SLEEP QUALITY OF CHINESE WOMEN IN THE POSTMENOPAUSAL PERIOD WITH DIAGNOSED BONE MINERAL DENSITY DECREASE

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Introduction. Studies indicate a high prevalence of poor sleep quality among postmenopausal women diagnosed with osteoporosis. Emerging evidence suggests a complex relationship between sleep and bone health, with specific considerations for postmenopausal Chinese women.

The aim of the study – to analyze sleep quality indicators of Chinese postmenopausal women with osteopenia and osteoporosis and to identify factors influencing them.

The main part. The study included 80 postmenopausal women with diagnosed osteopenia and osteoporosis. To determine the quality of sleep we used a validated questionnaire and scales from officially available sources "Pittsburgh Sleep Quality Index (PSQI)". The total assessment of the quality of sleep of postmenopausal women showed poor sleep quality in respondents with low bone mineral density, while the quality of sleep was significantly lower in women with diagnosed osteoporosis compared to the group with osteopenia (p=0.034). It was found that in postmenopausal women with reduced BMD, those with poor sleep quality predominated, in particular, 32.8 % of those with diagnosed osteopenia and 77.3 % of those with osteoporosis had poor sleep quality. Our findings highlight several key factors that negatively influence sleep quality in postmenopausal women with diminished bone health: advanced age, extended duration of menopause, increased comorbidity burden and higher body mass index.

Conclusions. Our findings indicate that advanced age, longer duration of menopause, increased comorbidity burden (notably cardiovascular issues and overweight/obesity), and higher BMI are key factors contributing to poor sleep in this population. These results emphasize the complex interplay of these elements and the critical need for comprehensive assessment and management of sleep disturbances in postmenopausal women with diminished bone health.

Key words: menopause; bone mineral density; osteoporosis; age; body mass index; obesity; comorbidity.

ЯКІСТЬ СНУ КИТАЙСЬКИХ ЖІНОК У ПОСТМЕНОПАУЗАЛЬНИЙ ПЕРІОД З ДІАГНОСТОВАНИМ ЗМЕНШЕННЯМ МІНЕРАЛЬНОЇ ЩІЛЬНОСТІ КІСТКОВОЇ ТКАНИНИ

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Вступ. Дослідження вказують на високу поширеність низької якості сну серед жінок у постменопаузальний період з діагностованим остеопорозом. Нові дані свідчать про складний взаємозв'язок між сном і здоров'ям кісткової тканини з урахуванням особливостей постменопаузального періоду китайських жінок.

Мета роботи – проаналізувати показники якості сну китайських жінок у постменопаузальний період з діагностованими остеопенією та остеопорозом і виявити фактори, що на них впливають.

Основна частина. У дослідженні взяли участь 80 жінок у постменопаузальний період з діагностованими остеопенією та остеопорозом. Для визначення якості сну використовували валідизований опитувальник та шкали з офіційно доступних джерел «Піттсбурзький індекс якості сну» (PSQI). Загальна оцінка якості сну жінок у постменопаузальний період показала низьку якість сну в респонденток з малою мінеральною щільністю кісткової тканини, а в жінок з діагностованим остеопорозом якість сну була достовірно нижчою порівняно з групою жінок з остеопенією (p=0,034). Встановлено, що серед жінок у постменопаузальний період зі зменшеною мінеральною щільністю кісткової тканини переважали особи з низькою якістю сну, зокрема 32,8 % з діагностованою остеопенією та 77,3 % з остеопорозом, які мали низьку якість сну. Результати наших досліджень вказують на кілька ключових факторів, які негативно впливають на якість сну жінок у постменопаузальний період зі зменшеною мінеральною

щільністю кісткової тканини: похилий вік, подовжену тривалість менопаузи, збільшення кількості супутніх патологій та вищий індекс маси тіла.

Висновки. Результати наших досліджень свідчать про те, що старший вік, більша тривалість менопаузи, збільшення кількості коморбідностей (зокрема, серцево-судинних захворювань і надмірної маси тіла/ожиріння) та вищий індекс маси тіла є ключовими факторами, які сприяють зниженню якості сну цієї групи населення. Такі результати підкреслюють складний взаємозв'язок цих елементів і гостру потребу в комплексній оцінці та лікуванні порушень сну жінок у постменопаузальний період зі зменшеною мінеральною щільністю кісткової тканини.

