Chinese workers, it was investigated how work-related stress and sleep disturbance can result in depressive symptoms. In addition, the study also measured the extent of depressive symptoms [29].

In the study, Structural Equation Modeling (SEM) was applied. This helps to investigate if sleep disturbance can mediate the connection between depression and work-related stress in both Chinese and Japanese employees. In addition, the model provided researchers the opportunity to assess and estimate direct and indirect pathways at the same time. As in SEM, we can portray how one variable can affect another. A direct pathway is referred to as how a variable, for instance A, has a direct effect on another variable called C. In contrast, an indirect pathway instead reveals the effect of a variable X on Y via a so-called mediator which we refer to as B [30] .

In the SEM model used in the research, the dependent variable was referred to as severity of depression, and the predictor variables referred to as job stress, social support and sleep disturbance [29]. The mediator in this case is sleep disturbance. If looking at the direct effect of work-related stress on depression, it was revealed that the standardized regression coefficient **β** (beta), which helps us to assess how strong a relationship can be between two variables, was estimated to be .08. Thus, a positive relationship between these variables simply indicates that if the work stress would increase, the depression severity would also increase. Furthermore, if analyzing the indirect pathway, assessing the indirect effect of sleep on depression via sleep disturbance, it revealed a **β**=.13, a higher value than previously mentioned. This demonstrates that sleep disturbance itself can act as a mediator and in fact is involved in a stronger development of depressive symptoms in response to stress due to work [29].

2.6 Pharmacological and non-pharmacological interventions to reduce depression among shift workers

2.6.1 Cognitive Behavioral Therapy for Insomnia (CBT-I)

A Finnish study examined the effectiveness of Cognitive Behavioral Therapy for Insomnia [31] . Furthermore, the study was focused on shift workers who suffered from chronic insomnia. In addition, it was also examined how the symptoms of insomnia and the effect of intervention would be different depending on free days and working days. 19 workers in the Finnish media industry, who worked irregular hours, were invited to participate in the study. Notable is that these workers had non organic insomnia. The study was then followed up after

6 months. In order to assess the outcome, the study used sleep diary as well as questionnaires and actigraphy. Also, the cognitive behavioral therapy for insomnia, CBT-I, was held by nurses in the occupational health service team. Important is that participants underwent a period of approximately 6-10 weeks without the aid of non-pharmacological insomnia treatment prior to starting CBT-I. This allowed us to compare between the waiting period and the outcome after treatment.

Participants used a sleep diary for approximately 3 weeks, which evaluated insomnia symptoms at different points in time, labeled T0-T4, where T0 defined the start of waiting period, (baseline) and T1 waiting period prior to CBT-I and T2 being the period after CBT-I. Finally, T3 defined as 3 month-follow up and T4 the time of 6 month follow up.

The main measures for insomnia were Sleep Onset Latency (SOL), which is the time taken to fall asleep, as well as Wake After Sleep Onset (WASO), which would indicate the total time awake after initially falling asleep. Additionally, items “When did you go to bed” and “When did you get up from bed” allowed calculation for total time in bed (TIB), total sleep time (TST) and sleep efficiency, i.e percentage of the time in bed spent sleeping (SE). In the sleep diary, participants in the study were also invited to rate sleep quality and restedness. Worth noting that participants also recorded potential use of medication that promoted sleep, referred to as SPM, which should include name of drug and dosage. Finally, the participant should include whether he or she was off work or had been working the day of filling the diary.

Furthermore, in order to evaluate insomnia symptoms further, the study also implemented the use of actigraphs. Actigraph recording was performed for a 2 week period simultaneously as the sleep diary at periods of T0, T1 and T2. The actigraphs were placed on the wrist for the whole day, and by the time participants pressed the a button at time of going to sleep, and again at time of waking up. By doing so, actigraph data allowed sleep parameters SOL, WASO, TST and SE to be analyzed.

