Fibromyalgia in China: sleep quality is related to symptoms, quality of life and especially mental health

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Abstract

Objective

To investigate sleep quality in patients with fibromyalgia (FM) and to analyse the effect of sleep on FM symptoms and quality of life.

Methods

Patients with FM and healthy subjects were recruited to assess their sleep quality, and patients were further assessed for pain, fatigue, depression, psychological stress and quality of life. The patients were divided into a sleep disorder group as measured by the Pittsburgh Sleep Quality Index (PSQI score >7 points) and a group without sleep disorders (PSQI score ≤7 points). Linear regression analysis was used to explore the effect of sleep quality on FM pain controlling for sex and age, and the effect of sleep quality on FM fatigue, depression, psychological stress and quality of life controlling for sex, age and pain.

Results

A *total of 450 patients and 50 healthy subjects participated in the study. The number of FM patients with sleep disorders was significantly higher than that of healthy subjects (90% vs. 14%, p≤0.001). In addition to the number of pain sites, the levels of pain, fatigue, depression, stress symptoms and quality of life were significantly impaired in FM patients with sleep disorders (p<0.05). In terms of the effects on quality of life assessed with the 36-item short-form health survey, the decrease in mental health was more substantial than the decrease in physical health (B=-12.10 vs. B=-5.40).*

Conclusion

Similar to FM patients in other countries and regions, a decrease in sleep quality is also the core symptom of FM patients in China and is significantly correlated with the severity of pain, fatigue, depression and stress symptoms and reduced quality of life, especially with regard to mental health, suggesting that the treatment of this disease should include sleep disorder interventions.

Key words

fibromyalgia, dyssomnias, symptom assessment, quality of life

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Introduction

Fibromyalgia (FM) is a chronic pain disease mainly characterised by tender points in specific body parts and generalised pain in the whole body. The disease has a broad spectrum of symptoms, often accompanied by a variety of non-specific symptoms such as sleep disorder, fatigue and a negative mood (1). The incidence rate is approximately 0.7%~9.3%, and the male to female ratio is 1:3 (2). As a consequence of this disease, the physical function and quality of life of patients is seriously affected. In Europe and the United States, the annual direct medical cost of each FM patient is as high as 5241 euros and 9573 dollars, respectively (3, 4), placing a great economic burden on medical systems.

Among the many non-specific symptoms, sleep disorder is one of the core symptoms of FM. Over 90% of FM patients have sleep disorders (5), manifesting as an abnormal sleep structure, with abnormal alpha wave activity on delta waves during slow-wave sleep (6), increased stage 1 non-rapid eye movement sleep (7), decreased slow-wave sleep (8), an increased number of awakenings, an increased number of limb movements, etc. (9). In 2010, the American College of Rheumatology (ACR) included sleep as 3 core non-specific symptoms in the Fibromyalgia Severity Scale of the new FM classification (10) and extended its inclusion to the subsequent 2011 (11) and 2016 (12) updates of the classification criteria.

The decline in sleep quality is closely related to the pathogenesis of FM. In 2015, a prospective study of 1599 normal people in Sweden showed that the long-term existence of sleep disorder can predict the appearance of pain in multiple parts of the body after 5 years and that good sleep quality can also predict the relief of pain in multiple parts of the body after 5 years (13). In a 10-year follow-up of 12,350 non-FM women by Mork *et al.*, a dose-dependent association was found between sleep problems and risk of FM among women who reported having sleep problems often or always, compared to women who never experienced sleep problems (14). This confirms that the severity of sleep disorder is positively correlated with the risk of FM.

Sleep disorder also affects the number of core symptoms, severity of symptoms, and quality of life of patients with FM. Sleep disorder is significantly related to the degree of anxiety and depression, but there is no unified conclusion about the correlation with pain and fatigue. Andrade (15) evaluated the sleep quality of 326 FM patients, and information was collected on whether the patients had symptoms such as generalised diffuse pain, memory loss, low mood, excessive anxiety, and concentration disorders. The results showed that the level of sleep quality was negatively associated with the number of FM symptoms. Another study (16) investigated the relationship between sleep quality and pain, depression, fatigue, and overall FM severity (assessed using the FIQ total score, including patient symptom severity, physical function, and overall impact of the disease). The results showed that sleep quality had a significant negative impact on depression and overall FM severity in patients with FM but had no impact on pain and fatigue. A Turkish study evaluated the relationship between sleep quality and overall FM severity in FM patients and found a significant positive correlation between the 2, with poorer sleep quality associated with greater impacts on physical function, overall symptoms, and the disease (17). Singh compared the sleep quality and quality of life of FM patients and healthy people and found that the sleep quality of FM patients was significantly reduced, seriously affecting the patients' quality of life (18). This is consistent with Alice Theadom's findings (19).

The aim of this study was to investigate the level of sleep quality in patients with FM and to analyse the correlation between sleep quality and core symptoms of FM, including pain, fatigue, depression, psychological stress and overall FM severity, and quality of life, to strengthen clinicians' understanding of FM patients with sleep disorders, to better grasp the sleep characteristics of FM patients, and to develop ideas for the treatment of and future research on this disease.

Materials and methods

Subjects

Patients with FM who met the 1990 (20), 2011 (11) or 2016 (12) American College of Rheumatology (ACR) diagnostic/classification criteria and sex- and age-matched healthy subjects were recruited from the outpatient department of Guang'anmen Hospital (a tertiary research hospital in Beijing, China) from October 2018 to December 2021. The study was approved by the Ethics Committee of Guang'anmen Hospital (ethics no. 2018-059-KY). All recruited participants signed a written informed consent form.

