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ORIGINAL ARTICLE

Fatigue in patients with ankylosing spondylitis: prevalence and relationships with disease-specific variables, psychological status, and sleep disturbance

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Abstract This study aims to evaluate the frequency of fatigue in Moroccan patients with ankylosing spondylitis (AS), and its relationships with disease-specific variables, psychological status, and sleep disturbance. A cross-sectional study included patients fulfilled the modified New York classification criteria for ankylosing spondylitis. To assess fatigue, the first item of Bath ankylosing spondylitis disease activity index (BASDAI) and the multidimensional assessment of fatigue (MAF) was used. The evaluation included the activity of the disease (BASDAI), global well-being (Bath ankylosing spondylitis global index), functional status (Bath ankylosing spondylitis functional index), metrologic measurements (Bath ankylosing spondylitis metrological index), and visual analog scale of axial or joint pain. The erythrocyte sedimentation rate and C-reactive protein were measured. To assess psychological status, the hospital anxiety and depression scale (HADS) was used. Sleep disturbance was assessed by the fourth item of Hamilton anxiety scale. One hundred and ten patients were included, of average age 38.0 years ± 12.6. In our data, 66.4% experienced severe fatigue (BASDAI fatigue ≥5). The mean total score of MAF was 26 ± 12.77. The disease-specific variables contributed significantly with both BASDAI fatigue and MAF as dependent variables, accounting for 71.3 and 65.6% of the variance, respectively. The contribution of the depression, anxiety, and sleep disturbance were 24.9, 18.4 and 15.4%, respectively. This study state the importance of fatigue in AS patients. Even though disease activity was the most powerful predictor of fatigue, the effects of psychogenic factors and sleep disturbance, should be taken into consideration in the management of AS.

Keywords Ankylosing spondylitis · Fatigue · Depression · Anxiety · Sleep disturbance · Disease activity

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Introduction

Fatigue encompasses complex interactions between biological, psychosocial, and behavioral processes, and had been defined medically as that state, following a period of mental or bodily activity, characterized by a lessened capacity for work and reduced efficiency of accomplishment, usually accompanied by a feeling of weariness, sleepiness or irritability [1]. In the other hand, fatigue is an enduring, subjective sensation of generalized tiredness or exhaustion [2].

Fatigue is accepted as a major symptom in many rheumatic diseases, including systemic lupus erythematous and

rheumatoid arthritis. In ankylosing spondylitis AS disease, fatigue has been only recently considered a core symptom greatly affecting patients [1, 3].

Indeed, fatigue has been ignored for a long time probably because it is a subjective functional sign of other factors (associated diseases, depression, side effects of drugs) or confounded with the other symptoms of the disease and/or disease consequences such as chronic pain or sleep disorders. In addition, fatigue is difficult to evaluate.

Fatigue has been recognized as an important symptom in AS and must be evaluated accurately and considered in therapeutic management [3].

It has many aspects, with different levels of intensity. Indeed fatigue has been conceptualized as a multidetermined phenomenon modulated by various factors. Fatigue can be explained by demographic and social factors, disease-specific variables, it is strongly associated with psychological factors and sleep disturbance [4].

However, there are limited studies about the multidimensional nature of fatigue on patients with AS, and especially its association with depression and sleep disturbance [5]. Our study is the first in Morocco that evaluates fatigue as principal criteria, knowing the frequency and severity of AS in our country. This is what makes the originality of our work.

This study was designed to assess the following in patients with AS: (a) the prevalence of fatigue (b) and its association with demographic variables (age, gender, disease duration), disease-specific variables (pain, morning stiffness, disease activity, and functional status), and other variables that can have an impact on fatigue (depression and sleep disturbance).

Patients and methods

110 consecutive patients with an age >18 years who fulfilled the modified New York classification criteria for ankylosing spondylitis [6], had differing levels of symptomatic activities, and were willing to participate in the study were recruited. The patients who had other diseases which may cause fatigue, such as fibromyalgia, malignancy, and other chronic diseases, were excluded from the study. We have the ethics committee consent on this matter.

Demographic characteristics, disease-specific variables (disease duration, duration of morning stiffness, the number of nocturnal awakenings, tender, and swollen joint count…) were documented for each patient. The disease activity and functional status of patients were evaluated by the Bath ankylosing spondylitis disease activity index (BASDAI) and the Bath ankylosing spondylitis functional index (BASFI), respectively. The Bath ankylosing spondylitis metrology index (BASMI), the Bath ankylosing spondylitis global score (BAS-G), and visual analog scale of axial or joint pain (VAS, 0–10 cm) were used for evaluation of metrologic measurements, global well-being, and pain, respectively. The erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were measured, and applied as biologic signs of inflammation. We consider that the ESR is positive if it exceeds 20 mm/1st H, and CRP was positive from 6 mg/l.