The results of sleep diary and actigraphy revealed that after CBT-I, SOL declined by 13 minutes. Additionally, sleep onset was approximated to be 6 minutes longer during workdays compared to days off work. When compared to actigraphy, the actigraphic SOL also improved by 4 minutes. However, in contrast to sleeping diary, there was no difference between sleep onset on workdays and days off. WASO did not demonstrate notable changes in sleep diary or actigraphy. It revealed that WASO, however, was shorter on workdays, with approximately 8 minutes in sleep diary and 7 minutes in actigraphy.

Overall assessment of TST revealed no increase overall. For sleep diary, TST was shortened on workdays (compared to days off) by 57 minutes, where actigraphy was shorter by 56 minutes. However, self-reported TST on workdays improved at both 3-and 6 month follow up compared to initial start. When discussing TST on days off, it was overall the same at 3 month follow up but later decreased at 6 month follow up time.

When discussing SE in the sleep diary, it was revealed to improve by around 3 % over time. In contrast, actigraphy did not show any remarkable changes. Additionally, there was no difference between work days or days off work. In addition to sleep efficiency, sleep quality overall after CBT improved by 13 %. Worth noting that sleep quality was 6 % worse on days where participants went to work. Finally, restedness (feeling refreshed during morning) improved by 7 % overall but felt around 8% less rested on days going to work compared to free days off work.

Apart from a sleep diary and actigraph, the participants were instructed to fill in 4 questionnaires at each point of measurement phase. To assess the severity of insomnia was assessed by The Insomnia Severity Index (ISI), which allowed assessing severity during 2 weeks. By using DBAS-16, Dysfunctional Beliefs and Attitudes about Sleep (16 item version), it allowed measuring dysfunctional sleep-related thoughts. The so-called Symptom Checklist-90 (SCL-90) was also applied in order to evaluate both psychiatric as well as somatic symptoms during the past month. Three subscales of SCL-90 were used, including Global Severity Index (GSI), Depression Scale (DEP) and Anxiety Scale (ANX). Finally, to assess health-related quality of life the study used a RAND 36-item health survey, which focuses on e.g. physical functioning, physical role limitations, pain, general health and mental health.

The ISI score in the study was reported to decrease by 44%. Similarly, the DBAS score also decreased with a percentage of 21%. When assessing psychiatric and somatic status with SCL-90 scale, it was revealed that depressive symptoms decreased by 18 % and anxiety by 8%. Lastly, the RAND 36 health survey revealed that mental health improved by 10% over time but physical health did not have any significant changes.

2.6.2 Led light therapy

As it is evident how CBT-I has benefits for reducing insomnia as well as depressive symptoms, it is of value to explore other non-pharmacological interventions.

A randomized control trial discussed the effects of light therapy on sleep and psychological symptoms, as well as heart rate variability in Taiwanese nurses that work shift [32]. In the study, it is discussed that low level LED light therapy can form a photobiomodulation effect by using red light to irradiate the body. Furthermore, it is thought that photons dissociate nitric oxide from enzymes which results in increased ATP production, electron transport and mitochondrial membrane potential. It is also believed that the mechanism involves activation of ion channels that are sensitive to light, which results in calcium entering the cell. In addition, there are a number of signaling pathways which become activated by calcium, nitric oxide and reactive oxygen species (ROS). In the end, it results in activation of transcription factors that cause a number of events, including increased protein synthesis, cell proliferation and migration, but also anti-inflammatory signalling.

In the study there were two groups consisting of Taiwanese nurses working in a medical center in Taipei. A total of 64 nurses were divided into two groups, a control group and experimental group, with 32 persons in each group. Inclusion criteria involved nurses who had participated in a one month shift work schedule the last 6 months, and also had insomnia with an ISI scored at least 9. Participants were required to complete 12 measurements in a period of one month.

