



The Impact of Sleep Problems on Rheumatoid Arthritis Disease Activity

Adel Ibrahim Azzam, MD, PhD

Department of Rheumatology and Rehabilitation, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Received: December 23, 2023

Revised: March 2, 2024

Accepted: March 28, 2024

Corresponding Author

Adel Ibrahim Azzam, MD, PhD
Department of Rheumatology
and Rehabilitation,
Faculty of Medicine, Al-Azhar University,
Cairo, Egypt
Tel +20-225102540
E-mail adelazzam25@yahoo.com

ORCID iD

Adel Ibrahim Azzam 
<https://orcid.org/0000-0001-6619-8855>

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Background and Objective Sleep difficulties tend to be more prevalent in rheumatoid arthritis (RA) patients than in the general population. Patients' mental, physiological, and life quality are all dependent on receiving good quality sleep. In practice, RA is managed not only by rheumatologists but also by a variety of other specialists. To assess subjective sleep quality in RA patients and its relationship to disease activity, pain intensity, and psychological state.

Methods Three hundred RA patients participated in a cross-sectional study in which they were evaluated clinically and underwent the Pittsburgh Sleep Quality Index (PSQI), Beck Depression Inventory-II, and Disease Activity Score-28 with erythrocyte sedimentation rate (DAS28-ESR). Two groups of RA patients were created based on the PSQI score. Group 1 included RA patients with good sleep, and Group 2 included RA patients with poor sleep.

Results The study included 276 females and 24 males, with a mean age of 38.5 ± 8.8 years and a disease duration of 4.3 ± 3.8 years. Sleep disturbances were found in 65.3% of our RA patients, with habitual sleep efficiency being the most commonly affected component (50%), and 91% of the patients studied did not take any sleep medication. Poor sleep was linked to increased DAS28, pain, and different degrees of depressive symptoms. All PSQI components and total PSQI scores showed a significant correlation with pain and depressive symptom severity scores. However, no correlation was found with disease duration or erosive joint changes.

Conclusions Patients with RA frequently encounter sleep problems. Individuals with RA exhibiting poor sleep quality are more likely to encounter varying degrees of depressive symptoms, disease activity flares, and more intense pain. This issue, as well as its expected consequences for RA disease parameters, should be recognized. **Sleep Med Res 2024;15(2):106-112**

Keywords Rheumatoid arthritis; Sleep quality; Pittsburgh Sleep Quality Index.

INTRODUCTION

Sleep is crucial for maintaining both physical and mental health. Over two-thirds of rheumatological patients have been found to have sleep problems [1]. Rheumatoid arthritis (RA) is a chronic inflammatory illness characterized mainly by pain and synovial inflammation. The chronic inflammatory process of RA can result in cartilage and bone destruction if left untreated [2]. Furthermore, psychological or cognitive disorders such as anxiety, loss of self-esteem, suicidal thoughts, and sleep problems are common among RA patients and may contribute to a marked loss of life quality [3,4]. Low-quality sleep is associated with fatigue, increased pain perception, decreased daily activity, worsened sociability, impaired memory function, an increased risk of cardiovascular diseases, and depression, all of which contribute to a poor quality of life. However, several factors related to RA disease, including medication, persistent pain, morning stiffness, and disease activity, can all affect how well the individual sleeps [5]. Many autoimmune rheumatic disorders have shown a correlation between

the activity of the disease and sleep issues. Thus, managing the activity of the rheumatic disease is critical for getting proper sleep [6].

Despite the fact that novel treatments for RA have been developed using advanced modern technologies, most patients' psychological and sleep concerns have not been adequately addressed. Sleep issues have been shown to have a deleterious impact on both mental and physical health, but the precise nature of the link between sleep disturbances and RA is still undefined [7]. Fatigue and insomnia have been consistently linked to depression, which is common among RA patients [8]. This significantly reduces quality of life, increases the burden of disease, and makes dealing with RA-related symptoms more challenging [9]. Thus, identifying and detecting sleep problems early in these patients could have a positive impact on their overall health [10].