Methods

A cross-sectional survey design was used. After they were informed of the purpose of the study and provided consent, participants were asked to fill out a set of questionnaires, which took about 15 minutes. The survey was divided into 3 sections. The first part was the diagnostic section, which included name, sex, age, duration of FM-related symptoms, and 1990, 2011 and 2016 ACR classification/diagnostic criteria. Doctors checked tenderness points (TPC) and filled out the 2016 diagnostic criteria. Patients completed a diagnostic criteria survey (2011 edition) by themselves. Then, patients who met the criteria completed the remaining sections. In the second part, patients' basic demographic information was collected, including smoking history, drinking history, marital status, work status and education level. The last part consisted of multiple scales to assess sleep, pain, fatigue, depression, perceived stress, overall FM severity and quality of life.

Sleep quality evaluation

The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality (21); the index contains 19 self-rated questions that measure 7 components of sleep quality: (1) subjective sleep quality, (2) sleep latency, (3) sleep duration, (4) habitual sleep efficiency, (5) sleep disturbances, (6) use of sleep medication, and (7) daytime dysfunction. Each part is scored from 0 to 3 (total of 21 points), with higher scores indicating lower sleep quality. According to a reliability and validity study of the PSQI in China, a total score greater than 7 indicates sleep disorder (22).

Pain evaluation

The WPI score was used to assess the number of pain areas and where the patient experienced pain in the past week (19 pain sites in 5 areas, *i.e.* left upper limb, left lower limb, right upper limb, right lower limb, and trunk). The score ranges from 0 to 19 points (11).

The pain visual analogue scale (pain VAS) score was used to evaluate the level of pain. The pain VAS is a linear scale from "0" to "10", representing no pain to unbearably severe pain, respectively. Patients are asked to mark the corresponding position on the scale to represent their pain level, which is the VAS score (23).

Depression evaluation

Depression was measured using the Beck Depression Inventory-II (BDI-II). The BDI-II consists of 13 groups of statements describing symptoms of depression. Patients are surveyed about their mood in the past week. Each question is scored on a scale from 0 to 3, and the overall score ranges from 0 to 39, with higher scores indicating more severe depression (24). The scale has good reliability and validity for the Chinese population (25).

Perceived stress evaluation

The Perceived Stress scale (PSS) is used to measure stress in a person's life. Patients are asked to respond considering their personal feelings in the past month. The scale contains a total of 14 items, and the score ranges from 0 to 56, with higher scores indicating higher perceived stress (26). The scale has satisfactory psychometric properties in China (27).

Fatigue evaluation

The Multidimensional Fatigue Scale (MFI) was used to evaluate the degree of fatigue. The questionnaire contains the following 5 subscales: general fatigue, physical fatigue, mental fatigue, reduced activity, and reduced motivation (28). Each subscale consists of 4 questions, with scores ranging from 4 to 20 and higher scores indicating higher levels of fatigue (28). The scale has good reliability and validity for the Chinese population (29).

Overall FM severity evaluation

The revised fibromyalgia impact questionnaire (FIQR) is an internationally recognised 21-item self-administered questionnaire for the overall assessment of FM severity and includes 3 subscales: function, overall effects and symptoms (30). The total FIQR score ranges from 0 to 100, with higher scores indicating more severe fibromyalgia-related symptoms (30). This questionnaire has been validated in Chinese patients with fibromyalgia (31).

Quality of life evaluation

The 36 item Short-Form health survey (SF-36) includes 36 items to evaluate health-related quality of life. It has 8 dimensions: physiological function, physical function, physical pain, general health, vitality, social function, emotional function, and mental health (32). The average value of physical function, physical function, physical pain and general health status serves as the physical component score (PCS), and the average value of vitality status, social function, emotional function and mental health serves as the mental component score (MCS). Each score for dimension ranges from 0 to 100 points, with higher scores indicating better quality of life (32). The Chinese version of the SF-36 showed good internal consistency, test-retest reliability and high validity in 2002 (33).

Statistical analysis

SPSS© version 25.0 was used for the statistical analysis. Continuous data are expressed as the mean and standard deviation (SD), and categorical data are expressed as the frequency (percentage). The normality of the distribution of the data was determined using the Kolmogorov-Smirnov test. The Mann-Whitney U-test and Student's t-test were used for continuous data, and the χ^2 test was used for categorical data. For the regression analysis, the patients were divided into a sleep

Table I. Comparison of PSQI scores between FM patients and healthy controls.

PSQI	FM (n=450)	HC (n=50)	*p*-value
Subjective sleep quality	1.9 (0.8)	0.7 (0.7)	**<0.001**
Sleep latency	1.8 (1.1)	0.8 (0.9)	**<0.001**
Sleep duration	1.4 (1.0)	0.6 (1.0)	**<0.001**
Habitual sleep efficiency	2.3 (0.5)	0.4 (0.9)	**<0.001**
Sleep disturbances	1.8 (0.7)	0.8 (0.6)	**<0.001**
Use of sleep medication	0.5 (1.0)	0.0 (0.0)	**<0.001**
Daytime dysfunction	2.4 (0.8)	1.0 (0.8)	**<0.001**
Total score	12.1 (3.5)	4.2 (3.7)	**<0.001**

PSQI: Pittsburgh Sleep Quality Index; FM: fibromyalgia; HC: healthy controls.
Numerical variables are shown as the mean (standard deviation).