Data collected during study by a questionnaire as well with ANSWatch, a device which can measure blood pressure, heart rate and heart rate variability as well as any irregular heartbeat. Variables referred to as background variables included age, sex, educational level as well as if the person was married or had kids. Also other sociodemographic such as work status (which unit, how many years and shift work status last month and current month), as well as use of any drugs for sleep.

The psychological symptoms were measured for a baseline value, and then every week after the session was completed. Insomnia was measured first for a baseline and then every 2 weeks after. To measure psychological symptoms, participants were assessed using Depression Anxiety Scale-21 (DASS-21), which includes questions for depression, anxiety and stress. Moreover, difficulties relating to sleep were measured using the insomnia severity index, which has been used in previous studies listed above.

It can be seen in table 2 that the experimental group after the one month period with LED therapy, scored lower in both ISI and DASS, as well as anxiety and stress being lower [32]. For instance, the mean ISI score after 4 weeks was measured 4.25 in the intervention group, whereas it was 12.59 in the control group. Difference between groups was statistically significant after 4 weeks as given $p<0.001$. For depression, the intervention group had a mean of 2.5, previously 7.69, whereas the control group scored 7.94 from the previous 10.44. The difference between the group also reveals statistically significant improvement.

In the intervention group, anxiety is shown to have decreased from mean 8.38 to 3.06, $p<0.001$. For the control group, 10.06 to 9.19. Stress in the control group at 4th week went from mean 14.5 to 12. In the intervention group, 12.19 decreased to 4.5. It can be concluded that after the one month with LED therapy, intervention group scored lower in insomnia (4.3 to 12.6, $p <0.001$), depression (2.5 vs 7.9, $p<0.001$), anxiety (3.1 vs 9.2), $p<0.001$) and stress (5.6 vs 12, $p<0.001$) than in the control group.

2.6.3 Melatonin

As discussed how CBT can thus improve insomnia as well as depressive symptoms, it is of interest to investigate whether pharmacological intervention with melatonin can improve sleep quality. This is relevant as demonstrated above, sleep disturbance has a correlation with development of depressive symptoms. A 2016 study evaluated the efficacy of melatonin, taken 30 minutes before sleep, in shift workers with sleep disturbances[33] .

In the article it is discussed that melatonin, the hormone secreted by pineal gland, has been widely used the last 20 years both for insomnia, both for adults and children. In the study, around 295 workers from Tehran Refinery Oil Co were invited to participate by responding to a questionnaire package which contained work-related and demographic characteristics. Also, Pittsburgh Sleep Quality Index and Insomnia Severity Index (ISI) were implemented. Notable that all who participated in the study worked on rotating shifts, meaning one week day shift and the other week night. Those eligible to participate in the study had been working shift work for at least one month. Furthermore, exclusion criteria were also mentioned, which included the use of sleep-aiding medicine, sedatives as well as presence of cardiac, renal and respiratory conditions.

Additionally, out of 295 workers, 50 workers who experienced difficulties falling asleep were also randomly selected, and Somnowatch was applied to examine sleeping patterns of the workers. The device used could monitor how often, and to which extent, the person is moving.

In order to have a baseline evaluation, workers were evaluated by the device for approximately 3 days. Notable that during these 3 days they did not use any medicine for sleep. It was decided that the 50 participants were divided in two groups, with 25 participants each. Group 1 were instructed to take a melatonin with 3 mg dosage, while the other group took a placebo approximately half an hour before going to sleep. This was done for 3 nights and assessed by the device. Washout time for 2 weeks was applied, where participants after would swap medicine. This meant that group 1 took placebo, and group 2 received the 3mg melatonin. Thus, double-blind design was applied in the study.

In the study, results revealed that out of the 295 workers, 103 selected either moderate, severe or very severe on ISI. Additionally, a SOL (sleep latency onset, time taken before falling asleep) of at least 20 minutes was revealed. Also, from the 50 workers who were randomly selected, 11 workers did not continue the study, while 5 additional workers did not complete all phases of the study and 6 either forgot the melatonin or the data of Somnowatch was not appropriate to be analyzed. This left a total of 39 workers, where all were men aged between 24-52 years.