Ключові слова: менопауза; мінеральна щільність кісткової тканини; остеопороз; вік; індекс маси тіла; ожиріння; супутні захворювання.

Introduction. Menopause, defined as the permanent cessation of menstruation, marks a significant physiological transition in a woman's life, characterized by a decline in ovarian function and fluctuating, then persistently low, levels of reproductive hormones, primarily estrogen and progesterone [1]. This hormonal shift is associated with a range of symptoms, including vasomotor symptoms like hot flashes and night sweats, mood disturbances (anxiety, depression), and musculoskeletal pain [2]. Sleep disturbances are among the most frequently reported complaints during the menopausal transition and in postmenopause, with prevalence rates ranging from 35 % to 60 % in postmenopausal women, significantly higher than in premenopausal women [3]. Untreated sleep disorders in this population carry substantial risks, including increased susceptibility to cardiovascular disease, diabetes, obesity, and impaired cognitive function [4, 5].

Studies indicate a high prevalence of poor sleep quality among postmenopausal women diagnosed with osteoporosis. For instance, one study found that 85.8 % of postmenopausal women with osteoporosis reported poor sleep quality [6]. While some research has shown a weak negative correlation between the duration of osteoporosis and sleep quality, direct associations between sleep quality and bone mineral density (BMD) have yielded conflicting results across studies [6, 7]. Some studies suggest that decreased sleep quality is associated with reduced BMD, while others report no significant relationship [7, 8]. However, a large study within the Women's Health Initiative found that short sleep duration (<5 hours/night) was associated with lower BMD and an increased risk of osteoporosis [9]. In China, with its large aging female population, understanding these health challenges is particularly crucial. Research indicates that sleep disturbances are highly prevalent among older adults in China, affecting nearly half of the elderly population [10]. Similarly, osteoporosis is a major public health concern in Chinese women, leading to increased fracture risk and impaired quality of life [11]. Emerging evidence suggests a complex relationship between sleep and bone health, with specific considerations for postmenopausal Chinese women.

The aim of our study was to analyze sleep quality indicators of Chinese postmenopausal women with osteopenia and osteoporosis and to identify factors influencing them.

The main part. The study included 80 postmenopausal women with diagnosed osteopenia and osteoporosis. In addition to the use of conventional examination methods, the structural and functional state of bone tissue and the degree of osteopenic changes were studied using a two-photon X-ray absorptiometer DPX-A (Lunag Co., USA). To detect changes in bone mineral density (BMD) in the lumbar spine, densitometry of the L1-L4 vertebrae was analyzed.

Anthropometric parameters (height, body weight, waist circumference) were measured and evaluated, and body mass index (BMI, kg/m^2) was calculated and interpreted according to WHO recommendations: normal body weight - 20.0–24.9 kg/m^2; overweight and obesity – 25.0 kg/m^2 and above.

To determine the quality of sleep we used a validated questionnaire and scales from officially available sources "Pittsburgh Sleep Quality Index (PSQI)" [12]. The main purpose of this tool is to assess the subjective quality of sleep and the occurrence of sleep disorders. The questionnaire consisted of 10 questions, which included 7 components: 1) subjective quality of sleep; 2) sleep latency; 3) sleep duration; 4) effectiveness of habitual sleep; 5) sleep disturbances; 6) use of sleeping pills; 7) daytime disturbances. Each component can be scored on a scale from 0 to 3, where 0 means very good quality and 3 means very poor quality. The maximum score of the instrument is 21 points; a score of >5

indicates that the patient has great difficulty with at least two components or moderate difficulty with more than three components, so the higher the score, the worse the quality of sleep. The internal consistency of the scales of the Pittsburgh Sleep Quality Index (PSQI) questionnaire was tested using Cronbach's α method. If the Cronbach's α coefficient is <0.5, the questionnaire is unreliable, if α≥0.5, the quality of the questionnaire is poor, α>0.6 – questionable, α>0.7 – sufficient; α>0.8 – good and α>0.9 – very good. In our study, the Cronbach's α coefficient for PSQI was α = 0.78.

The statistical analysis of the study results was carried out with the help of computer software using Microsoft Office Excel and Statistica 7.0.

