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Sleep disorders in women during the menopausal transition – a narrative literature review[1]

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Abstract: Sleep, defined as a reversible neurobehavioral state regulated by circadian rhythms, is essential for health. Sleep disorders, especially during the perimenopausal period (age 45– 55), are a significant health problem, affecting up to 60% of women during this period. These women often report a deterioration in sleep quality, frequent awakenings, and chronic feelings of sleep deprivation. This narrative literature review synthesizes current scientific reports on the biological, physical, and psychosocial mechanisms underlying these complaints. The etiopathogenesis of sleep disorders is multifactorial, with hormonal changes considered to be the main cause. Fluctuations and decreases in estrogen and progesterone (and its metabolite allopregnanolone) are directly associated with a deterioration in sleep structure, a decrease in sleep efficiency, and disruption of the circadian rhythm, including the action of melatonin. Estrogen deficiency may also increase the risk of sleep-disordered breathing. The clinical picture is dominated by insomnia, the main symptoms of which are difficulty staying asleep and prolonged wakefulness after falling asleep. The review lists vasomotor symptoms, mood disorders (anxiety and depression), and nocturia resulting from hormonal dysregulation affecting bladder capacity and urine production at night as secondary factors of insomnia. In addition, an increase in the frequency of primary disorders, including obstructive sleep apnea and restless legs syndrome, is observed during the perimenopausal period. Sleep disorders are often underestimated and undiagnosed, which contributes to the deterioration of mental health and professional functioning and increases the risk of chronic diseases and injuries (e.g., falls). The level of knowledge about proper sleep hygiene among women is generally low. The conclusions of the review point to the multidimensional nature of the problem and the need for a holistic, interprofessional, team-based approach to improve the quality of life for women during the menopausal transition.

Keywords: climacteric syndrome, menopausal transition, menopause, perimenopause, sleep disorders, sleep quality

1. Introduction

Sleep is defined as a reversible, repetitive neurobehavioral state regulated by circadian rhythms and homeostatic mechanisms (Carskadon and Dement, 2005). The quality of sleep is determined based on five measurable components:

- quantity (length of sleep per day);
- continuity (ease of falling asleep and staying asleep);
- circadian rhythm (synchronization with the 24-hour cycle);

1 Article in Polish language: https://stowarzyszeniefidesetratio.pl/fer/64P_palu.pdf

- daytime alertness (no excessive sleepiness during the day);
- perception of sleep quality (subjective satisfaction with sleep) (Buysse, 2014; Haufe & Leeners, 2023).

Scientific literature increasingly emphasizes the link between the etiopathogenesis of many diseases and sleep deficit (Hale, Troxel & Buysse, 2020). Sleep disorders are a broad category of conditions that vary in their causes, symptoms, and pathophysiological mechanisms. They can be primary or secondary, being a symptom of other somatic, neurological, or mental illnesses. According to the International Classification of Sleep Disorders (ICSD-3), they include any difficulties related to the initiation and maintenance of sleep, its abnormal length or quality, as well as the occurrence of abnormal behaviors during sleep (Epstein, 2018; Hereford, 2013; Sateia, 2014).

Sleep disorders, both in terms of sleep deprivation and reduced sleep quality, can lead to serious health consequences, such as cardiovascular dysfunction, mental weakness, cognitive impairment, and decreased immunity. Sleep deprivation disrupts the natural nighttime decrease in blood pressure. The lack of this natural nighttime pause, combined with increased production of cortisol (the stress hormone) as a result of HPA axis dysregulation increases the burden on the cardiovascular system. As a result, insomnia becomes a risk factor for hypertension and heart disease. It is worth noting that the risk of developing these conditions naturally increases after menopause (Lightman, Birnie & Conway-Campbell, 2020).

Sleep fragmentation negatively affects glucose and lipid metabolism. Disrupted production of appetite-regulating hormones (leptin and ghrelin) and impaired insulin sensitivity can lead to insulin resistance and abdominal obesity. This metabolic feedback loop increases the risk of type 2 diabetes and puts additional strain on the cardiovascular system (Tandon et al., 2022).