To quantify the quality of sleep, a variety of questionnaires have been developed [11], including patient-reported measures like the Pittsburgh Sleep Quality Index (PSQI) [12], Epworth Sleepiness Scale [13], and Athens Insomnia Scale [14].

As a result, the primary goal of this study was to assess subjective sleep quality in RA patients. The secondary goal was to investigate the relationship between RA sleep problems and disease activity, pain intensity, and psychological state.

METHODS

A total of 300 patients with RA were recruited consecutively from the outpatient clinics of the Rheumatology and Rehabilitation Department at our university hospital. This single-center cross-sectional study was done over a period of 6 months (February 2022 to July 2023), and data analyses were done over another period of 6 months. Inclusion criteria were patients with RA diagnosed according to the 2010 American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) criteria [15], aged more than 18 years, and capable and willing to follow the research protocol's requirements. Patients with other autoimmune rheumatic diseases, a history of or current inflammatory joint disease (e.g., gout), comorbid fibromyalgia, substance abuse, or other mental illnesses were excluded. Participants who refused to sign the written informed consent form were also excluded from the study.

The Disease Activity Score-28 with erythrocyte sedimentation rate (DAS28-ESR) was used for assessment of the disease activity in 28 joints [16].

The PSQI assesses self-reported sleep disruptions during the previous month with its 7 components of sleep quality measured by the scale. The 7 component scores (ranging from 0 to 21) are added together to provide a global PSQI score. The PSQI global score separates patients into "good sleepers" (PSQI total score ≤ 5) and "poor sleepers" (PSQI total score > 5) [12].

The Health Assessment Questionnaire for Pain (HAQ-pain)

scale is a 15-cm visual analogue scale with anchor points of 0 (no pain) and 100 (very severe pain) [17].

The Beck Depression Inventory-II (BDI-II) is a 21-item self-reported questionnaire used for screening of depressive symptoms. The range from 0 to 13 is considered minor, 14 to 19 is mild, 20 to 28 is moderate, and 29 to 63 is severe [18]. Established psychiatric surveys, such as BDI-II, are valid for assessing the degree of depression in RA patients [19].

The existence of erosions was assessed using the Larsen score. Grades range from 0 to 5, and the total score is between 0 and 160 [20].

To compare for objectives, the patients were divided into two groups based on their PSQI scores. Group 1 included RA patients with good sleep, and group 2 included RA patients with poor sleep.

The study was approved by the Ethics Committee of the Al-Azhar Faculty of Medicine Ethics Board under the number 0000024, and all patients signed a written informed consent before entering the study. It is in accordance with the legal principles of the Declaration of Helsinki.

Analytical Statistics

The sample size was calculated using data from a previous study by Abbasi et al. [9]. To achieve an alpha error of 0.05 and a power of 0.80, a sample size of 235 patients was needed. The sample size was calculated using G*Power, Version 3.1.9.2 for Windows (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). The data was coded and entered using the statistical package SPSS version 15 (SPSS Inc., Chicago, IL, USA). The data was summarized using descriptive statistics: mean, standard deviation, minimum and maximum values for quantitative variables and number and percentage for qualitative variables. Statistical differences between groups were used using the chi-square test for qualitative variables, the independent sample t-test for quantitative variables normally distributed, and the non-parametric Mann-Whitney test for quantitative variables which are not normally distributed. Correlations were done to test for linear relations between variables. Correlations between quantitative variables were done using the Spearman correlation coefficient. p-values less than or equal to 0.05 were considered statistically significant. Logistic regression analysis was done to find significant predictors for sleep disturbance among studied groups.