The parameters of Sleep Latency Onset (SOL), Sleep Efficiency (SE), total sleep time (TST), Wake After Sleep Onset (WASO) were obtained from the use of Somnowatch.

In the study, results obtained from Table 1 , it is concluded that SOL, with melatonin, decreased from baseline 0.27 to 0.20 hours [33]. Regarding SE, the average of 3 days revealed that SE increased from baseline 82.19 to 85.5%, with melatonin, indicating improvement. TST increased with melatonin from 5.59 to 5.9 hours (+0.31h) but was not statistically significant given p-value=0.056. When discussing WASO, it decreased from 0.97 to 0.81 hours but, similar to TST, did not pose significant properties given p=0.208. If discussing placebo, it was concluded that there were no measurable effect on the parameters mentioned above.

3. Conclusions

In this literature review, it is proven how shift workers are prone to higher risk of developing sleep disturbance and depression. Several parameters, including sleep quality, depressive symptoms and severity of insomnia were reported to be worse in shift workers to non-shift workers. However, there are also differences between the different types of shift workers. For instance, True shift workers in comparison to Fixed shift workers, reported a worse sleep quality and higher insomnia severity index score. However, when depression was measured it revealed an statistically not significant value, indicating that the depression can be a key factor itself contributing to worse sleep, rather than timing of the shift. In addition, the study also revealed that shift workers experience more depressive symptoms and increased daytime sleepiness in comparison to non-shift workers.

When discussing the effects of shift work, this study reveals that they can manifest in different ways. It is revealed that shift workers can experience both a lower energy and enthusiasm at work, referred to as languidity, in combination with difficulties rather than flexibility to adapt to shift work in general. In addition, shift work is also revealed to correlate with a worsened sleep quality, manifested for instance by a high PSQI score. As demonstrated previously, shift workers are prone to experience higher levels of stress, which also supports the correlation between stress and poor sleep quality. In turn this also explains how it can precipitate the poor flexibility to shift work adaptation.
The combination of disturbed sleep and work stress is revealed to precipitate the depressive symptoms. There is a direct effect of work related stress on depression, showing a positive relationship between these variables. However, sleep disturbance is revealed to act as a mediator in developing depressive symptoms, and has also been proven that it is involved in a stronger development of depression rather than work stress itself.

Finally, when discussing the interventions to treat depression among shift workers, the effect both from pharmacological methods as well as the non-pharmacological interventions seem to be promising. Melatonin administration revealed a promising effect on several parameters, both on improving sleep efficiency and reducing sleep latency onset. This indicates that for shift workers, administration of melatonin can be of benefit by aiding in falling asleep quicker and sleeping more efficiently. Non-pharmacological intervention with CBT-I revealed, similar to melatonin, a decrease in sleep latency onset. In addition, sleep quality after CBT-I revealed an improvement measuring up to 13%. The intervention of CBT-I further resulted in a significant decrease in insomnia severity, which was assessed by 44%. In addition, reductions in psychiatric symptoms such as depression and anxiety also proved to be thanks to this intervention. LED-light therapy intervention displayed a promising effect on reducing the severity of insomnia, as well as reducing depressive symptoms, stress and anxiety. This demonstrates that also non-pharmacological interventions are reliable options in treating depression, not only the aid of pharmacological aids with melatonin, which is commonly used nowadays.

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Appendages

Table 1. Demographic and clinical characteristics of the study participants.

