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ORIGINAL ARTICLE

Sleep quality and associated factors in ankylosing spondylitis: relationship with disease parameters, psychological status and quality of life

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Abstract The aim of this study is to investigate sleep quality in patients with ankylosing spondylitis (AS) and to evaluate the relationship of the disease parameters with sleep disturbance. Eighty AS patients (60 males and 20 females) fulfilling the modified New York criteria, and 52 age- and gender-matched controls (33 males and 19 females) were enrolled in the study. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Pain was measured by visual analogue scale. The disease activity and functional status were assessed by the Bath AS disease Activity Index and the Bath AS Functional Index. The Bath AS Metrology Index was used to evaluate mobility restrictions, and the Bath AS Radiology Index was employed to evaluate the radiological damage. The psychological status and quality of life were assessed with the hospital anxiety-depression scale and AS quality of life scale. The patients with AS had significantly more unfavourable scores in the subjective sleep quality, habitual sleep efficiency domains ($p < 0.001$) and the total PSQI score ($p < 0.05$). Poor sleep quality (total PSQI score) was positively correlated with increased pain, poor quality of life, higher depressed mood, higher disease activity and mobility restrictions. Pain was also an independent contributor to poorer sleep quality ($p = 0.002$). The sleep quality is disturbed in patients with AS. The lower quality of sleep is greatly associated with the pain, disease activity, depression, quality of life and increased limitation of mobility.

Keywords Ankylosing spondylitis · Disease parameters · Psychological state · Quality of life · Sleep quality

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Introduction

Ankylosing spondylitis (AS) is a chronic, progressive, inflammatory disease of the axial skeleton, large peripheral joints and entheses [1]. AS is the prototype spondyloarthropathy. While in the early phases, the disease generally involves the sacroiliac joints and it may also involve the axial skeleton in the more advanced phases [2].

Pain, stiffness, fatigue and sleep problems are important concerns in patients with AS [3]. Sleep disturbances have been reported to be more frequent in rheumatic diseases than amongst the normal population [4, 5]. Various sleep problems including poor quality of sleep, sleep onset insomnia, difficulty awakening and obstructive sleep apnoea syndrome have been reported in AS [6]. Sleep disturbances due to axial pain and stiffness in the latter half of the night are an important characteristic of the inflammatory back pain in patients with AS [7].

Inadequate sleep is influenced by multiple factors including the disease status, and behavioural and psychosocial variables [8, 9]. The relationship between the sleep complaints and depressed mood is consistent with findings from the epidemiological studies on sleep in the general population [10–12]. There are only a limited number of studies in the literature investigating the sleep quality and the related factors in AS. In a study, poorer sleep efficiency was associated with increasing disease activity, deteriorating

functional status, more severely depressed mood and perceived stress in patients with AS [13]. Furthermore, Deodhar et al. [14] found that sleep problems significantly correlated with the quality of life, pain and disease activity in patients with AS.

The aim of this study is to determine the frequency of sleep disorders in patients with AS and to reveal the relationship of the specific components of sleep disturbance with the disease activity, functional status, mobility and radiological damage, as well as investigating the influence of the depression and diminished quality of life on sleep in AS.

Patients and methods

The present study had a cross-sectional design approved by the local ethics committee. Eighty patients between the ages of 16 and 60, who presented to the Dicle University School of Medicine, Department of Physical Medicine and Rehabilitation outpatient clinic and were diagnosed with definite AS according to the 1984 Modified New York Criteria [15], were enrolled in our study. The control group consisted of 52 healthy volunteers who were randomly chosen from amongst the employees of our hospital. Both groups were given information about the study before they were presented with informed consent forms to fill out and sign.

Patients with any kind of collagen tissue disorders or any other inflammatory articular diseases, malignancies, diseases of the central nervous system, chronic kidney disease, chronic liver disease and thyroid diseases besides the AS, and those who were pregnant were excluded from the study.