RESULTS

RA Patients' Demographic and Clinical Data

The participants in this study were 300 RA patients who were diagnosed using the 2010 ACR/EULAR criteria. Table 1 shows the demographic and clinical features of RA patients. The majority of the patients were female, with a mean age of 38.5 ± 8.8

Table 1. Demographic and clinical characteristics of rheumatoid arthritis patients

Characteristic	Value (n = 300)
Age (yr)	38.5 ± 8.8 (20–49)
Disease duration (yr)	4.3 ± 3.8 (0.2–20)
Sex	
Male	24 (8)
Female	276 (92)
DAS28-ESR	4.93 ± 1.37 (1.38–8.09)
Total PSQI score	8 ± 5 (0–19)
Pain severity (HAQ-pain)	47 ± 26 (10–100)
BDI-II	16 ± 11 (0–54)
Depression (BDI-II)	
NO	12 (4)
Minimal	130 (43.3)
Mild	59 (19.7)
Moderate	58 (19.3)
Severe	41 (13.7)
Drug	
Current MTX use	231 (77)
Steroids use	167 (55.7)

Values are presented as mean ± standard deviation (range) or n (%). DAS28-ESR, Disease Activity Score-28 with erythrocyte sedimentation rate; PSQI, Pittsburgh Sleep Quality Index; BDI-II, Beck Depression Inventory-II; HAQ-pain, Health Assessment Questionnaire for Pain; MTX, methotrexate.

years and a disease duration of 4.3 ± 3.8 years.

On assessing the severity of depressive symptoms among our sample of RA patients, we discovered that 12 (4%) of RA patients were not depressed, and 130 (43.3%) reported minimal depression. Additionally, 59 patients (19.7%) exhibited mild depression, 58 patients (19.3%) showed moderate depression, and 41 patients (13.7%) were severely depressed.

Sleep Quality and Related Variables in RA Patients

The global PSQI varied from 0 to 19, with a mean of 8 ± 5. Patients with a global PSQI score of more than 5 were considered poor sleepers, while those with a global PSQI score of 5 or less were considered good sleepers. One hundred four patients (34.7%) were good sleepers, whereas 196 patients (65.3%) were poor sleepers (Table 2). Poor sleep was prevalent among RA patients and was associated with female sex, older age, and unemployment status. There was no statistically significant relationship regarding marital status, disease duration, and current medication among RA patients with good or poor sleep ($p > 0.05$). Morning stiffness showed a highly statistically significant difference among both groups. However, erosive joint changes assessed by Larsen score showed no statistical difference among groups.

The DAS28-ESR score showed a statistically significant differ-

Table 2. Comparison of the PSQI between rheumatoid arthritis patients

Demographics	Sleep quality		p-value
	Good sleeper (n = 104)	Poor sleeper (n = 196)	
Age (yr)	36.4 ± 9.2 (20–49)	39.6 ± 8.4 (20–49)	0.002*
Disease duration (yr)	3.8 ± 3.7 (0.2–20)	4.6 ± 3.8 (0.2–20)	0.079
Sex			0.045*
Male	13 (12.5)	11 (5.6)	
Female	91 (87.5)	185 (94.4)	
Marital status			0.099
Married	83 (79.8)	171 (87.2)	
Widow	5 (4.8)	11 (5.6)	
Divorced	4 (3.8)	6 (3.1)	
Single	12 (11.5)	8 (4.1)	
Occupation			0.004*
Working	27 (26)	25 (12.8)	
Not working	77 (74)	171 (87.2)	
Current MTX use	82 (78.8)	149 (76)	0.666
Current steroid use	51 (49)	117 (59.7)	0.088
Anti-CCP	68 (65.4)	141 (71.9)	0.291
RF	83 (79.8)	159 (81.1)	0.878
Larsen score	9 ± 11 (0–50)	11 ± 14 (0–76)	0.143
Morning stiffness (min)	23 ± 38 (0–180)	45 ± 48 (0–180)	<0.001*

Values are presented as mean ± standard deviation (range) or n (%). * $p < 0.05$, statistically significant.