Sleep is fundamental to psychophysical well-being. Despite this obvious fact, many people do not meet their body's daily needs for this regenerative rest (Baranwal, 2022). Women are more likely than men to report a deterioration in sleep quality, difficulty maintaining sleep continuity, including frequent awakenings and feelings of sleep deprivation (Perger et al., 2024). Sleep disorders are also among the most common and troublesome complaints during the perimenopausal period, which is a natural stage of the aging process, usually occurring between the ages of 45 and 55 (Lialy et al., 2023; Matthews et al., 2020; Santoro et al., 2021). Population studies indicate that the prevalence of sleep problems increases from 16-42% in the premenopausal period to 39-47% in the perimenopausal period, and after menopause, it can affect more than half (about 60%) of women (Baker et al., 2018; Tandon et al., 2022).

Epidemiological data indicate that insomnia not only increases the risk of many diseases, such as obesity, hypertension, diabetes, and heart disease, but also points to the possibility of a biological link between sleep disorders and the occurrence of osteoporosis, resulting from common risk factors (e.g., age, weight changes) and mechanisms affecting bone metabolism. In postmenopausal women, sleep disorders increase the risk of falls, which are the main cause of fractures (Cauley et al., 2023; Miner et al., 2021). Another interesting aspect is that insomnia

may affect ovarian function, while improving sleep quality may potentially delay the onset of natural menopause (Ghan et al., 2024). In light of these findings and due to the increase in the prevalence of sleep disorders in recent years, it is necessary to pay more attention to sleep problems in perimenopausal women (Arteaga et al., 2025; Lee et al., 2020).

The aim of this narrative review of the available literature is to critically analyze and synthesize current scientific reports on the biological and psychosocial mechanisms underlying sleep disorders in perimenopausal women. The study aims to draw attention to the complexity of the problem and the importance of a holistic and interprofessional approach to the diagnosis and treatment of these conditions. To this end, publications were searched for in the PubMed, Scopus, and Cochrane Library databases. The search was based on the following set of keywords: *perimenopause, menopause, climacteric syndrome, sleep disorders, insomnia*, and *sleep quality*. The analysis focused on sources published in English and Polish over the last five years (2020-2025), with a preference for system-

atic reviews, meta-analyses, and large cohort studies to ensure the highest quality of content. In justified cases, older publications were also included if they provided important historical information for a full understanding of the clinical context.

The final selection of articles was carried out as part of a narrative review with a systematic literature search. Articles were initially selected based on their abstracts, and then the full text of the publications was evaluated in terms of direct thematic relevance and clinical significance for women experiencing the menopausal transition. This process aimed to focus on the most current and reliable evidence regarding the etiology and consequences of sleep disorders in this group of women.

2. Etiopathogenesis of sleep disorders in the perimenopausal period

Reports in the literature indicate that sleep disorders in perimenopausal women are multifactorial in nature. They result from interactions between hormonal and organic disorders, as well as genetic, ethnic, personal, and environmental factors. This multifaceted approach is important for the clinical assessment of patients (Aksan and Dilbaz, 2024; Santos et al., 2021). Correct diagnosis, therefore, requires not only an assessment of physical symptoms such as hot flashes, but also a detailed psychological and socioeconomic history.

2.1. Endocrine changes during perimenopause and sleep architecture

Female sex hormones, estrogens and progesterone, have a direct impact on sleep structure. Sleep problems intensify during periods of significant hormonal fluctuations (Dorsey et al., 2020). Estrogens have a beneficial effect on sleep, improving its efficiency and stabilizing circadian rhythms. Therefore, a decrease in estradiol levels, and especially its fluctuations, is associated with reduced sleep efficiency, more frequent awakenings, and sleep-disordered breathing (Haufe, 2023).

A decrease in estradiol levels during perimenopause may affect cortisol levels, but the results of studies in this area are inconclusive. It has been found that elevated cortisol levels in women correlate with age. However, it remains unclear whether this increase is a direct consequence of aging or whether it is secondary to a decrease in sex hormone levels. Animal studies confirm the influence of estradiol on the regulation of stress hormones, but estrogen therapy in humans has ambiguous effects, so the role of estradiol in the functioning of the hypothalamic-pituitary-adrenal (HPA) axis during menopause remains unclear (Lightman et al., 2020).