The demographical and clinical characteristics of the patients, the disease duration (disease duration is defined as the duration since the onset of the first symptoms of AS), degree of morning stiffness and medications [non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), anti-tumour necrosis factor (TNF)] were recorded. The duration of the morning stiffness (min) and pain [10 cm visual analogue scale (VAS)] was also noted. The erythrocyte sedimentation rate (ESR) was measured through the Westergren method (mm/h), and the serum C-reactive protein (CRP) level was measured by nephelometry (mg/dl).

The disease activity was evaluated using the Bath AS Disease Activity Index (BASDAI) [16]. The functional statement was evaluated with the Bath AS Functional Index (BASFI) [17]. The reliability and validity of the Turkish version of BASDAI and BASFI have already been demonstrated [18, 19]. The scores of the spinal and hip measurements were determined through the Bath AS Metrology Index (BASMI) [20]. AP pelvis, lateral cervical and lateral lumbar spine radiographies were made. The Bath Ankylosing Spondylitis Radiology Index (BASRI) was used to evaluate the radiological damage [21].

For both the AS and the control group, the Pittsburgh Sleep Quality Index (PSQI) Sleep Questionnaire was used in order to evaluate the quality and disturbance of sleep [22]. The reliability and validity of the Turkish version of this questionnaire have been verified by Agargun et al. [23].

The disease-related quality of life was measured with the ankylosing spondylitis quality of life questionnaire (ASQoL) [24]. This questionnaire consists of 18 items with dichotomous responses (yes/no). The reliability and validity of the Turkish version of this questionnaire have been verified by Duruöz et al. [25].

Measurements of disease variables

BASDAI consists of a 10-cm horizontal VAS used to answer six questions pertaining to the five major symptoms of AS. The symptoms assessed include fatigue, spinal pain, peripheral joint pain or swelling, tenderness and morning stiffness. The questions are answered on a VAS, anchored with labels ‘none’ and ‘very severe’ at either end of the first five items and ‘0 h’ and ‘2 or more hours’ for the duration of morning stiffness. The mean score of the two items on morning stiffness is considered as one variable. The resulting score is then divided by 5 to give the final BASDAI score (0–10).

BASFI consists of eight questions on daily activities and two additional questions that assess patients’ ability to cope with everyday life. Each question is answered on a 10-cm horizontal VAS. Scores on each item range from 0 (easy) to 10 (impossible). A mean of the 10 items is calculated to obtain the final score, with higher scores indicating greater disability.

BASMI is a validated composite index of four spinal measures (cervical rotation [CR], tragus-to-wall distance, modified Schober’s test and lateral lumbar flexion [LLF]) and one hip mobility measure (intermalleolar distance [IMD]). Each measure is assigned a score of 0–2, with the higher score signifying greater impairment in mobility, so that the maximum aggregate score is 10.

BASRI was used for evaluating the radiological damage. AP pelvis, lateral cervical and lateral lumbar spine radiographs were made. The sacroiliac and hip joints and the spine were scored on a simple scale between 0 and 4 (0 = normal, 1 = suspicious, 2 = mild, 3 = moderate and 4 = severe). These scores were added together to produce the BASRI score (0–12).

Sleep assessment

The PSQI measures the self-reported sleep quality and disturbances over the last month. The scale has 19 items

and measures seven components of sleep quality: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. A global PSQI score corresponding to the total of the individual scores from the seven components is calculated (range = 0–21). The PSQI global score accurately distinguishes 'good sleepers' (PSQI total score $\leq$5) from 'poor sleepers' (PSQI > 5).

Measurement of the psychological variables

The hospital anxiety and depression scale (HADS) were applied to the patients with AS. This scale has been developed by Zigmond and Snaith [26] and its Turkish version was verified in terms of its validity and reliability by Aydemir et al. [27]. HADS is a Likert-type self-evaluation scale that consists of 14 items; seven to investigate the depression symptoms (HADS-D) and the other seven to investigate the anxiety symptoms (HADS-A).