Fatigue

Fatigue was assessed by the fatigue item of the BASDAI and the multidimensional assessment of fatigue MAF. The fatigue item of the BASDAI was used as the disease-specific measure. The BASDAI has been developed to assess self-reported disease activity in AS [6, 7], and was adapted in the Moroccan cultural context, and validated in patients with AS by Rostom and Benbouazza [8]. The severities of fatigue, spinal pain, joint pain, localized tenderness, morning stiffness, and duration of stiffness are measured by visual analog scales (VASs) that range from 0 = no problems to 100 = most severe problem. In accordance with previous studies [9, 10], the fatigue item was used to estimate fatigue.

The multidimensional assessment of fatigue (MAF) scale contains 16 items and covers four dimensions of fatigue: severity (MAF 1 and MAF 2), distress (MAF 3), degree of interference in activities of daily living (MAF 4), and timing (MAF 5). Items are rated using a 10-point numerical scale (14 items) or multiple-choice (4 choices) responses (2 items). A global fatigue index (GFI) can be computed using 15 out of the 16 items and ranges from 1 (no fatigue) to 50 (severe fatigue) [11, 12].

Patients were dichotomized into a F+ group (fatigue = major symptom) if the BASDAI fatigue score was ≥5.0 and a F− group (fatigue = minor symptom) if the fatigue score was <5.0.

Depression

The hospital anxiety and depression scale (HADS) was used in patients with ankylosing spondylitis to assess depression and anxiety. This scale was developed by Zigmond and Snaith [13], and Arabic version of this scale was assessed by Malasi TH and Mirza IA, [14] for its validity and reliability. The hospital anxiety and depression scale (HADS) is a 14-item scale designed to detect anxiety and depression, independent of somatic symptoms. It consists of two 7-item subscales measuring depression and anxiety. A 4-point response scale (from 0 representing absence of symptoms, to 3 representing maximum

symptomatology) is used, with possible scores for each subscale ranging from 0 to 21. Higher scores indicate higher levels of disorder. A number of clinical classification schemes have been used to categorize scores on the HADS. In the original article, the following cut offs were suggested: 0–7 = "non-cases"; 8–10 = "possible case"; 11–21 = "probable case". This scale is used to scan anxiety and depression in a short time to diagnose the level of risk in physically ill patients. We used HADS-D ≥8 to define the depressed subgroup and HADS-A ≥8 to define the anxious subgroup [15, 16].

Sleep disturbance

The Hamilton anxiety scale is a rating scale developed to quantify the severity of anxiety symptomatology [17]. It consists of 14 items, each defined by a series of symptoms. Each item is rated on a 5-point scale, ranging from 0 (not present) to 4 (severe). Sleep disturbance was assessed by the fourth item of Hamilton, and scored according to: 0: not present, 1: mild, 2: moderate, 3: severe, 4: very severe.

Statistical analysis

Data were analyzed using SPSS for Windows, version 13 and level of significance was set as $P < 0.05$.

Descriptive data were used for assessing the parameters related to disease. The differences in terms of variables that are studied in patients who are grouped as F+ and F− according to BASDAI fatigue score were evaluated with independent sample t test and Mann–Whitney U test. The relationships between the fatigue and the other evaluation parameters were examined with the Spearman's rank correlation analysis. Two different hierarchical regression models were used in order to determine predictors of fatigue. In the first model, BASDAI fatigue score and MAF fatigue score were taken as the dependent variable. Independent variables were entered into the models in four blocks, including different categories. Block 1 consisted of demographic variables (age and sex), block 2 consisted of disease-specific variables (morning stiffness, number of nocturnal awakenings, axial and joint pain, disease duration, BASDAI, BASFI), block 3 consisted of other variables related with fatigue (sleep disturbance, depression, and anxiety), and block 4 consisted of medication used by patients (nonsteroidal anti-inflammatory drugs (NSAID), disease-modifying antirheumatic drugs: sulfasalazine, methotrexate, leflunomide, and TNF blockers). In the second model, stepwise hierarchical regression analysis was repeated with the independent variables, which were obtained from the first model.

Result

The patient sample comprised 75 men and 35 women. The mean age of patients was 38.52 ± 12.62 years, and the median of disease duration was 9 (0–40) years. Demographic and disease-related data, the level of fatigue, depression, anxiety, and sleep disturbance of the patients are given in Table 1; Fig 1. It was observed that 54.4% of patients had ESR ≥20 mm/1rst H, 85.5% had CRP ≥6 mg/l, 87.3% received NSAID, and 36.4% received disease-modifying antirheumatic drugs.

The mean fatigue items of the BASDAI, the MAF which assesses fatigue multidimensionally were 5.47 ± 2.88 and 26.73 ± 12.77, respectively. The MAF subscale scores are provided in Table 2. The mean of HAD depression and HAD anxiety were 9.10 ± 5.39 and 9.59 ± 5.09, respectively.