Sleep fragmentation, which is typical for menopause, can disrupt the rhythm of cortisol secretion, regardless of the shortening of individual sleep phases. Cortisol levels before bedtime

may be affected by both sleep deprivation and sleep fragmentation, as well as their mutual interaction (Cohn et al., 2023). Equally important is the decrease in progesterone levels resulting from the absence of ovulation, which correlates with sleep disturbances and more frequent awakenings. This effect is attributed, among other things, to low levels of allopregnanolone, a neuroactive metabolite of progesterone responsible for its calming and soporific effects. Allopregnanolone acts as a positive allosteric modulator of the GABA-A receptor, enhancing the inhibitory effect of gamma-aminobutyric acid in the brain. The loss of this endogenous sedative effect contributes directly to sleep fragmentation and a reduction in slow-wave sleep, resulting in a feeling of insufficient regeneration (Słopień et al., 2018).

Hormones of the hypothalamic-pituitary-ovarian axis can modulate sleep regulation by influencing the adenosine system, which promotes sleep, and the arousal systems in the hypothalamus. In addition, estradiol may influence sleep indirectly through thermoregulatory systems in the hypothalamus (Ballot et al., 2022; Dorsey et al., 2020).

2.2. Modifications of the circadian rhythm

Circadian rhythm disorders and age-related dysregulation of melatonin secretion contribute to the severity of insomnia in women. Since sex hormones

participate in the sensitization of neurons to melatonin, low estrogen levels are directly associated with reduced melatonin production and the occurrence of sleep disorders in perimenopausal women. Estrogen receptors are located in regions of the brain involved in the regulation of sleep and circadian rhythm, including the suprachiasmatic nucleus. The loss of estrogen in these centers may directly impair

circadian rhythm synchronization and reduce the nighttime peak of melatonin secretion. As a result, women experience a shift in their sleep phase and it is difficult for them to achieve the desired duration of sleep (Troia et al., 2025).

2.3. Symptoms of menopausal syndrome and sleep disorders

The available literature on the subject has well documented the relationship between sleep disturbances and vasomotor symptoms in perimenopausal women (Proserpio et al., 2020; Zolfaghari et al., 2020). Studies by Maki et al. (2024) provided evidence of a significant correlation between night sweats and sleep disturbances. More than half of the study participants (60%) indicated night sweats as the main cause of nighttime awakenings. Reducing their number led to improved sleep quality, shorter wakefulness after falling asleep, and improved sleep efficiency.

Similarly, a study by Tomida et al. (2021) conducted among Japanese women showed a clear link between hot flashes and sleep problems, even after taking the role of potential confounding factors into account. An international cross-sectional study conducted in Latin America also observed an increase in the frequency of sleep disorders with the coexistence of vasomotor symptoms in perimenopausal women (Arteaga et al., 2025).

These observations confirm the widespread nature of the correlation between hormonal fluctuations and sleep dysregulation, extending beyond Euro-American populations. These studies also indicate that the severity of night sweats and hot flashes is a direct predictor of sleep fragmentation, which is important for the clinical assessment of patients. This correlation confirms the belief that the treatment of vasomotor symptoms is an integral part of effective insomnia therapy in this group of women. In addition, hot flashes and night sweats show statistically significant associations with symptoms of depression and anxiety, which in turn contribute to the development of insomnia (Palacios et al., 2022). Since women in the perimenopausal period experience significant changes in their professional lives and show greater emotional sensitivity, their anxiety rates are significantly higher than those of women of childbearing age. In addition to physiological factors, the increased psychological burden in this age group results from the complex interaction of cognitive factors, personality traits, professional pressure, economic status, and access to social support groups (Zeng et al., 2025).

The relationship between menopause, sleep disorders, and mood disorder symptoms in middle-aged women has been well documented in the literature. These associations may be particularly pronounced in perimenopausal women who have previously experienced premenstrual dysphoric disorder, as the hormonal changes associated with perimenopause may exacerbate pre-existing menstrual-related mood disorders. Women experiencing low mood are more likely to experience vasomotor symptoms. This may indicate a complex, reciprocal relationship between the three main problems women experience, during menopausal transition: mood (depression, anxiety), sleep, and hot flashes. The common cause of these problems is a decrease in estrogen levels, which leads to overactivity of KNDy neurons in the brain. This overactivity both triggers hot flashes and affects the pathways that regulate sleep and mood (Maki et al., 2024). However, simply noting the co-occurrence of these symptoms is not enough—it is crucial to recognize their chronology. An important research question remains whether low mood leads to poorer sleep quality and perception of vasomotor symptoms, or whether sleep disturbances (e.g., caused by hot flashes) primarily worsen mood. Unraveling this sequence is crucial for developing the most effective treatment strategy for sleep disorders (Bowman et al., 2021). Another significant problem in women during perimenopause is the development of nocturia, i.e., the need to urinate at night. This process is multifactorial and is caused by postmenopausal estrogen deficiency, which affects the urinary and