Statistical analyses

The calculations were performed using the Statistical Package for Social Sciences software version 16.0 for Windows. The Kolmogorov–Smirnov test was used to confirm that data were within the ranges of normal distribution in both groups. A nonparametric test was employed for the variables outside the normal distribution. The comparison of data between two groups was carried out through the Mann–Whitney *U* test. Correlations between the sleep disturbance, depression status and the AS-related variables were investigated with the help of Spearman's correlation. A multivariate linear regression analysis was performed to analyse the relationship between the clinical parameters and the PSQI scores. A hierarchical stepwise method was used to construct the multiple regression models in relation to various dependent variables. Statistical significance was based on a value of $p < 0.05$ with a 95 % confidence interval.

Results

Eighty AS patients (60 males and 20 females) and 52 controls (33 males and 19 females) were included in the study. The clinical and demographical characteristics of the patients are listed in Table 1. Although there was no significant difference between the AS patients and controls regarding their age and sex, the AS patients had higher scores in the subjective sleep quality and habitual sleep efficiency domains and also higher total PSQI scores (Table 2). The mean global PSQI score was 6.4 ± 3.7, with 50 % of the AS patients classified as poor sleepers (PSQI global score >5). Amongst the patients, 46.2 % were treated with NSAIDs and/or DMARDs and 53.8 % were treated only with anti-TNF. No significant relationship was observed between the treatment modality and the total PSQI scores ($p > 0.05$).

Table 1 Clinical and demographical characteristics of the AS patients

Variable	Values (mean ± SD)
Age (years)	35.3 ± 6.7
Sex (male, %)	75
Disease duration (years)	9.1 ± 6.3
Duration of morning stiffness (min)	23 ± 32.4
Pain (VAS, cm)	4.05 ± 2.9
ESR (mm/h)	15.8 ± 14.7
CRP (mg/dl)	3.6 ± 4.4
BASFI	2.4 ± 2.0
BASDAI	2.7 ± 1.9
BASMI	3.1 ± 2.2
BASRI	5.6 ± 2.2
HADS-D	5.1 ± 4.2
HADS-A	5.09 ± 4.5
ASQoL	14.3 ± 23.8

VAS visual analogue scale, *ESR* erythrocyte sedimentation rate, *CRP* C-reactive protein, *BASFI* Bath Ankylosing Spondylitis Functional Index, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *BASMI* Bath Ankylosing Spondylitis Metrology Index, *BASRI* Bath Ankylosing Spondylitis Radiology Index, *HADS-A* hospital anxiety and depression scale-anxiety, *HADS-D* hospital anxiety and depression scale-depression, *ASQoL* ankylosing spondilytis quality of life

Table 2 Mean scores of the AS patients and controls for the sleep domains (mean ± SD)

	Patient ($n = 80$)	Control ($n = 52$)	p
Age (years)	35.3 ± 6.7	34.6 ± 6.4	0.55
Sex (male, %)	75	63.5	0.15
Subjective sleep quality	1.3 ± 0.7	0.8 ± 0.6	<0.0001
Sleep latency	0.9 ± 1.06	0.8 ± 0.7	0.21
Sleep duration	1.2 ± 0.9	1.01 ± 0.7	0.11
Habitual sleep efficiency	0.8 ± 1.1	0.2 ± 0.7	<0.0001
Sleep disturbance	1.9 ± 0.7	1 ± 0.5	0.09
Use of sleeping medication	0.1 ± 0.5	0.1 ± 0.5	0.46
Daytime dysfunction	0.5 ± 0.7	0.7 ± 0.6	0.13
Total PSQI	6.4 ± 3.7	4.6 ± 3	0.004

SD standard deviation, *PSQI* Pittsburgh Sleep Quality Index

Correlation analysis between the sleep components and clinical, laboratory, radiological, psychological and QoL parameters

According to Spearman's correlation analysis, poor sleep quality (PSQI total score >5) was positively correlated

Table 3 Coefficient of correlations between sleep parameters and clinical, laboratory, radiological and psychological variables