PSQI, Pittsburgh Sleep Quality Index; RA, rheumatoid arthritis; MTX, methotrexate; CCP, cyclic citrullinated peptide; RF, rheumatoid factor.

ence between both groups. High disease activity (DAS28 > 5.1) was higher in the poor sleep group (57.1%) in comparison to the other group (36.5%) (Table 3). Additionally, a very small prevalence of low disease activity or remission was associated with the poor sleep group. The HAQ-pain scale and depression with varying severity rating scores showed a highly statistically significant difference among both groups.

Correlation of PSQI Components with RA Disease Parameters

On analyzing the PSQI components of the studied patients, each component was scored from 0 (no difficulty) to 3 (severe difficulty). Among the 7 PSQI components, the most significant component of sleep disruption was the reduced habitual sleep efficiency (hours slept/hours in bed × 100%). One hundred fifty (50%) of our patients received a score of 3 (indicating

Table 3. Values of the DAS28-ESR, HAQ, and depression scores in rheumatoid arthritis patients with good and poor sleep

	Sleep quality		p-value
	Good sleeper (n = 104)	Poor sleeper (n = 196)	
DAS28-ESR			0.004*
Remission	11 (10.6)	8 (4.1)	
Low	11 (10.6)	14 (7.1)	
Moderate	44 (42.3)	62 (31.6)	
High	38 (36.5)	112 (57.1)	
HAQ-pain	35.1 ± 25.7 (10–100)	52.55 ± 24.47 (10–100)	<0.001*
Depression (BDI-II)			<0.001*
No	10 (9.6)	2 (1)	
Minimal	63 (60.6)	67 (34.2)	
Mild	16 (15.4)	43 (21.9)	
Moderate	12 (11.5)	46 (23.5)	
Severe	3 (2.9)	38 (19.4)	

Values are presented as mean ± standard deviation (range) or n (%).
*p < 0.05, statistically significant.
DAS28-ESR, Disease Activity Score-28 with erythrocyte sedimentation rate; HAQ-pain, Health Assessment Questionnaire for Pain; BDI-II, Beck Depression Inventory-II.

a sleep efficiency of less than 65%). The use of sleep medications was the least prominent of the 7 PSQI components, with 91% of our patients scoring 0, indicating that they did not use any medication for their difficult sleep (Table 4).

On correlating components of the PSQI and the total PSQI score with RA disease parameters, all components of the PSQI and total PSQI were correlated with pain and depressive symptoms ($p < 0.05$). Most of the components were correlated with either morning stiffness or DAS28.

Table 5 shows a significant correlation between PSQI components and depression and HAQ-pain ($p < 0.05$). Sleep scores were also correlated with morning stiffness and DAS28, with the exception of the use of sleep medication component, which revealed no correlation ($r = 0.033$, $p = 0.566$, and $r = 0.055$, $p = 0.338$, respectively). The PSQI components including the global PASQI score showed no correlation with disease duration or Larsen score ($p \geq 0.05$).

DISCUSSION

This research reveals that sleep problems are common in RA patients and are linked to higher levels of pain, disease activity, and depression.

Because RA is multifaceted, health outcomes in RA are influenced by a variety of psychosocial, economic, and medical factors. Poor sleep quality has been found to affect between 30%

and 75% of RA patients [6]. Despite its prevalence, it is rarely evaluated in standard clinical practice [21].

In the present study, 196 (65.3%) of RA patients were poor sleepers and 104 (34.7%) were good sleepers, with the reduced habitual sleep efficiency being the most significant component of sleep disruption encountered by our RA patients. This closely coincides with the findings of Kontodimopoulos et al. [6]. Previous studies have found a link between RA and sleep problems, with RA patients having less quality sleep than healthy controls [9,22,23]. According to reports, pain is still the most common cause of sleep problems in RA patients, and it has been observed that, in a vicious cycle, pain reduces sleep quality, which exacerbates joint problems [24].