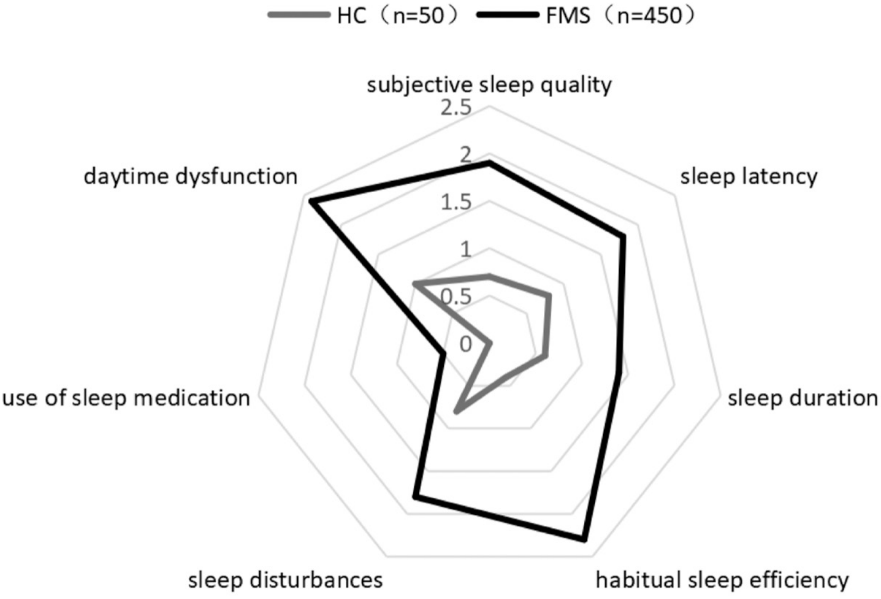

Fig. 1. Radar map of PSQI scores for FM patients and healthy controls.

Table II. Somnific medications of 83 FM patients.

Somnific medications	Patients, n (%)	Daily dose
Benzodiazepines		
Lorazepam	22 (26.5)	0.25-3 mg
Estazolam	8 (9.6)	1/2 mg
Clonazepam	6 (7.2)	2 mg
Oxazepam	4 (4.8)	15 mg
Alprazolam	1 (1.2)	0.4 mg
Chinese patent medicine for sleeping	19 (22.9)	5-10 g
Ciclopironones: zopiclone	17 (20.5)	3.75/7.5 mg
Other		
Zolpidem tartrate	4 (4.8)	10 mg
Olanzapine	2 (2.4)	2.5 mg

FM: fibromyalgia syndrome.

disorder group (PSQI score ≤7) and non-sleep disorder group (PSQI score ≤7). Because it has been reported that age (34), sex (35) and pain (36) have an impact on the symptoms and quality of life of FM patients, linear regression analysis was conducted after adjusting for age, sex and pain (pain VAS). When exploring the effect of sleep quality on FM pain, the analysis was conducted after adjusting for sex and age, and when exploring the effect of sleep quality on symptom severity and quality of life, except for pain, analysis was conducted after adjusting for sex, age and pain. The results are reported as the regression coefficient (B) with 95% confidence interval (95% CI). *p*-values <0.05 were considered statistically significant. Because each of the 8 dimensions of the SF-36 has the same score range, B values were used to compare the magnitude of impact of each dimension. A radar map was used to represent sleep characteristics more visually, the further coordinates were from the centre, the higher was the corresponding score.

Results

Impaired sleep quality in FM patients

A total of 450 FM patients and 50 healthy controls (HC) participated in the survey. The average age of FM patients was 48.6 (SD: 12.5) years (range: 12–79 years), the male to female ratio was 1:6.1 (63:387), the average body mass index (BMI) was 23.2 (SD: 3.0) kg/m^2 (range: 15.2–34.4 kg/m^2), the mean disease duration was 57.7 (SD: 80.9) months (range 3–480 months), and the TPC was 12.5 (SD: 4.2). The average age of HCs was 48.5 (SD: 14.4) years, there were 43 females and 7 males, the male to female ratio was approximately 1:6.1, the average BMI was 23.7 (SD: 2.7) kg/m^2, and the TPC was 1.8 (SD: 2.4). There were no significant differences in age, sex or BMI between FM patients and HC, and the 2 groups were comparable.

Ninety percent of FM patients had sleep disorders (405/450), a significantly higher percentage than the 14% (7/50) of HC ($p<0.001$). A comparison of sleep quality between FM patients and HC is shown in Table I. Compared with those for HC, the total PSQI score and scores for each dimension of the PSQI for FM patients were significantly higher ($p<0.001$), suggesting that compared with HC, FM patients had significant decreases in various aspects of subjective sleep quality. The 3 dimensions with the highest PSQI scores for FM patients were habitual sleep efficiency, daytime dysfunction, and subjective sleep quality, indicating that these 3 dimensions were the most severely disrupted.

Table III. Comparison of demographic characteristics of FM patients with and without sleep disorders.

Characteristics	With sleep disorders (n=405), M (SD) or patients (n %)	Without sleep disorders (n=45), M (SD) or patients (n %)	*p*-value
Age, years	49.0 (12.5)	45.6 (12.2)	0.07
BMI, kg/m^2	23.3 (3.1)	22.8 (2.5)	0.27
Disease duration, month	56.6 (77.9)	68.1 (104.2)	0.82
TPC	12.5 (4.1)	12.1 (4.4)	0.48
Sex, female	350 (86.4%)	37 (82.2%)	0.44
History of smoking (yes)	32 (7.4%)	3 (6.7%)	0.69
History of drinking (yes)	25 (5.5%)	0 (0.0%)	0.27
Marital status			0.82
Unmarried	37 (9.2%)	6 (13.6%)	
Married	334 (83.1%)	35 (79.5%)	
Divorced	22 (5.5%)	2 (4.5%)	
Death of spouse	9 (2.2%)	1 (2.3%)	
Employment			0.47
Employed	170 (42.3%)	23 (52.3%)	
Retired	156 (38.8%)	12 (27.3%)	
Homemaker	42 (10.4%)	3 (6.8%)	
Unemployed	33 (8.2%)	6 (13.6%)	
Education level			
<9th grade	96 (23.8%)	5 (11.1%)	0.11
High school	100 (24.9%)	11 (25.0%)	
College and more	205 (51.0%)	29 (65.9%)	

BMI: body mass index; TPC: number of tenderness points; M (SD): mean (standard deviation); BMI: body mass index.

Table IV. Comparison of core symptoms between FM patients with and without sleep disorders.