Variables[a]	Subjective sleep quality	Sleep latency	Sleep duration	Habitual sleep eff.	Sleep disturbance	Sleeping medication	Daytime dysfunc.	Total PSQI
Duration of morning stiffness	0.21	0.19	0.04	−0.04	0.13	−0.13	0.20	0.12
Pain (VAS)	0.27*	0.08	0.28*	0.27*	0.34**	0.27*	−0.07	0.36**
ESR	0.17	0.03	−0.19	−0.17	0.06	−0.21	0.16	0.18
CRP	0.12	−0.11	0.09	0.02	0.13	0.07	0.03	0.07
BASFI	0.12	0.09	−0.01	−0.13	0.04	−0.10	0.14	0.04
BASDAI	0.21	0.25*	0.20	0.17	0.34**	−0.18	0.01	0.29**
BASMI	0.18	0.32**	0.25*	0.25*	0.14	−0.09	0.05	0.27*
BASRI	−0.06	0.10	−0.15	−0.12	−0.20	−0.18	0.03	0.12
HADS-D	0.31**	0.29**	0.18	0.07	0.27*	0.13	0.15	0.36**
HADS-A	0.21	0.07	0.07	−0.01	0.21	0.19	0.18	0.19
ASQoL	0.34**	0.14	0.36**	0.30**	0.22*	0.17	−0.03	0.34**

PSQI Pittsburgh Sleep Quality Index

* $p < 0.05$; ** $p < 0.01$

[a] See Table 1 for acronym definitions

with increased pain, poor quality of life, higher depressed mood, higher disease activity and restricted mobility. However, we did not observe any relationship between the sleep parameters and anxiety and BASFI and BASRI scored (Table 3). Correlations between disease variables and sleep quality components are shown in Table 3.

The multiple regression analysis indicated that BASDAI is independently associated with sleep disturbance ($p < 0.05$). Also, the BASMI is observed to be independently associated with longer sleep latency ($p < 0.05$). Pain is independently associated with sleep disturbance, use of sleeping medication and the total PSQI score ($p < 0.05$). And finally, ASQoL is independently associated with subjective sleep quality, shorter sleep duration and poorer habitual sleep efficiency ($p < 0.05$, $p = 0.001$ and $p < 0.0001$, respectively) (Table 4).

Table 4 Final multivariate regression models in AS patients, PSQI domains as dependent variable

	R^2	β	p
Subjective sleep quality			
ASQoL	0.070	0.265	0.017
Sleep latency			
BASMI	0.076	0.276	0.013
Sleep duration			
ASQoL	0.124	0.352	0.001
Habitual sleep efficiency			
ASQoL	0.191	0.438	<0.0001
Sleep disturbance			
Pain (VAS)	0.178	0.425	<0.0001
BASDAI		0.250	0.021
Sleeping medication			
Pain (VAS)	0.140	0.392	0.001
PSQI total score			
Pain (VAS)	0.114	0.441	0.002

VAS visual analogue scale, *BASMI* Bath Ankylosing Spondylitis Metrology Index, *ASQoL* ankylosing spondilytis quality of life, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *PSQI* Pittsburgh Sleep Quality Index

Discussion

Parallel to the previous studies [5, 28], the sleep quality in our patients was observed to be disturbed in comparison with the healthy controls. We have also observed that the sleep quality is influenced by pain, disease activity, depression, quality of life and increased limitation of movement in patients with AS. According to our observations, 50 % of our AS patients had sleep problems (PSQI total score > 5). The prevalence of sleep problems in our patients appears to be higher than the ratios reported in the general population (15–35 %) [29–31].

Symptoms of depression and anxiety are prevalent in patients with chronic musculoskeletal pain [32, 33]. Clinical and epidemiological studies have already established the link between sleep problems and depression in other populations [34]. Dew et al. [35] have reported that depressive symptoms diminish the quality of sleep. Moreover, Da Costa et al. [13] found that depression is independently associated with poor sleep quality, sleep duration and efficiency in patients with SpA. We have also observed a correlation between the depression and sleep disturbance parameters, such as sleep latency, subjective sleep quality and the total

PSQI score. According to our knowledge, there is no previous study in the literature evaluating the relationship between sleep quality and anxiety in patients with AS. Still, we did not observe any relationship between sleep quality and anxiety in the present study. Since AS is a chronic disease, the level of anxiety we have measured through the HADS may have indicated low results. Since the mean duration of disease in our patients was long, a depressive outlook rather than anxiety was in the foreground.