In this study, poor sleep quality was associated with the older age and female gender of RA patients, in opposition to Luyster et al. [25], who reported that sleep disorders were most prevalent in the 20–40-year-old age group and declined thereafter. Louie et al. [26] found that women with RA were much more likely than men to have sleeping disorders, a finding consistent with our results.

Deterioration of the circadian rhythm of many physiological activities that maintain homeostasis, as well as medical diseases such as cardiovascular or respiratory diseases or chronic arthritis, can impair sleep quality and make sleep consolidation difficult [27].

It has been reported that there is an association between disease-modifying anti-rheumatic drugs (DMARDs) and quality of sleep [22]. However, the current study demonstrated no link between sleep quality and RA medications such as DMARDs or glucocorticoids, which is in accordance with previous research [28]. Contrarily, chronic glucocorticoid administration has been linked to worsened sleep quality, longer waking times, increased rapid eye movement sleep, and increased sleep latency [29].

In this study, we found that RA patients with poor sleep had a longer duration of morning stiffness, which was consistent with previous research [22]. On the other hand, no significant correlation was found between erosive joint changes assessed by the Larsen score and poor sleep quality. This differs from the study done by Sariyildiz et al. [22], who found a positive correlation between Larsen score and poor sleep quality. This difference can be attributed to the higher disease duration of their patients and the different scoring method used in their study.

In the current study, disease activity assessed by DAS28 was associated with poor sleep quality. Higher DAS28 scores were detected in 57.1% of RA patients with poor sleep versus 36.5% detected in patients with good sleep. Sleep latency was the only domain of the PSQI score that showed no correlation with RA disease activity ($r = 0.055$, $p = 0.338$). This was in agreement with previous research [30]. Furthermore, according to Szady et al. [31], hospitalized patients experiencing flaring of their RA disease were found to have poor sleep quality as determined by the PSQI. This positive correlation could be clarified by the re-

Table 4. Analysis of PSQI component scores of the studied patients

PSQI components	Score 0	Score 1	Score 2	Score 3
Subjective sleep quality	45 (15)	108 (36)	126 (42)	21 (7)
Sleep latency	121 (40.3)	38 (12.7)	83 (27.7)	58 (19.3)
Sleep duration	40 (13.3)	80 (26.7)	60 (20)	120 (40)
Habitual sleep efficiency	57 (19)	52 (17.3)	41 (13.7)	150 (50)
Sleep disturbance	123 (41)	164 (54.7)	9 (3)	4 (1.3)
Use of sleep medication	273 (91)	5 (1.7)	13 (4.3)	9 (3)
Daytime dysfunction	126 (42)	37 (12.3)	118 (39.3)	19 (6.3)

Values are presented as n (%).

PSQI, Pittsburgh Sleep Quality Index.

Table 5. Correlations of the global PSQI and component scores with disease parameters

	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Comp7	Total PSQI
Disease duration								
r	0.013	0.018	0.016	0.060	-0.008	-0.047	0.028	0.032
p	0.824	0.761	0.779	0.296	0.896	0.415	0.628	0.580
Morning stiffness (min)								
r	0.275	0.172	0.198	0.174	0.264	0.033	0.273	0.261
p	<0.001	0.003	0.001	0.002	<0.001	0.566	<0.001	<0.001
DAS28-ESR								
r	0.300	0.126	0.222	0.234	0.286	0.055	0.314	0.297
p	<0.001	0.029	<0.001	<0.001	<0.001	0.338	<0.001	<0.001
Larsen score								
r	-0.029	-0.040	0.044	0.106	-0.047	-0.070	-0.009	0.011
p	0.616	0.490	0.446	0.067	0.415	0.231	0.871	0.856
Depression								
r	0.530	0.294	0.346	0.393	0.447	0.262	0.547	0.530
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
HAQ-pain								
r	0.413	0.256	0.259	0.293	0.381	0.214	0.402	0.413
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