	With sleep disorders (n=405), M (SD)	Without sleep disorders (n=45), M (SD)	B	95% CI	*p*-value*
WPI score	11.6 (4.5)	10.6 (4.6)	0.14	(-1.21,1.49)	0.84
Pain VAS score	5.9 (1.9)	5.1 (1.7)	0.70	(0.10,1.30)	**0.022**
BDI score	8.9 (6.4)	5.1 (4.9)	3.21	(1.37,5.06)	**0.001**
PSS score	27.3 (8.7)	20.2 (9.1)	6.14	(3.47,8.81)	**<0.001**
MFI score					
General fatigue	16.3 (3.5)	14.8 (3.3)	1.25	(0.34,2.16)	**0.007**
Physical fatigue	15.2 (3.0)	12.0 (4.5)	2.60	(1.51,3.68)	**<0.001**
Mental fatigue	14.2 (3.9)	10.8 (5.0)	2.89	(1.52,4.26)	**<0.001**
Reduced activity	13.7 (3.6)	11.6 (4.4)	1.55	(0.27,2.82)	**0.017**
Reduced motivation	12.4 (3.7)	10.5 (3.7)	1.24	(-0.04,2.51)	0.06
FIQR total score	47.0 (20.3)	28.4 (19.9)	15.01	(9.09,20.92)	**<0.001**

B: regression coefficient; 95% CI: 95% confidence interval; M (SD): mean (standard deviation); WPI: Widespread Pain Index; VAS: visual analogue scale; BDI: Beck Depression Inventory; PSS: Perceived Stress Scale; MFI: Multidimensional Fatigue Scale; FIQR: Revised Fibromyalgia Impact Questionnaire.
*The effect of sleep on symptoms, controlling for sex, age and pain VAS or excluding pain VAS and only adjusting for sex and age.

A more intuitive comparison of sleep scores for FM patients and HC for various dimensions is shown in Fig. 1. The scores for FM patients on 3 dimensions, *i.e.* daytime dysfunction, habitual sleep efficiency, and subjective sleep quality, were much higher than those for HC, and the scores for use of sleep medication and sleep duration were less different from those for HC.

The use of somnific medications in patients with sleep disorders

Among 405 patients with sleep disorders, 83 (20.5%) patients had taken medicine for their sleep disturbances at least once a week in the past one month when evaluated as outpatients. The most commonly used medication was benzodiazepines (41/83, 49.4%), followed by Chinese patent medicine (19/83, 22.9%) and zopiclone (17/83, 20.5%). The somnific medications used by these 83 patients are shown in Table II.

Correlation between sleep disorders and core symptoms of FM and quality of life

A comparison of the demographics of FM patients with and without sleep disorders is shown in Table III. There were no significant differences in age, BMI, disease duration, TPC, sex, smoking history, drinking history, marital status, work status, and education level between the 2 groups, and the 2 groups were comparable.

A comparison of core symptoms in FM patients with sleep disorders and in those without sleep disorders is shown in Table IV. After adjusting for age and sex, sleep disorders had a negative effect on pain VAS ($p<0.05$). After further adjustment for pain VAS score, except for the WPI score ($p=0.84$), depression, stress perception, fatigue and overall FM impact were significantly more severe in FM patients with sleep disorders than in those without sleep disorders, and there was a positive correlation ($B>0$, $p<0.05$).

A comparison of the quality of life of FM patients with sleep disorders and those without sleep disorders is shown in Table V. After adjusting for the effects of age, sex and pain level, except for the 3 dimensions of physical function, physiological function, and general health, the PCS and MCS scores of the SF-36 as well as other dimensions for FM patients were higher than those for patients without sleep disorders ($p<0.05$), and all had negative correlations ($B<0$). Among them, the impact on the emotional function dimension score was the most significant ($B=-18.49$), and the negative impact on MCS ($B=-12.10$) was more substantial than the impact on PCS ($B=-5.40$) ($p<0.001$).

Comparison of sleep quality, core symptoms and quality of life in patients with and without somnific medications among 405 patients with sleep disorders

Comparisons of patients who took somnific medications or not on FM core symptoms and quality of life are presented in Table VI. Those patients who took somnific medications were likely to have worse sleep quality with higher scores in subjective sleep quality, sleep latency, sleep duration dimensions (p=0.000), and likely to experience more severe pain (p=0.005) and depression (p=0.003), and greater overall impact of disease (p=0.049) compared to the patients who did not take somnific medications. The physical pain and social function of patients who took somnific medications was affected significantly more than that of patients who did not take somnific medications, with lower SF-36 physical pain and social function subscale scores (p=0.004 and p=0.002, respectively).

Table V. Quality of life of FM patients with and without sleep disorders.

SF-36 score	With sleep disorders (n=405), m(SD)	Without sleep disorders (n=45), m(SD)	B	95% CI	*p*-value*
Physical function	59.7 (25.6)	66.8 (27.0)	-3.33	(-11.03, 4.36)	0.40
Physiological function	15.8 (31)	27 (36.9)	-9.18	(-18.96, 0.61)	0.07
Physical pain	39.6 (18.1)	49.2 (16.9)	-5.56	(-10.12, -1.00)	**0.017**
General health	30.6 (18.1)	35.8 (17.9)	-3.70	(-9.26, 1.85)	0.19
Vitality	40.6 (15.1)	50.5 (16.8)	-9.62	(-14.38, -4.86)	**<0.001**
Social function	57.2 (20.0)	70.5 (21.9)	-11.22	(-18.46, -3.98)	**0.002**
Emotional function	40.6 (43.4)	60.2 (46.3)	-18.49	(-32.13, -4.84)	**0.008**
Mental health	41.8 (19.8)	50.9 (21.9)	-9.08	(-15.17, -3.00)	**0.004**
Physical component summary	36.4 (16.6)	44.7 (16.9)	-5.40	(-10.19, -0.61)	**0.027**
Mental component summary	48.2 (19.6)	61.1 (21.5)	-12.10	(-18.06, -6.15)	**<0.001**

SF-36: Quality of Life Scale; m(SD): mean (standard deviation); B: regression coefficient; 95% CI: 95% confidence interval.
*Effect of sleep on quality of life, controlling for sex, age and pain VAS.