AS and other spondyloarthropathies affect the quality of life negatively [36, 37]. It has been shown that the diminished quality of life and the disability are correlated with the depression and anxiety [38]. Ozcetin et al. [39] have reported a serious decrease in the quality of life in patients with rheumatoid arthritis, osteoarthritis and fibromyalgia accompanied by a high depression score. Sleep disorders also affect the quality of life and the psychological and physical function in adults with chronic diseases [40, 41]. It has also been shown in another study that the fatigue and the quality of life are closely associated with sleep disorders in patients with AS [5]. Similarly, the diminished quality of life in our study was positively correlated with poor sleep quality. Moreover, by the multivariate regression analysis, the ASQoL was independently associated with shorter sleep duration and poor sleep efficiency. Many patients with AS have difficulty in performing the activities of daily life. This may cause higher fatigue during the day and interrupted sleep at night, thus leading to sleep disorders. Also, the depression that develops as a result of the diminished quality of life in the patients may give rise to sleep disorders.

Sleep disorders are positively correlated with the pain and fatigue in patients with rheumatismal diseases [42]. It has been reported that the pain is associated with difficulty in getting to sleep and poor quality of sleep in patients with AS [43]. Hultgren et al. [5] reported that the pain is the main reason of sleep disturbances in patients with AS. A recent study emphasized that dissolving the pains that occur at night in patients with AS is the most important predictor of improved sleep [14]. We have also found that the pain is positively correlated with poor sleep quality and with five out of the seven sleep disturbance parameters (except sleep latency and daytime dysfunction). The multiple regression analysis indicated that pain is independently associated with sleep disturbance, use of sleeping medications and poor sleep quality.

In our patients, poor sleep quality was observed to be clearly correlated with the level of mobility restriction measured with the BASMI. Moreover, a higher BASMI score was an independent contributor of longer sleep latency in patients with AS. Possibly, due to the restrictions in spinal mobility, patients with AS are more prone to have obstructive sleep apnoea compared to the general population [44]. Also, the difficulty in changing position during the sleep as a result of the restricted mobility may contribute to the sleep disorder.

In a report investigating the correlation of the disease activity with sleep disorders in patients with AS, a positive relationship was detected between the BASDAI score and the sleep disorders. However, since no relationship was described in the multiple regression analysis, only a weak association was reported between the sleep disorders and disease activity [13]. On the contrary, we have observed a significant positive correlation between the disease activity and the sleep disorders in both Spearman's correlation test and the multiple regression analysis in our study.

Da Costa et al. [13] have found a significant relationship between the bad functional status and disturbed sleep parameters (subjective sleep quality, latency, duration and efficiency). Still, we did not detect any relationship between the BASFI scores and the sleep quality. Also, in this study, which is according to our knowledge the first one to evaluate the relationship between BASRI and sleep disorders, no association was observed between the radiological damage and the sleep parameters. Sleep disturbance may only caused by the inflammatory (acute) component of mobility restriction, not by the radiological (chronic) component.

The present study had certain limitations, the primary one being its cross-sectional design. Prospective studies are needed in order to fully reveal the relationship between the disease activity, depression, quality of life, pain, restricted mobility and sleep quality. Besides, we evaluated the sleep quality with a questionnaire, while a polysomnographic evaluation could have supplied more accurate results.

Conclusion

Based on the results of this study, we may conclude that sleep disorders in patients with AS are more common compared to the general population. The PSQI is a widely employed method, and the results obtained from the present study are coherent with those reported in recent articles [13, 45]. The study has underlined the need to investigate sleep disorders during the routine examination of the patients with AS. Sleep disturbances in patients with AS occur due to multifactorial origins, and therefore, non-pharmacological treatment options (like cognitive behavioural therapy) should also be considered besides the pharmacological treatment methods.

Conflict of interest None.

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