	Non-SWs (n=2,093)	Fixed SWs (n=375)	True SWs (n=3,823)			
	Mean±SD (n, %)	Mean±SD (n, %)	Mean±SD (n, %)	t, χ^2	Post-hoc analysis	η^2
Age (years)	37.79±9.73	38.98±10.72	36.51±9.59	<0.001***	Fixed>Non=True	0.026
Sex				0.86		<0.001
Male	999 (47.7%)	182 (48.5%)	1,806 (47.2%)			
Female	1,094 (52.3%)	193 (51.5%)	2,017 (52.8%)			
Income	4.23±0.99	3.82±1.09	4.27±0.96	<0.001***	True=Non>Fixed	0.011
Work hours/week	31.08±19.61	31.95±19.84	31.40±19.94	0.69		0.013
PSQI	6.25±3.23	7.30±3.77	7.36±3.56	<0.001***	True=Fixed>Non	0.026
$PSQI_{adj}$	6.32±0.08	7.24±0.18	7.35±0.06	<0.001***		0.018
ESS	7.83±3.88	7.91±3.94	8.44±3.99	<0.001***	True>Fixed=Non	0.007
ESS_{adj}	7.87±0.09	8.01±0.21	8.40±0.07	<0.001***		0.004
ISI	7.98±5.82	10.12±6.55	10.13±6.12	<0.001***	True=Fixed>Non	0.032
ISI_{adj}	8.11±0.14	10.07±0.32	10.03±0.10	<0.001***		0.021
CES-D	7.11±5.84	9.23±6.52	8.64±6.27	<0.001***	Fixed=True>Non	0.019
$CES\text{-}D_{adj}$	7.24±0.14	9.00±0.32	8.57±0.10	<0.001***		0.011

Table 1. Source: Somi Lee, Jooyoung Lee, Sehyun Jeon, Yunjee Hwang, Jichul Kim, Seog Ju Kim, Sleep disturbances and depressive symptoms of shift workers: Effects of shift schedules,Journal of Psychiatric Research,Volume 161,2023,Pages 371-376,ISSN 0022-3956,
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Table 2. Comparison of sleep- and depression-related variables between fixed evening SWs and fixed night SWs.

	Fixed evening SWs (n=212)	Fixed night SWs (n=163)			
	Mean±SD	Mean±SD	F	p-value	η^2
$PSQI_{adj}$	6.91±0.28	7.87±0.32	4.53	0.03	0.013
ESS_{adj}	8.03±0.28	7.73±0.33	0.45	0.50	0.001
ISI_{adj}	9.49±0.48	10.97±0.56	3.58	0.05	0.010
$CES\text{-}D_{adj}$	8.89±0.48	9.59±0.56	0.90	0.37	0.002

Table 2. Source: Somi Lee, Jooyoung Lee, Sehyun Jeon, Yunjee Hwang, Jichul Kim, Seog Ju Kim, Sleep disturbances and depressive symptoms of shift workers: Effects of shift schedules,Journal of Psychiatric Research,Volume 161,2023,Pages 371-376,ISSN 0022-3956,
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Table 2. Associations of Shift Work and Its Frequency and Type With Depression and Anxiety[a].

Characteristics	Incident depression (n = 3956)		Incident anxiety (n = 2838)	
	HR (95% CI)	*P* value	HR (95% CI)	*P* value
Shift work				
Model 0				
Nonshift work	1 [Reference]	NA	1 [Reference]	NA
Shift work	1.42 (1.31-1.53)	<.001	1.30 (1.18-1.43)	<.001
Model 1				
Nonshift work	1 [Reference]	NA	1 [Reference]	NA
Shift work	1.28 (1.18-1.38)	<.001	1.19 (1.08-1.31)	<.001
Model 2				
Nonshift work	1 [Reference]		1 [Reference]	
Shift work	1.22 (1.12-1.33)	<.001	1.16 (1.04-1.28)	<.001
Physical activity	1.22 (1.13-1.33)	<.001	1.16 (1.04-1.28)	<.001
Dietary characteristics	1.22 (1.12-1.33)	<.001	1.16 (1.04-1.28)	<.001
Smoking status	1.21 (1.11-1.31)	<.001	1.14 (1.03-1.27)	<.001