Table VI. Sleep quality, core symptoms and quality of life of patients who did and did not take somnific medications among 405 patients with sleep disorders.

	Patients who took somnific medications (n=83), M (SD)	Patients who did not take somnific medications (n=322), M (SD)	*p*-value
PSQI Total score	16.1 ± 2.6	11.9 ± 2.5	**0.000**
Subjective sleep quality	2.4 ± 0.7	1.9 ± 0.8	**0.000**
Sleep latency	2.4 ± 0.9	1.9 ± 1.0	**0.000**
Sleep duration	1.9 ± 1.2	1.4 ± 1.0	**0.000**
Habitual sleep efficiency	2.2 ± 0.5	2.3 ± 0.5	0.41
Sleep disturbances	2.0 ± 0.7	1.9 ± 0.6	0.14
Daytime dysfunction	2.6 ± 0.7	2.5 ± 0.7	0.21
WPI score	12.0 ± 4.4	11.5 ± 4.5	0.38
Pain VAS score	6.4 ± 1.9	5.7 ± 1.9	**0.005**
BDI score	10.8 ± 7.1	8.4 ± 6.1	**0.003**
PSS score	28.1 ± 9.0	27.1 ± 8.7	0.38
MFI score	66.7 ± 15.8	65.2 ± 16.9	0.51
FIQR total score	50.9 ± 21.1	46.0 ± 20.0	**0.049**
SF-36			
Physical function	58.7 ± 23.9	60.0 ± 26.1	0.68
Physiological function	12.0 ± 27.1	16.8 ± 31.9	0.20
Physical pain	34.6 ± 18.4	40.9 ± 17.8	**0.004**
General health	28.7 ± 18.0	31.1 ± 18.2	0.29
Vitality	39.7 ± 14.4	40.8 ± 15.3	0.53
Social function	49.5 ± 26.6	59.2 ± 24.3	**0.002**
Emotional function	37.5 ± 41.5	41.4 ± 43.9	0.46
Mental health	40.3 ± 20.8	42.2 ± 19.6	0.45
Physical component summary	33.5 ± 16.0	37.2 ± 16.7	0.07
Mental component summary	44.9 ± 20.6	49.0 ± 19.2	0.08

M (SD): mean (standard deviation); PSQI: Pittsburgh Sleep Quality Index; WPI: Widespread Pain Index; VAS: visual analogue scale; BDI: Beck Depression Inventory; PSS: Perceived Stress Scale; MFI: Multidimensional Fatigue Scale; FIQR: Revised Fibromyalgia Impact Questionnaire; SF-36: Quality of Life Scale.

Discussion

In this cross-sectional study of 450 FM patients, 90% of the patients had sleep disorders, and FM patients, compared with healthy individuals, reported significant impairment in subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, and daytime dysfunction. The use of sleep medication was also significantly higher among FM patients than among HC. One-fifth of patients with sleep disorders took somnific medications, and the most frequently used drugs were benzodiazepines, including Lorazepam, Estazolam, Clonazepam, Oxazepam, and Alprazolam, followed by Chinese patent medicines, and zopiclone. The severity of sleep disorders in FM patients was significantly positively correlated with physical function, pain, depression, stress perception, and fatigue symptoms but had no effect on the diffuseness of pain (assessed by the WPI). The severity of sleep disorders more significantly negatively affected mental health than physical health but had not yet had an effect on physical function, physiological function, and general health. Moreover, patients who took somnific medications even had worse sleep quality, and more likely to experience more severe pain and depression, as well as greater overall impact of the disease and poorer social functioning. These results help to enhance clinicians' understanding of the characteristics of sleep disorders in FM patients and their correlation with symptom severity and quality of life, thereby facilitating the development of treatment protocols and research ideas for this disease.

In this study, 90% of FM patients had sleep disorders, mainly manifesting as daytime dysfunction, decreased sleep efficiency and decreased sleep quality, suggesting that sleep disorders in FM patients are prominent and common. However, the shortening of sleep time and the use of sleep medications were not as high as expected. In previous studies (37), the total PSQI scores for FM patients ranged from 5.2 to 15.5; the score of 12.1 in this study was in the upper-middle part of that range, similar to the results of studies in Spain (11.6±3.7 points) (38), and Brazil (12) (10–16) points) (39). In this study, the PSQI scores for FM patients were high in 3 dimensions: daytime dysfunction (mean: 2.4), sleep efficiency (mean: 2.3) and sleep quality (mean: 1.9), and the scores for 2 dimensions, *i.e.* sleep time (mean: 1.4) and use of sleep medications (mean: 0.5), were low, suggesting that the sleep problems experienced by FM patients were mainly due to inefficient sleep, decreased sleep quality, and daytime dysfunction resulting from sleep problems rather than shortened sleep time and the use of sleep medications. This result is consistent with previous findings that sleep disorders in FM patients are characterised by severe nonrestorative features (5). Therefore, the practice of simply prolonging sleep time to obtain better quality sleep is not advisable for FM patients and may not only fail to compensate for sleep but also aggravate fatigue (40). In addition, although the "use of sleep medications" dimension score in this study was significantly higher for FM patients than for HCs, the score was the lowest among all dimension scores (mean: 0.5 points), indicating that FM patients did not use sleep medications frequently. Similar results were reported for the Osorio CD study, which also found that the more prominent sleep problems in FM patients were prolonged sleep onset, sleep disorder, and daytime dysfunction and that the use of sleep medications was comparable to that of healthy individuals (39).