PSQI, Pittsburgh Sleep Quality Index; DAS28-ESR, Disease Activity Score-28 with erythrocyte sedimentation rate; HAQ-pain, Health Assessment Questionnaire for Pain; comp1, subjective sleep quality; comp2, sleep latency; comp3, sleep duration; comp4, habitual sleep efficiency; comp5, sleep disturbance; comp6, use of sleep medication; comp7, daytime dysfunction.

lease of inflammatory cytokines, which influence various neurobiological sleep mechanisms.

It is worth noting that some researchers studying sleep and interleukin 6 (IL-6) receptor blockade in RA have proposed that abnormal IL-6 regulation may be the cause of sleep problems. This pilot study, which followed 15 patients for 6 months, found that IL-6 inhibitor tocilizumab improved sleep quality in RA patients, despite the fact that changes in PSQI scores over time were not linked to equivalent changes in DAS28-ESR [32].

Pain and sleep problems in RA patients are connected to one another. Although pain interferes with sleep, sleep disorders provide an understanding of the connection between RA and

pain severity [28]. The current study showed that HAQ-pain scores were higher among the poor sleep quality group, and pain was correlated with all components of PSQI as well as the total PSQI score. In line with our findings, Treharne et al. [33] reported that poor sleep was linked to a higher level of pain ($r = 0.31$, $p < 0.001$). The link between poor sleep and pain intensity in RA patients may be explained by the release of cytokines such as IL-1 and IL-6 and tumor necrosis factor alpha, which anxiously stimulate the spinal cord and enhance the pain pathway and increase pain intensity even though the inflammation appears to be under control.

It has been documented that there is a reciprocal relation-

ship between psychological disorders such as depression and sleep disturbances in RA [34]. This indicates that poor sleep can lead to the development of depression and that depression increases the likelihood of having sleep problems [35].

In this study, symptoms of severe depression were reported in 19.4% of RA patients with poor quality sleep compared to 2.9% detected among those with good quality sleep. Depression was found to be a significant predictor of sleep quality and correlated with all components of the PSQI score, which is consistent with earlier research [28]. Changes in the function of the neurotransmitter serotonin may explain the mechanism by which sleep problems play a role in the establishment of depression [36].

Given the prevalence of sleep problems among RA patients, it is worth noting that the vast majority (91%) of our patients did not consider any sleep prescriptions, compared to 75% and 82% in Danish and Canadian studies, respectively [37], demonstrating that the problem is underrated among the Egyptian patient population.

The study limitations need to be addressed. Even though the PSQI score is approved for use in RA, it only pertains to the preceding 4 weeks, which might cause recall bias to affect the results. The lack of a healthy control group was another limitation. In addition, the body mass index, which is another possible confounder, has not been recorded. The limited sample size, as well as the greater number of women, may limit the generalization of the results of the study's findings; nonetheless, this is to be anticipated in RA patients.

In conclusion, sleep issues are frequent among RA patients and are associated with a wide variety of illness-related issues such as disease activity, pain, and depressive symptoms, all of which, if recognized and addressed, can improve the patient's sleep quality and sense of well-being. Patients with RA should have their sleep problems assessed on a regular basis as part of their overall management plan.

Availability of Data and Material

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

Conflicts of Interest

The author has no potential conflicts of interest to disclose.