renal systems and sleep mechanisms. Dysfunction of estrogen receptor stimulation in the urogenital system leads to a reduction in bladder capacity and an increase in the symptoms of overactive bladder. At the same time, estrogen deficiency disrupts the circadian rhythm of vasopressin secretion, which induces sodium-water diuresis and increased urine production at night (nocturnal polyuria). In addition, nocturia and sleep disturbances exacerbate each other: frequent awakenings caused by vasomotor symptoms increase awareness of bladder fullness and the need to urinate. Importantly, nocturia itself is a sleep-fragmenting factor, as each need for nighttime urination interrupts sleep continuity and can lead to secondary insomnia and difficulty falling back asleep (Pauwaert et al., 2024).

With regard to other symptoms typical of the menopausal transition, available studies have not shown that urogynecological symptoms, with the exception of nocturia, as well as various types of musculoskeletal pain, significantly affect sleep quality (Santos et al., 2020). Muscle and joint pain is often reported by women in the perimenopausal period, but its relationship with sleep quality is more complex. According to Santos et al. (2020), it is not a major predictor of sleep disorders. However, it should be noted that chronic pain is a recognized factor in exacerbating insomnia. If musculoskeletal pain is so intense that it prevents the patient from assuming a comfortable position or causes them to wake up, it becomes a direct cause of sleep fragmentation. Hormonal and inflammatory changes associated with the onset of menopause increase susceptibility to pain, which in turn can be a secondary cause of insomnia (Tandon et al., 2022). In clinical practice, controlling chronic pain through physical therapy or other methods is a necessary prerequisite for the effective treatment of accompanying insomnia (Lialy et al., 2023).

2.4. Coexisting primary sleep disorders

Sleep disorders in perimenopausal women may also be the result of primary sleep disorders. Among sleep-related breathing disorders, particular attention is paid to obstructive and central sleep apnea (Troia et al., 2025). Sleep-related breathing disorders are associated with menopausal status, which is linked to increased visceral fat accumulation. This in turn, affects, the development of these disorders regardless of a woman's overall body weight. During the postmenopausal period, there is a shift in fat accumulation from the hips to the abdominal and visceral areas, which results in an increased volume of adipose tissue around the upper airways and their susceptibility to collapse. Studies indicate that visceral fat may be an independent risk factor for obstructive sleep apnea in women, beyond body mass index alone. The incidence of this condition increases with the passage of time since the onset of menopause (Wang et al., 2025). In addition, studies conducted on a group of women in menopausal transition with sleep disorders found that they had higher body mass index values (Arteaga et al., 2025). The authors pointed to a statistically significant relationship between sleep disorders and obesity, which appears to be bidirectional, as obesity often leads to obstructive sleep apnea, which disrupts sleep. Meanwhile, reduced sleep time is associated with an increased risk of obesity in adults.

Another primary sleep disorder that is more common in perimenopausal women is restless legs syndrome. This is a sensorimotor disorder characterized by a strong urge to move the legs, which appears or intensifies during rest, especially in the evening or at night. Women with postmenopausal insomnia may have difficulty falling asleep due to cognitive arousal or hot flashes, while women with restless legs syndrome experience physical discomfort and an internal compulsion to move. Four basic diagnostic criteria are characteristic of this syndrome, the most typical of which is the appearance of symptoms during rest (sitting or lying down) and achieving temporary, complete, or partial relief by moving the limbs (Manconi et al., 2021).

It should be emphasized that sleep disorders associated with menopause may be the result of factors specific to the unique physiological changes that occur during the menopausal transition in women (Maki et al., 2024). The etiology is directly related to endocrine and vasomotor changes characteristic of menopause (Proserpio et al., 2020).