Drinking	1.22 (1.12-1.33)	<.001	1.16 (1.05-1.28)	<.001
Sleep duration	1.20 (1.11-1.31)	<.001	1.14 (1.03-1.27)	<.001
TV viewing or sedentary time	1.22 (1.12-1.32)	<.001	1.15 (1.04-1.27)	<.001
BMI	1.18 (1.09-1.29)	<.001	1.14 (1.03-1.26)	<.05
Frequency of shift work				
Model 0				
Never	1 [Reference]	NA	1 [Reference]	NA
Sometimes	1.37 (1.22-1.53)	<.001	1.21 (1.05-1.39)	<.01
Usually or always	1.46 (1.32-1.61)	<.001	1.37 (1.22-1.54)	<.001
Model 1				
Never	1 [Reference]	NA	1 [Reference]	NA
Sometimes	1.27 (1.13-1.42)	<.001	1.13 (0.99-1.30)	.07
Usually or always	1.29 (1.16-1.42)	<.001	1.23 (1.09-1.39)	<.001
Model 2				
Never	1 [Reference]	NA	1 [Reference]	NA
Sometimes	1.23 (1.10-1.38)	<.001	1.11 (0.97-1.28)	.13
Usually or always	1.21 (1.09-1.35)	<.001	1.19 (1.05-1.35)	<.01
Type of shift work				

Type of shift work				
Model 0				
Shift but nonnight shift workers	1 [Reference]	NA	1 [Reference]	NA
Night shift workers	0.99 (0.86-1.14)	.88	0.92 (0.77-1.10)	.36
Model 1				
Shift but nonnight shift workers	1 [Reference]	NA	1 [Reference]	NA
Night shift workers	0.99 (0.86-1.15)	.93	0.92 (0.77-1.10)	.35
Model 2				
Shift but nonnight shift workers	1 [Reference]	NA	1 [Reference]	NA
Night shift workers	1.05 (0.90-1.21)	.55	0.98 (0.82-1.17)	.81

Table 2. Source: Xu M, Yin X, Gong Y. Lifestyle Factors in the Association of Shift Work and Depression and Anxiety. JAMA Netw Open. 2023 Aug 1;6(8):e2328798. doi: 10.1001/jamanetworkopen.2023.28798. PMID: 37578795; PMCID: PMC10425829.

TABLE 1 General characteristics of participants (N = 379)

Characteristics	Categories	*N*	%
Gender	Female	363	95.78
	Male	16	4.22
Education	Junior college degree and below	153	40.37
	Bachelor's degree and above	226	59.63
Marital status	Unmarried	165	43.54
	Married	211	55.67
	Divorced	3	0.79
Has children	Yes	167	44.06
	No	212	55.94
Hospital type	Traditional Chinese medicine hospital[a]	240	63.32
	General hospital	139	36.68
Working department	Internal medicine	141	37.20
	Surgery	84	22.16
	Obstetrics and gynaecology	13	3.43
	Paediatrics	18	4.75
	Emergency	47	12.40
Professional title	Nurse	157	41.42
	Nurse practitioner	180	47.49
	Nurse-in-charge	42	11.08
Monthly income (RMB)	<8,000	211	55.67
	≥8,000	168	44.33
Having night shift	Yes	330	87.07
	No	49	12.93
Taking a nap	Yes	76	20.05
	No	303	79.95
Circadian rhythm amplitude (LV)	Languid	181	47.76
	Vigorous	198	52.24
Circadian rhythm stability (FR)	Flexible	26	6.86
	Rigid	353	93.14
Work stress	Mild stress	28	7.39
	Moderate stress	275	72.56
	Severe stress	76	20.05

Table 1. Source: Wu S, Wu C, Wang X, Fei W, Fu Y. Mediating effect of circadian rhythm between work stress and sleep quality in Chinese shift-working nurses: A cross-sectional survey. *Nurs Open*. 2023 Feb;10(2):560–9. doi:10.1002/nop2.1322. Available from: https://www.proquest.com/docview/2763943878