Funding Statement

None

Acknowledgements

None

REFERENCES

- Boeselt T, Koczulla R, Nell C, Beutel B, Guenter K, Cassel W, et al. Sleep and rheumatic diseases. *Best Pract Res Clin Rheumatol* 2019;33:101434.
- Lyne L, Åkerstedt T, Alfredsson L, Lehtonen T, Saevarsdottir S, Klareskog L, et al. Sleep problems in rheumatoid arthritis over 12 years from diagnosis: results from the Swedish EIRA study. *RMD Open* 2022;8:e001800.
- Žagar I, Delimar V, Pap M, Perić D, Laktašić Žerjavić N, Perić P. Prevalence and correlation of depressive symptoms with functional scores, therapy and disease activity among Croatian patients with rheumatoid arthritis: a preliminary study. *Psychiatr Danub* 2018;30:452-8.
- An J, Nyarko E, Hamad MA. Prevalence of comorbidities and their associations with health-related quality of life and healthcare expenditures in patients with rheumatoid arthritis. *Clin Rheumatol* 2019;38:2717-26.
- Coskun Benlidayi I. Sleep impairment: an obstacle to achieve optimal quality of life in rheumatoid arthritis. *Rheumatol Int* 2018;38:2183-92.
- Kontodimopoulos N, Stamatopoulou E, Kletsas G, Kandili A. Disease activity and sleep quality in rheumatoid arthritis: a deeper look into the relationship. *Expert Rev Pharmacoecon Outcomes Res* 2020;20:595-602.
- Ellis SK, Walczyk JJ, Buboltz W, Felix V. The relationship between self-reported sleep quality and reading comprehension skills. *Sleep Sci* 2014;7:189-96.
- Radwan A, Borai A. Quality of sleep in rheumatoid arthritis patients: relationship with disease activity, depression and functional status. *Egypt Rheumatol* 2021;43:183-7.
- Abbasi M, Yazdi Z, Rezaie N. Sleep disturbances in patients with rheumatoid arthritis. *Niger J Med* 2013;22:181-6.
- Davis EM, Ramani C, Quigg M. Neurologic manifestations of systemic disease: sleep disorders. *Curr Treat Options Neurol* 2020;22:30.
- Wells GA, Li T, Kirwan JR, Peterson J, Aletaha D, Boers M, et al. Assessing quality of sleep in patients with rheumatoid arthritis. *J Rheumatol* 2009;36:2077-86.
- Buyse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;28:193-213.
- Omachi TA. Measures of sleep in rheumatologic diseases: Epworth Sleepiness Scale (ESS), Functional Outcome of Sleep Questionnaire (FOSQ), Insomnia Severity Index (ISI), and Pittsburgh Sleep Quality Index (PSQI). *Arthritis Care Res (Hoboken)* 2011;63(Suppl 11):S287-96.
- Soldatos CR, Dikeos DG, Paparrigopoulos TJ. Athens insomnia scale: validation of an instrument based on ICD-10 criteria. *J Psychosom Res* 2000;48:555-60.
- Aletaha D, Neogi T, Silman AJ, Funovits J, Felson DT, Bingham CO 3rd, et al. 2010 rheumatoid arthritis classification criteria: an American College of Rheumatology/European League Against Rheumatism collaborative initiative. *Arthritis Rheum* 2010;62:2569-81.
- Prevo ML, van't Hof MA, Kuper HH, van Leeuwen MA, van de Putte LB, van Riel PL. Modified disease activity scores that include twenty-eight-joint counts. Development and validation in a prospective longitudinal study of patients with rheumatoid arthritis. *Arthritis Rheum* 1995;38:44-8.
- Fries JE, Spitz PW, Young DY. The dimensions of health outcomes: the health assessment questionnaire, disability and pain scales. *J Rheumatol* 1982;9:789-93.
- Beck AT, Steer RA, Brown GK. *Manual for the Beck Depression Inventory*. 2nd ed. San Antonio: Psychological Corporation 1988.
- Zyrianova Y, Kelly BD, Gallagher C, McCarthy C, Molloy MG, Sheehan J, et al. Depression and anxiety in rheumatoid arthritis: the role of perceived social support. *Ir J Med Sci* 2006;175:32-6.
- Larsen A. How to apply Larsen score in evaluating radiographs of rheumatoid arthritis in long-term studies. *J Rheumatol* 1995;22:1974-5.
- Kumar A, Handa R, Upadhyaya SK, Gupta SJ, Malgutte DR. Sleep quality in rheumatoid arthritis. *Indian J Rheumatol* 2022;17:34-40.
- Sariyildiz MA, Batmaz I, Bozkurt M, Bez Y, Cetincakmak MG, Yazmalar L, et al. Sleep quality in rheumatoid arthritis: relationship between the disease severity, depression, functional status and the quality of life. *J Clin Med Res* 2014;6:44-52.
- Taylor-Gjevre RM, Gjevre JA, Nair B, Skomro R, Lim HJ. Components of sleep quality and sleep fragmentation in rheumatoid arthritis and