The total assessment of the quality of sleep of postmenopausal women showed poor sleep quality in respondents with low bone mineral density, while the quality of sleep was significantly lower in women with

diagnosed osteoporosis compared to the group with osteopenia (p=0.034) (Table 1).

Table 1. **Total sleep quality index of postmenopausal women according to PSQI Score**

Indicator	Normal BMD	Osteopenia	Osteoporosis	p
Total number of points	3 (1; 7)	8 (5; 11)	12 (9; 16)	0.034*

Note. * – statistically significant difference.

The respondents were divided into subgroups according to the PSQI Score and BMD status (Fig.). It was found that in postmenopausal women with reduced BMD, those with poor sleep quality predominated, in particular, 32.8 % of those with diagnosed osteopenia and 77.3% of those with osteoporosis had poor sleep quality.
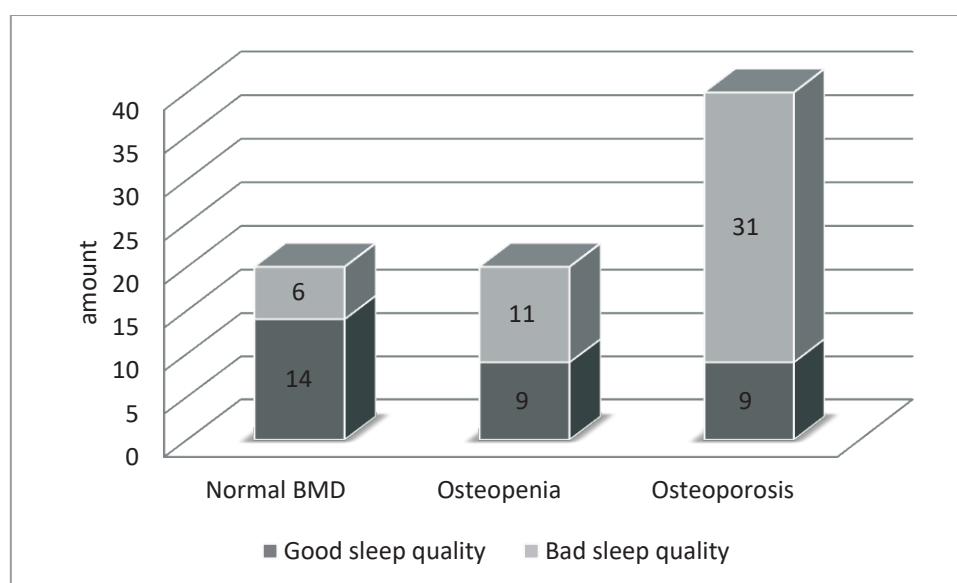

Fig. **Percentage of postmenopausal women with good and poor sleep quality depending on BMD.**

It was found that the quality of sleep is influenced by the age of patients (Table 2). Thus, the age of patients with poor sleep quality in women with osteopenia (by 9.87 %) and osteoporosis (by 10.71 %) was found to be significantly higher than in the group of patients with good sleep quality. It is worth noting that in postmenopausal women with normal BMD, the age of patients was almost the same with different sleep quality.

Table 2. **Dependence of sleep quality on the age of the respondents included in the study**

Indicator	Women with normal BMD (n=20)	Women with diagnosed osteopenia (n=20)	Women with diagnosed osteoporosis (n=40)
Good sleep quality	54.48 ± 3.16	56.36 ± 3.52	60.14 ± 2.97
Poor sleep quality	57.12 ± 4.98	61.92 ± 3.11	66.58 ± 4.61
p	p>0.05	p<0.05*	p<0.05*

Note. * – statistically significant difference.

Analysis of the duration of menopause showed that sleep quality deteriorates in women with reduced BMD, with worse sleep quality in osteoporosis (Table 3). Thus, the duration of menopause in patients with poor sleep quality with osteopenia (by 38.59 %) and osteoporosis (by 65.53 %) was found to be significantly longer than in the group of patients with good sleep quality. As women age and progress further into the postmenopausal period, hormonal changes (especially estrogen decline) become more pronounced, impacting both sleep architecture and bone metabolism [13]. The Study of Women's Health Across the Nation (SWAN) found that sleep quality and quantity decline as women transition through menopause [14]. This aligns with our data showing older age and longer menopausal duration correating with poorer sleep in women with osteopenia and osteoporosis.