The use of sleep medications was lower than expected, may be related to the suboptimal efficacy of sleep medications in the treatment of sleep disorders in patients with FM (5) and may also be related to concerns about the side effects of sleep medications in FM patients (5).

In this study, in addition to having no effect on the number of somatic pain sites, sleep disorder was associated with pain level, fatigue, depression, stress perception symptoms, and overall FM impact in FM patients. The more severe the sleep disorder, the more severe were the above symptoms and overall FM impact. Previous studies have demonstrated the relationship between sleep quality and FM symptoms. For example, sleep quality in FM patients can predict pain levels the next day (41), and reduced sleep quality can lead to increased sensitivity to pain (42); however, there are also studies (16) that showed that sleep quality in FM patients was not associated with pain. In this study, although sleep disorder was related to the degree of physical pain in patients, it was not related to the number of pain sites. This phenomenon deserves further study. Sleep has a powerful recovery-enhancing effect, sleep disorder is a determining factor in fatigue, and improving sleep is likely to have a beneficial effect on reducing fatigue, a common symptom of chronic musculoskeletal disorders (43). This study also found a positive relationship between sleep quality and depression, a finding that is consistent with the results reported by Ulus *et al.* (16), suggesting that sleep contributes to maintaining emotional well-being. Similar to previous research (16, 17), this study further supports the correlation between sleep quality and the overall impact of FM on patients: the worse the sleep quality, the more severe the physical function, overall symptoms, and overall impact of the disease in patients with FM.

The severity of sleep disorders affects many core symptoms of FM, in turn adversely affecting quality of life, especially mental health. When rheumatic diseases, such as rheumatoid arthritis and Sjögren's syndrome, are accompanied by FM, physical pain is aggravated, and quality of life is further reduced (44). Thus, pain is also a major factor affecting quality of life. Therefore, after correcting for age and sex, this study also corrected for pain and found that sleep disorders still have a very prominent impact on quality of life, a result that is consistent with previous research findings that sleep quality is an independent risk factor for the physical and mental health of FM patients (45). This study found that sleep quality had the greatest impact on emotional function and had a greater impact on mental health than on physical health, a finding that is consistent with the results of Strombeck's study (44). This may be because sleep is crucial in mental health and because the inability to get enough sleep weakens an individual's resilience, which changes the individual's ability to cope with stress and various negative events that occur in the outside world (46). The emotional impact of sleep increases over time, and continuous sleep deprivation can lead to a gradual deterioration in mood. Sleep problems in FM patients can eventually lead to depression (47). Therefore, the substantial impact of sleep on the mental state and mood of FM patients should not be underestimated, and sufficient attention should also be paid to the mental and emotional state of patients with sleep disorders. The finding that patients who took somnific medications still suffered from sleep problem and worse body pain, as well as worse depression, thus, were more affected by the FM as a whole. We could infer that the sleep quality of these patients was no worse than the others who also had sleep disorders for which they took somnific medications that did not improve their sleep, especially subjective sleep quality, sleep latency, and sleep duration. This might indicate that the current commonly used sleep medications are likely to be effective only in habitual sleep efficiency, sleep disturbances and daytime dysfunction. More targeted sleep treatment programmes are needed.

The study has some limitations. First, the cross-sectional design makes it impossible to judge a causal relationship between sleep and other symptoms. In addition, sleep quality was assessed by self-report. This reporting style is subjective. In this study, only the PSQI scale was used to assess sleep quality, but the PSQI is a very mature, internationally recognised, and widely used self-measurement tool for assessing sleep quality. It has been translated and widely used in many countries for sleep-related cross-sectional surveys (48). In future studies, sleep diaries may be used (49) together with sleep actigraphy or objective sleep measures to jointly assess patient sleep quality.

Because there is currently no satisfactory and effective treatment for FM, sleep is an important factor affecting the main symptoms and quality of life of patients. Clinicians should pay attention to the predictive role of sleep quality on other core symptoms of FM and determine the need for interventions for sleep disorders in FM patients. By improving the quality of sleep, the vicious cycle of the mutual influence between symptoms can be broken to promote improvements in the overall symptoms of FM patients. In the future, interventions that include approaches for improving sleep disorders can be investigated as measures to treat FM patients.