- osteoarthritis. *Musculoskeletal Care* 2011;9:152-9.
24. Katz P. Causes and consequences of fatigue in rheumatoid arthritis. *Curr Opin Rheumatol* 2017;29:269-76.
 25. Luyster FS, Chasens ER, Wasko MC, Dunbar-Jacob J. Sleep quality and functional disability in patients with rheumatoid arthritis. *J Clin Sleep Med* 2011;7:49-55.
 26. Louie GH, Tektonidou MG, Caban-Martinez AJ, Ward MM. Sleep disturbances in adults with arthritis: prevalence, mediators, and subgroups at greatest risk. Data from the 2007 national health interview survey. *Arthritis Care Res (Hoboken)* 2011;63:247-60.
 27. Edwards BA, O'Driscoll DM, Ali A, Jordan AS, Trinder J, Malhotra A. Aging and sleep: physiology and pathophysiology. *Semin Respir Crit Care Med* 2010;31:618-33.
 28. Nicassio PM, Ormseth SR, Kay M, Custodio M, Irwin MR, Olmstead R, et al. The contribution of pain and depression to self-reported sleep disturbance in patients with rheumatoid arthritis. *Pain* 2012;153:107-12.
 29. Balbo M, Leproult R, Van Cauter E. Impact of sleep and its disturbances on hypothalamo-pituitary-adrenal axis activity. *Int J Endocrinol* 2010; 2010:759234.
 30. Westhovens R, Van der Elst K, Matthys A, Tran M, Gilloteau I. Sleep problems in patients with rheumatoid arthritis. *J Rheumatol* 2014;41:31-40.
 31. Szady P, Bączyk G, Kozłowska K. Fatigue and sleep quality in rheumatoid arthritis patients during hospital admission. *Reumatologia* 2017;55: 65-72.
 32. Fragiadaki K, Tektonidou MG, Konsta M, Chrousos GP, Sfakakis PP. Sleep disturbances and interleukin 6 receptor inhibition in rheumatoid arthritis. *J Rheumatol* 2012;39:60-2.
 33. Treharne GJ, Lyons AC, Hale ED, Douglas KM, Goodchild CE, Booth DA, et al. Sleep disruption frequency in rheumatoid arthritis: perceived stress predicts poor outcome over one year. *Musculoskeletal Care* 2007; 5:51-64.
 34. Lee YC, Chibnik LB, Lu B, Wasan AD, Edwards RR, Fossel AH, et al. The relationship between disease activity, sleep, psychiatric distress and pain sensitivity in rheumatoid arthritis: a cross-sectional study. *Arthritis Res Ther* 2009;11:R160.
 35. Franzen PL, Buysse DJ. Sleep disturbances and depression: risk relationships for subsequent depression and therapeutic implications. *Dia-logues Clin Neurosci* 2008;10:473-81.
 36. Daut RA, Fonken LK. Circadian regulation of depression: a role for serotonin. *Front Neuroendocrinol* 2019;54:100746.
 37. Løppenthin K, Esbensen BA, Jennum P, Østergaard M, Tolver A, Thomsen T, et al. Sleep quality and correlates of poor sleep in patients with rheumatoid arthritis. *Clin Rheumatol* 2015;34:2029-39.