Table 3. **Dependence of sleep quality on the duration of menopause among the respondents included in the study**

Indicator	Women with normal BMD (n=20)	Women with diagnosed osteopenia (n=20)	Women with diagnosed osteoporosis (n=40)
Good sleep quality	3.52 ± 2.11	5.96 ± 3.18	6.15 ± 2.25
Poor sleep quality	5.37 ± 3.09	8.26 ± 4.26	10.18 ± 3.74
p	p>0.05	p<0.05*	p<0.05*

Note. * – statistically significant difference.

Comorbidity analysis indicates the prevalence of poor sleep quality among women with diagnosed osteopenia and osteoporosis and 2 or more comorbidities (Table 4). At the same time, among women with osteopenia and osteoporosis and comorbidity (≥2), the percentage of patients with poor sleep quality was 10 % and 25 % higher, respectively. In the structure of comorbidity of patients with osteopenia and osteoporosis and poor sleep quality

(n=39), cardiovascular diseases (coronary heart disease (30.77 %) and arterial hypertension (43.59 %)) and overweight (48.72 %) prevailed. This suggests a complex interplay where multiple health issues collectively impair sleep. Specifically, cardiovascular diseases and obesity are frequently comorbid with both poor sleep and osteoporosis, creating a complex web of interconnected health issues [15]. Research suggests that systemic inflammation, often associated with these comorbidities, can negatively impact both sleep and bone health [16].

Given the high prevalence of overweight among the patient cohort, we found a significantly higher BMI in patients with poor sleep quality with osteoporosis (by 33.21 %) compared to the group of patients with good sleep quality (Table 5). It is worth noting that in patients with poor sleep quality and diagnosed osteopenia and osteoporosis, BMI was significantly higher than in women with normal BMI by 39.56 % and 72.79 %, respectively. This indicates that excess weight may be a significant contributor to sleep disturbances in women with compromised bone health. While obesity can sometimes lead to higher BMD due to increased mechanical loading, it also contributes to systemic inflammation and metabolic disturbances that can negatively affect sleep [17]. Studies have shown a correlation between higher BMI and worse sleep quality in postmenopausal women [18]. This suggests that while BMI's direct effect on BMD can be complex, its negative impact on sleep quality is clearer in this population.

Our findings highlight several key factors that negatively influence sleep quality in postmenopausal women with diminished bone health: advanced age, extended duration of menopause, increased comorbidity burden and higher body mass index. Our results emphasize the critical need for healthcare professionals to assess and address sleep quality as an integral part of managing postmenopausal women, especially those with osteopenia or osteoporosis.

Table 4. **Dependence of sleep quality on the number of comorbidities among postmenopausal women**

Indicator /number of comorbidities	Women with normal BMD (n=20)			Women with diagnosed osteopenia (n=20)			Women with diagnosed osteoporosis (n=40)		
	1	2	≥3	1	2	≥3	1	2	≥3
Good sleep quality	8 (40 %)	4 (20 %)	2 (10 %)	3 (15 %)	5 (25 %)	1 (5%)	5 (12,5 %)	4 (10 %)	0
Poor sleep quality	1 (5 %)	1 (5 %)	4 (5 %)	1 (5%)	7 (35 %)	3 (15 %)	2 (5 %)	19 (47.5 %)	10 (25 %)

Table 5. **Dependence of sleep quality on body mass index among respondents included in the study**

Indicator	Women with normal BMD (n=20)	Women with diagnosed osteopenia (n=20)	Women with diagnosed osteoporosis (n=40)
Good sleep quality	19.46 ± 2.24	22.31 ± 3.42	24.36 ± 2.11
Poor sleep quality	18.78 ± 3.12	26.21 ± 3.18	32.45 ± 3.47
p	p>0.05	p>0.05	p<0.05*

Note. * – statistically significant difference.

Conclusions. This study establishes a significant link between poor sleep quality and reduced bone mineral density in postmenopausal women, with sleep quality being particularly compromised in osteoporosis. Our findings indicate that advanced age, longer duration of menopause, increased comorbidity burden (notably cardiovascular issues and overweight/obesity), and higher BMI are key factors contributing to poor sleep in this population. These results emphasize the complex interplay of these elements and the critical need for comprehensive assessment and management of sleep disturbances in postmenopausal women with diminished bone health.

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