References

1. SARZI-PUTTINI P, GIORGI V, MAROTTO D, ATZENI F: Fibromyalgia: An update on clinical characteristics, aetiopathogenesis and treatment. *Nat Rev Rheumatol* 2020; 16(11): 645-60. https://doi.org/10.1038/s41584-020-00506-w
2. SIRACUSA R, PAOLA RD, CUZZOCREA S, IMPELLIZZERI D: Fibromyalgia: pathogenesis, mechanisms, diagnosis and treatment options update. *Int J Mol Sci* 2021; 22(8): 3891. https://doi.org/10.3390/ijms22083891
3. BOONEN A, VAN DEN HEUVEL R, VAN TUBERGEN A *et al.*:Large differences in cost of illness and wellbeing between patients with fibromyalgia, chronic low back pain, or ankylosing spondylitis. *Ann Rheum Dis* 2005; 64(3): 396-402. https://doi.org/10.1136/ard.2003.019711
4. BERGER A, DUKES E, MARTIN S, EDELSBERG J, OSTER G: Characteristics and healthcare costs of patients with fibromyalgia syndrome. *Int J Clin Pract* 2007; 61(9): 1498-508. https://doi.org/10.1111/j.1742-1241.2007.01480.x
5. ROIZENBLATT S, NETO NSR, TUFIK S: Sleep disorders and fibromyalgia. *Curr Pain Headache Rep* 2011; 15(5): 347-57. https://doi.org/10.1007/s11916-011-0213-3
6. HAURI P, HAWKINS DR: Alpha-delta sleep. *Electroencephalogr Clin Neurophysiol* 1973; 34(3): 233-7. https://doi.org/10.1016/0013-4694(73)90250-2
7. WU Y, CHANG L, LEE H, FANG S, TSAI P: Sleep disturbances in fibromyalgia: A meta-analysis of case-control studies. *J Psychosom Res* 2017; 96: 89-97. https://doi.org/10.1016/j.jpsychores.2017.03.011
8. SARZI-PUTTINI P, RIZZI M, ANDREOLI A *et al.*: Hypersomnolence in fibromyalgia syndrome. *Clin Exp Rheumatol* 2002; 20(1): 69-72.
9. BESTEIRO GONZÁLEZ JL, SUÁREZ FERNÁNDEZ TV, ARBOLEYA RODRÍGUEZ L, MUÑIZ J, LEMOS GIRÁLDEZ S, ALVAREZ FERNÁNDEZ A: Sleep architecture in patients with fibromyalgia. *Psicothema* 2011; 3(23):3 68-73.
10. WOLFE F, CLAUW DJ, FITZCHARLES MA *et al.*: The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care Res* (Hoboken) 2010; 62(5): 600-10. https://doi.org/10.1002/acr.20140
11. WOLFE F, CLAUW DJ, FITZCHARLES MA *et al.*: Fibromyalgia criteria and severity scales for clinical and epidemiological studies: a modification of the ACR Preliminary Diagnostic Criteria for Fibromyalgia. *J Rheumatol* 2011; 38(6): 1113-22. https://doi.org/10.3899/jrheum.100594
12. WOLFE F, CLAUW DJ, FITZCHARLES M *et al.*: 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. *Semin Arthritis Rheum* 2016; 46(3): 319-29. https://doi.org/10.1016/j.semarthrit.2016.08.012
13. AILI K, NYMAN T, SVARTENGREN M, HILLERT L: Sleep as a predictive factor for the onset and resolution of multi-site pain: A 5-year prospective study. *Eur J Pain* 2015; 19(3): 341-9. https://doi.org/10.1002/ejp.552
14. MORK PJ, NILSEN TIL: Sleep problems and risk of fibromyalgia: longitudinal data on an adult female population in Norway. *Arthritis Rheum* 2012; 64(1): 281-4. https://doi.org/10.1002/art.33346
15. ANDRADE A, VILARINO GT, SIECZKOWSKA SM, COIMBRA DR, BEVILACQUA GG, STEFFENS RDAK: The relationship between sleep quality and fibromyalgia symptoms. *J Health Psychol* 2020; 25(9): 1176-86. https://doi.org/10.1177/1359105317751615
16. ULUS Y, AKYOL Y, TANDER B, DURMUS D, BILGICI A, KURU O: Sleep quality in fibromyalgia and rheumatoid arthritis: Associations with pain, fatigue, depression, and disease activity. *Clin Exp Rheumatol* 2011; 29 (Suppl. 69): S92-6.
17. BOLUKBAS Y, CELIK B: Assessment of sleep quality in fibromyalgia syndrome and its effect on postural balance and functional status. *J Back Musculoskelet* 2021; 34(2): 235-42. https://doi.org/10.3233/BMR-181320
18. SINGH R, RAI NK, RASTOGI A, ENDUKURU C, JOSHI A, MISHRA SS: Impact of sleep disturbances and autonomic dysfunction on the quality of life of patients with fibromyalgia. *J Basic Clin Physiol Pharmacol* 2021; 32(6): 1021-9. https://doi.org/10.1515/jbcpp-2020-0007
19. THEADOM A, CROPLEY M, HUMPHREY K: Exploring the role of sleep and coping in quality of life in fibromyalgia. *J Psychosom Res* 2007; 62(2): 145-51. https://doi.org/10.1016/j.jpsychores.2006.09.013
20. WOLFE F, SMYTHE HA, YUNUS MB *et al.*:The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Report of the Multicenter Criteria Committee. *Arthritis Rheum* 1990; 33(2): 160-72. https://doi.org/10.1002/art.1780330203
21. POPEVIĆ MB, MILOVANOVIĆ APS, MILOVANOVIĆ S, NAGORNI-OBRADOVIĆ L, NEŠIĆ D, VELAGA M: Reliability and validity of the pittsburgh sleep quality Index-Serbian translation. *Eval Health Prof* 2018; 41(1): 67-81. https://doi.org/10.1177/0163278716678906
22. LIU X, TANG M, HU L *et al.*: Reliability and validity study of the Pittsburgh sleep quality index. *Chin J Psychiatry* 1996; 2:103-7.
23. HUSKISSON E: Measurement of pain. *Lancet* 1974; 2(7889): 1127-31. https://doi.org/10.1016/s0140-6736(74)90884-8
24. RICHTER P, WERNER J, HEERLEIN A, KRAUS A, SAUER H: On the validity of the Beck Depression inventory: A review. *Psychopathology* 1998; 31(3): 160-8. https://doi.org/10.1159/000066239
25. WANG Z, YUAN C, HUANG J *et al.*: Reliability and validity of the Chinese version of the Beck depression inventory (2nd edition) in patients with depression. *Chin J Mental H* 2011; 25(06): 476-80. https://doi.org/10.3969/j.issn.1000-6729.2011.06.014
26. NIELSEN MG, ØRNBØL E, VESTERGAARD M *et al.*: The construct validity of the Perceived Stress Scale. *J Psychosom Res* 2016; 84: 22-30. https://doi.org/10.1016/j.jpsychores.2016.03.009
27. HUANG F, WANG H, WANG Z *et al.*: Psychometric properties of the perceived stress scale in a community sample of Chinese. *BMC Psychiatry* 2020; 20(1): 130. https://doi.org/10.1186/s12888-020-02520-4
28. SMETS EMA, GARSSEN B, BONKE B, DE HAES JCJM: The multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to assess fatigue. *J Psychosom Res* 1995; 39(3): 315-25. https://doi.org/10.1016/0022-3999(94)00125-O
29. CHUANG LL, CHUANG YF, HSU MJ, HUANG YZ, WONG A, CHANG YJ: Validity and reliability of the Traditional Chinese version of the Multidimensional Fatigue Inventory in general population. *Plos One* 2018; 13(5): e0189850. https://doi.org/10.1371/journal.pone.0189850
30. BURCKHARDT CS, CLARK SR, BENNETT RM: The fibromyalgia impact questionnaire: Development and validation. *J Rheumatol* 1991; 18(5): 728-33.
31. LI Y, JIANG Q, JIA Y *et al.*: A Chinese version of the revised Fibromyalgia Impact Questionnaire: A validation study. *Int J Rheum Dis* 2023; 26(2): 242-9. https://doi.org/10.1111/1756-185X.14472
32. BRAZIER JE, HARPER R, JONES NM *et al.*:Validating the SF-36 health survey questionnaire: New outcome measure for primary care. *BMJ* 1992; 305(6846): 160-4. https://doi.org/10.1136/bmj.305.6846.160
33. LI L, WANG H, SHEN Y: Development and psychometric tests of a Chinese version of the SF-36 Health Survey Scales. *Zhōnghuá yùfáng-yīxué zázhì* 2002; 36(2): 109. https://doi.org/10.3760/j:issn:0253-9624.2002.02.011
34. JIAO J, VINCENT A, CHA SS, LUEDTKE CA, OH TH: Relation of age with symptom severity and quality of life in patients with fibromyalgia. *Mayo Clin Proc* 2014; 89(2): 199-206. https://doi.org/10.1016/j.mayocp.2013.09.021
35. YUNUS MB: Gender differences in fibromyalgia and other related syndromes. *J Gend Specif Med* 2002; 5(2): 42-7.
36. TURK DC, FILLINGIM RB, OHRBACH R, PATEL KV: Assessment of psychosocial and functional impact of chronic pain. *J Pain* 2016; 17 (9, Supplement): T21-T49. https://doi.org/10.1016/j.jpain.2016.02.006
37. DIAZ-PIEDRA C, DI STASI LL, BALDWIN CM, BUELA-CASAL G, CATENA A: Sleep disturbances of adult women suffering from fibromyalgia: A systematic review of observational studies. *Sleep Med Rev* 2015; 21: 86-99. https://doi.org/10.1016/j.smrv.2014.09.001
38. MUNGUÍA-IZQUIERDO D, LEGAZ-ARRESE A: Determinants of sleep quality in middle-aged women with fibromyalgia syndrome.