TABLE 2 Work stress, circadian rhythm and sleep quality of participants

Variables	Score range	*M*	*SD*
Sleep quality	0–15	6.75	3.12
Daytime dysfunction	0–3	1.85	.90
Sleep latency	0–3	1.40	.92
Sleep disturbance	0–3	1.29	.72
Subjective sleep quality	0–3	1.28	.67
Sleep duration	0–3	0.56	.67
Habitual sleep efficiency	0–3	0.37	.75
Use of sleep medication	0	0.00	.00
Work stress	35–140	94.36	17.66
Time distribution and work quantity (TDWQ)	1–4	3.07	.64
Nursing specialty and nursing work (NSNW)	1–4	2.84	0.53
Nursing care of patients (NCP)	1–4	2.79	.55
Work environment and equipment (WEE)	1–4	2.60	.71
Management and interpersonal relations (MIR)	1–4	2.30	.65
Circadian rhythm	17–55	34.57	4.83
Circadian rhythm amplitude (LV)	11–30	22.09	3.94
Circadian rhythm stability (FR)	5–25	12.49	3.97

Table 2. Source: Wu S, Wu C, Wang X, Fei W, Fu Y. Mediating effect of circadian rhythm between work stress and sleep quality in Chinese shift-working nurses: A cross-sectional survey. *Nurs Open*. 2023 Feb;10(2):560–9. doi:10.1002/nop2.1322. Available from: https://www.proquest.com/docview/2763943878

Table 2.

Mean scores and proportions with sleep quality and psychological symptoms by intervention and control status.

	Control (n = 32)			Intervention (n = 32)			Mean difference, p	Differences in % with the symptom, p
	Mean	SD	n (%) with the symptom	Mean	SD	n (%) with the symptom		
Sleep measures								
Insomnia								
Pretest	13.81	4.04	32 (100%)	13.34	3.01	32 (100%)	−0.47, 0.600	0, —
2nd week	12.44	4.29	30 (94%)	8.09	3.48	19 (59%)	−4.35, *< 0.001	−35%, *0.002
4th week	12.59	4.79	30 (94%)	4.25	3.3	5 (16%)	−8.34, *< 0.001	−78%, *0.001
Psychological measures								
Depression								
Pretest	10.44	8.03	15 (47%)	7.69	6.18	11 (34%)	−2.75, 0.130	−13%, 0.446
1st week	7.38	6.86	11 (34%)	5.06	5.1	9 (28%)	−2.32, 0.131	−6%, 0.788
2nd week	8.19	7.54	12 (38%)	4.19	4.58	4 (13%)	−4, *0.013	−25%, *0.041
3rd week	8.13	7.6	11 (34%)	3.13	3.63	2 (6%)	−5, *0.002	−28%, *0.011
4th week	7.94	7.51	13 (41%)	2.5	3.7	3 (9%)	−5.44, *0.001	−32%, *0.008
Anxiety								
Pretest	10.06	5.67	24 (75%)	8.38	6.71	15 (47%)	−1.68, 0.281	−28%, *0.039
1st week	9.38	5.55	19 (59%)	5.5	6.03	9 (28%)	−3.88, *0.010	−31%, *0.023
2nd week	9.06	5.81	19 (59%)	4.75	4.68	8 (25%)	−4.31, *0.002	−34%, *0.011
3rd week	8.63	6.51	17 (53%)	4.63	5.24	7 (22%)	−4, *0.009	−31%, *0.019
4th week	9.19	5.92	18 (56%)	3.06	4.4	4 (13%)	−6.13, *< 0.001	−43%, *< 0.001
Stress								
Pretest	14.5	5.99	14 (44%)	12.19	8.21	11 (34%)	−2.31, 0.246	−10%, 0.609
1st week	13	6.83	9 (28%)	8.75	6.85	7 (22%)	−4.25, *0.016	−6%, 0.774
2nd week	12.69	7.63	10 (31%)	6.94	6.45	4 (13%)	−5.75, *0.002	−18%, 0.129
3rd week	11.94	7.28	9 (28%)	6.31	5.99	2 (6%)	−5.63, *0.001	−22%, *0.043
4th week	12	7.26	10 (31%)	4.5	5.61	3 (9%)	−7.5, *< 0.001	−22%, 0.060

* $p < 0.05$.