3. Clinical picture

Among the many different sleep disorders in perimenopausal women, insomnia is the most commonly diagnosed (Cohn et al., 2023). According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders, insomnia is defined as quantitative or qualitative dissatisfaction with sleep (First, 2013).

It may be characterized by several of the following symptoms: difficulty falling asleep, difficulty staying asleep, or waking up too early in the morning without being able to fall back asleep. Nocturnal sleep interruptions are often associated with vasomotor symptoms that interrupt sleep and make it difficult to fall back asleep (English et al., 2021).

As mentioned earlier, the main problem for women during menopause is an increased number of awakenings and longer periods of wakefulness after falling asleep, while difficulties with falling asleep itself are less common. Although prolonged sleep latency is less common in women, it can occur in women with high levels of anxiety and cognitive arousal, which often accompany hormonal changes and stress associated with menopause (Ballot et al., 2022).

In a systematic review, Kingsberg et al. (2023) analyzed eight studies (described in ten publications) focusing on the prevalence of sleep disorders in middle-aged women. The most commonly diagnosed symptoms of sleep disorders in these women were difficulty falling asleep and frequent awakenings. However, it should be emphasized that the studies analyzed used different definitions of "frequent nighttime awakening," which led to inconsistencies in the results. The differences also concerned the research tools used, such as the Menopause Rating Scale (MRS), Insomnia Severity Index (ISI), as well as the objectives and assumptions of the researchers. Although the data clearly confirm the prevalence of sleep problems in the postmenopausal period, the lack of standardization in the definition and diagnosis of insomnia makes it difficult to more accurately determine the symptomatology and prevalence of these disorders.

The clinical picture and etiology of sleep disorders in perimenopausal women are diverse and go beyond the mechanisms directly related to the onset of menopause itself. This points to the complex nature of sleep problems in this group of women, as the symptoms may be the result of the coexistence and interaction of many potentially independent pathogenic mechanisms (Manconi et al., 2021).

4. Sleep disorders and the psychosocial functioning of women

Fragmented sleep and chronic insomnia during menopause have profound and long-lasting consequences for normal psychophysical functioning, going beyond mere discomfort. The relationship between sleep and mental health is particularly evident in this age group of women. Sleep disorders are associated with an increase in symptoms of depression and anxiety (Bowman et al., 2021). It should be emphasized that sleep disorders in middle-aged women are not only a symptom of depression, but often occur as an independent risk factor or precursor to future depressive episodes. This phenomenon is exacerbated by a decrease in the levels of neurosteroids, such as allopregnanolone, which have anxiolytic and sedative effects and whose concentration decreases during late menopausal transition (Slopien et al., 2018).

Chronic sleep disorders are a significant risk factor for deterioration in physical health and the development of cardiometabolic diseases. Sleep fragmentation and reduced sleep duration lead to dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis and disturbances in cortisol levels (Lightman et al., 2020). The increase in abdominal obesity, insulin resistance, and dyslipidemia observed after menopause is closely related to sleep disorders in women. Reduced sleep quality can negatively affect cognitive function. Menopausal women report difficulty concentrating, memory problems, and a decline in overall productivity, which is directly correlated with fragmented sleep and awakenings induced by vasomotor disturbances (Tomida et al., 2021). The observed decline in cognitive and functional efficiency is a significant factor limiting professional productivity in this group (Kagan et al., 2021). This phenomenon points to the need for effective therapeutic interventions, as untreated sleep disorders can be a significant barrier to maintaining the

professional and social activity of women, especially at a time when they often reach the peak of their professional and intellectual potential.

Given the insufficient level of knowledge about sleep hygiene (Shi et al., 2024) and the increasingly widespread trend of using sleeping pills (Solomon et al., 2020), promoting non- pharmacological approaches is becoming particularly important. The SWAN (*Study of Women's Health Across the Nation)* cohort study conducted by Solomon et al. (2020) showed that the use of sleep medications by women complaining of sleep disorders has increased significantly over the past 20 years. Importantly, this increase was observed among perimenopausal women in all ethnic groups. It is concerning that pharmacotherapy is often the first therapeutic intervention for insomnia, usually without prior attempts at behavioral modification or first-line therapies such as cognitive behavioral therapy for insomnia (CBT-I). Long-term use of sleep medications, especially benzodiazepines, is associated with the risk of developing tolerance, dependence, and adverse effects such as falls and cognitive impairment, which pose a particular risk in the postmenopausal female population (Solomon et al., 2020).