J Sleep Res 2012; 21(1): 73-9. https://doi.org/10.1111/j.1365-2869.2011.00929.x

39. OSORIO CD, GALLINARO AL, LORENZI-FILHO G, LAGE LV: Sleep quality in patients with fibromyalgia using the Pittsburgh Sleep Quality Index. *J Rheumatol* 2006; 33(9): 1863.
40. HAMILTON NA, AFFLECK G, TENNEN H *et al.*: Fibromyalgia: The role of sleep in affect and in negative event reactivity and recovery. *Health Psychol* 2008; 27(4): 490-7. https://doi.org/10.1037/0278-6133.27.4.490
41. AFFLECK G, URROWS S, TENNEN H, HIGGINS P, ABELES M: Sequential daily relations of sleep, pain intensity, and attention to pain among women with fibromyalgia. *Pain* 1996; 68(2): 363-8. https://doi.org/10.1016/S0304-3959(96)03226-5
42. AĞARGÜN MY, TEKEOĞLU I, GÜNEŞ A, ADAK B, KARA H, ERCAN M: Sleep quality and pain threshold in patients with fibromyalgia. *Compr Psychiat* 1999; 40(3): 226-8. https://doi.org/10.1016/S0010-440X(99)90008-1
43. SABES-FIGUERA R, MCCRONE P, HURLEY M, KING M, DONALDSON AN, RIDSDALE L: The hidden cost of chronic fatigue to patients and their families. *BMC Health Serv Res* 2010; 10: 56. https://doi.org/10.1186/1472-6963-10-56
44. STROMBECK B, EKDAHL C, MANTHORPE R, WIKSTROM I, JACOBSSON L: Health-related quality of life in primary Sjogren's syndrome, rheumatoid arthritis and fibromyalgia compared to normal population data using SF-36. *Scand J Rheumatol* 2000; 29(1): 20-8. https://doi.org/10.1080/030097400750001761
45. WAGNER J, DIBONAVENTURA MD, CHANDRAN AB, CAPPELLERI JC: The association of sleep difficulties with health-related quality of life among patients with fibromyalgia. *BMC Musculoskel Dis* 2012; 13(1): 199. https://doi.org/10.1186/1471-2474-13-199
46. MCEWEN BS: Protective and damaging effects of stress mediators. *N Engl J Med* 1998; 338(3): 171-9. https://doi.org/10.1056/NEJM199801153380307
47. BIGATTI SM, HERNANDEZ AM, CRONAN TA, RAND KL: Sleep disturbances in fibromyalgia syndrome: Relationship to pain and depression. *Arthritis Rheum* 2008; 59(7): 961-7. https://doi.org/10.1002/art.23828
48. CLIMENT-SANZ C, MARCO-MITJAVILA A, PASTELLS-PEIRO R, VALENZUELA-PASCUAL F, BLANCO-BLANCO J, GEA-SANCHEZ M: Patient reported outcome measures of sleep quality in fibromyalgia: A COSMIN systematic review. *Int J Environ Res Public Health* 2020;17(9): 2992. https://doi.org/10.3390/ijerph17092992
49. FORTIER-BROCHU E, BEAULIEU-BONNEAU S, IVERS H, MORIN CM: Insomnia and daytime cognitive performance: A meta-analysis. *Sleep Med Rev* 2012; 16(1): 83-94. https://doi.org/10.1016/j.smrv.2011.03.008