Table 2. Source: Liao YH, Tai CJ, Ming JL, Lin LH, Chien LY. The Effectiveness of Low-Level LED Light Therapy for Sleep Problems, Psychological Symptoms, and Heart Rate Variability in Shift-Work Nurses: A Randomized Controlled Trial. J Nurs Manag. 2025 Jun 17;2025:6478834. doi: 10.1155/jonm/6478834. PMID: 40557249; PMCID: PMC12187440.

Table 1
The mean (standard deviation) of TST, SE, SOL and WASO at baseline, after placebo administration and after melatonin therapy

		TST (hours)	SE (%)	SOL (hours)	WASO (hours)
Day 1	Baseline	5.67 (1.38)	81.58 (9.94)	0.29 (0.25)	1.1 (0.9)
	Placebo	5.3 (0.89)	83.68 (10.24)	0.33 (0.32)	0.78 (0.65)
	melatonin	5.86 (1.34)	85.41(7.93)	0.21 (0.17)	0.83 (0.55)
	P value <0.05	b	a	b	
Day 2	Baseline	5.5 (1.5)	82.71 (11.82)	0.24 (0.19)	0.92(0.79)
	Placebo	5.2 (1.6)	79.2 (13.5)	0.34 (0.28)	1 (0.8)
	melatonin	5.5 (1.4)	84.8 (8.5)	0.24 (0.28)	0.7 (0.5)
	P value <0.05		b		
Day 3	Baseline	5.55 (1.55)	82.45 (11.29)	0.26 (0.27)	0.89 (0.57)
	Placebo	6.24 (1.8)	85.16 (8.14)	0.22 (0.20)	0.84 (0.52)
	melatonin	6.2 (1.8)	86 (9.74)	0.15 (0.14)	0.83 (0.6)
	P value <0.05			a, b	
Average of 3 days	Baseline	5.59 (1)	82.19 (9)	0.27 (0.14)	0.97 (0.59)
	Placebo	5.6 (0.97)	82.54 (8.1)	0.31 (0.16)	0.9 (0.52)
	melatonin	5.9 (0.97)	85.5 (6.3)	0.20 (0.15)	0.81 (0.39)
	P value <0.05		a, b	a, b	

TST, total sleep time; SE, sleep efficiency; SOL, sleep onset latency; WASO, wakening after sleep onset. a baseline vs melatonin, b placebo vs melatonin.

Table 1. Source: Sadeghniiat-Haghighi K, Bahrami H, Aminian O, Meysami A, Khajeh-Mehrizi A. Melatonin therapy in shift workers with difficulty falling asleep: a randomized, double-blind, placebo-controlled crossover field study. *Work*. 2016;55(1):225-30. doi:10.3233/WOR-162376.

Declaration

I, Antony Elia Gawrieh, certify that this Research Paper on the topic

"Maiņu darba ietekme uz garīgo veselibu uzvars uz depresiju"

(Title of the Research Paper in Latvian)

"The Impact of shift work on mental health: Focus on depression"

(Title of the Research Paper in English)

is my own independent research. All other sources of data, definitions and quotations in my Research Paper are referenced accordingly. The text of this Research Paper has never been submitted in any way to any other National Examination Commission for evaluation in its entirety or parts, and has never been published in its entirety.

_______________ /_Antony Elia, Gawrieh_/

(Student's signature) (Name, surname)

___ ____21.10____ 2025.