Education on sleep hygiene and access to cognitive-behavioral therapy for insomnia should be a priority for public health care, improving not only sleep quality but also the overall health of women in various aspects of their functioning (Hale et al., 2020). From a public health perspective, promoting sleep health involves not only treating insomnia, but also taking steps to optimize quality of life. Hale et al. (2020) emphasize that sleep hygiene and broad access to non-pharmacological treatments for insomnia are effective preventive and therapeutic tools.

5. Limitations

Due to the methodology adopted, this narrative literature review has certain limitations that should be taken into account when interpreting its conclusions presented. First of all, in a narrative review, the process of selection of the presented literature was not systematic, which could have resulted in a subjective selection of sources evaluated in terms of their substantive significance and clinical relevance.

Furthermore, the methodology applied here precludes meta-analysis and statistical evaluation of study results, which is only possible in systematic reviews. In addition, the limitations of the review stem from methodological restrictions included in the analysis of the studies.

The available literature on this area is still largely based on sleep measurement methods (e.g., PSQI, ISI scales) that may be biased and differ from objective measurements (e.g., actigraphy or polysomnography). Subjective perception of sleep is often distorted by co- occurring symptoms such as depression or anxiety, which can lead to overreporting of disorders.

In terms of etiology, most of the included studies are observational or cross-sectional in nature, which makes it impossible to establish a direct cause-and-effect relationship between hormonal fluctuations and sleep disturbances. This makes it difficult to clearly distinguish whether insomnia is a direct effect of hormonal fluctuations and vasomotor symptoms, or whether it is exacerbated by secondary factors such as an increased risk of obstructive sleep apnea in the postmenopausal period, which requires a completely different therapeutic approach.

Despite these methodological limitations, this review makes an important contribution to the advancement of knowledge about sleep disorders in perimenopausal women. It can be considered a starting point for further in-depth analysis of sleep disorders, which are an important issue from the point of view of medical care for women during the menopausal transition. This review provides a basis for formulating hypotheses and identifies gaps in knowledge that need to be filled through further carefully designed prospective and randomized controlled trials.

Summary and practical implications

Sleep disorders in women during perimenopause include difficulty falling asleep, frequent nighttime awakenings, and premature morning awakening. The deterioration in sleep quality is not only a consequence of the somatic and psychological symptoms typical of menopause, but also a factor that exacerbates their occurrence, which significantly

affects the quality of life in this group of women. The etiology of these disorders is multifactorial and results from hormonal disorders as well as organic, environmental, and personal factors. Sleep disorders in perimenopausal women are often underestimated and underdiagnosed, which negatively affects their daily functioning, mental health, family life, and professional work. In addition, low awareness of healthy behaviors and proper sleep hygiene, as well as entrenched negative beliefs and attitudes, hinder the implementation of effective non-pharmacological interventions.

A critical analysis of the available literature highlights the urgent need to raise awareness among professionals involved in women's health about sleep disorders in the perimenopausal period. Downplaying insomnia as a "typical" symptom of menopause often leads to ineffective treatment and uncontrolled use of sleep medications (Solomon et al., 2020), which can mask the presence of more serious sleep disorders, such as obstructive sleep apnea (Wang et al., 2025). There is a need to reassess the role of pharmacotherapy as first-line treatment and evaluate its effectiveness in the context of lasting improvement in quality of life, rather than just short-term symptom relief (Tandon et al., 2022).

The conclusions drawn from the literature review can be used, among other things, as a basis for developing standardized review protocols and implementing uniform diagnostic and therapeutic standards aimed at optimizing interprofessional care for women in the perimenopausal period. It is crucial to adopt a holistic approach to health, in which sleep is treated not as a symptom but as one of the fundamental pillars of public health (Hale et al., 2020). The priority should be to incorporate sleep hygiene education and the widespread use of cognitive-behavioral therapies into routine medical and psychological care, enabling women to regain control over their own health and reducing the need for pharmacotherapy.

In summary, women in menopausal transition who receive optimized comprehensive, interprofessional care have a real chance of improving their sleep quality and thus alleviating other ailments typical of this period of life.

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