It was observed that 66.4% of patients had fatigue, 64.5% had sleep disorders, 55.5% had depression, and 60% had anxiety.

66.4% (73) of the patients were included in the F+ group, and 33.6% (37) in the F− group. F+ group

Table 1 Demographic and disease-related characteristics of patients with ankylosing spondylitis

Age[a], year	38.52 ± 12.62
Disease duration[b], years	9 (0–40)
The number of nocturnal awakenings[a]	1.46 ± 1.43
Duration of morning stiffness[b], min	30 (0–180)
Axial pain[a] (VAS)	44.90 ± 27.98
Joint pain[a] (VAS)	28.22 ± 33.48
Tender joint count[a]	2.78 ± 4.44
Swollen joint count[a]	1.30 ± 2.52
Fatigue item of BASDAI[a]	5.47 ± 2.88
BASDAI[a]	4.41 ± 2.62
BASFI[a]	5.52 ± 3.07
BASMI[a]	4.91 ± 3.59
BAS-G[a]	60.86 ± 26.51
ESR (mm/1st H)	29.24 ± 23.23
CRP (mg/l)	21.05 ± 23.99
MAF1[a]	26.73 ± 12.77
HAD Anxiety[a]	9.59 ± 5.09
HAD Depression[a]	9.10 ± 5.39
Male percentage	68.2%
Coxitis	58.2%

[a] Mean ± SD, [b] median (range)

VAS visual analog scale, *BASDAI* bath ankylosing spondylitis disease activity index, *BASFI* bath ankylosing spondylitis functional index, *BASMI* bath ankylosing spondylitis metrology index, *BAS-G* bath ankylosing spondylitis global score, *HAD* hospital anxiety and depression scale, *ESR* erythrocyte sedimentation rate, *CRP* C-reactive protein

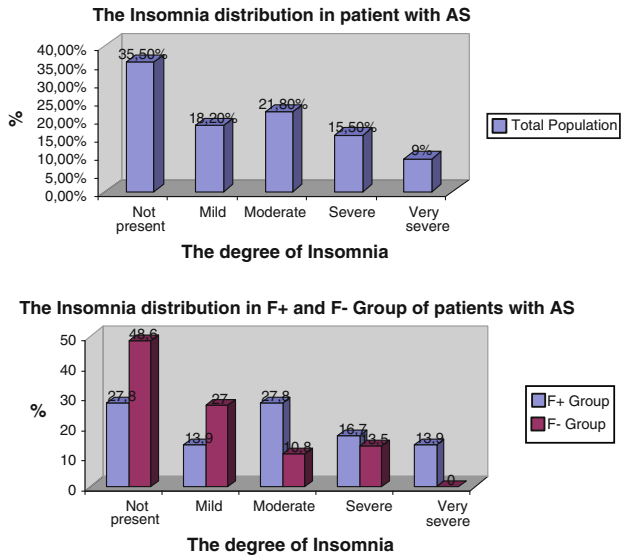

Fig. 1 The insomnia distribution of patients with ankylosing spondylitis

Table 2 Total and subscale scores of MAF patients with Ankylosing Spondylitis

Total MAF	26.73 ± 12.77
MAF1 Severity of fatigue	5.62 ± 2.94
MAF 2 Severity of fatigue	5.57 ± 3.03
MAF 3 Distress of fatigue	5.33 ± 3.06
MAF 4 Degree of interference in activities of daily living	5.25 ± 2.87
MAF 5 Timing of fatigue	4.91 ± 2.13

Mean ± SD, *MAF* multidimensional assessment of fatigue

scored significantly different from the F− group with respect to each subscales of the MAF, all disease-specific variables (disease duration, duration of morning stiffness, the number of nocturnal awakenings, tender, and swollen joint count…), depression, anxiety, and sleep disturbance ($P < 0.02$). With regard to positive CRP, there was not a statistically significant difference between the two groups ($P > 0.05$) (Table 3).

The fatigue level according to the fatigue question of BASDAI was significantly associated with MAF ($P < 0.0001$).

Both the disease-specific variables, such as disease activity ($r = 0.886$, $P = 0.000$), functional status ($r = 0.595$, $P = 0.000$), metrological measurements ($r = 0.325$, $P = 0.001$), global well-being ($r = 0.708$, $P = 0.000$), joint pain ($r = 0.440$, $P = 0.000$), axial pain ($r = 0.331$, $P = 0.000$, duration of morning stiffness ($r = 0.526$, $P = 0.000$), number of nocturnal awakenings ($r = 0.530$, $P = 0.000$), ESR ($r = 0.437$, $P = 0.000$), and CRP ($r = 0.288$, $P = 0.002$), and depression ($r = 0.482$, $P = 0.000$), anxiety ($r = 0.412$, $P = 0.000$), and sleep disturbance ($P = 0.000$) were significantly correlated with the fatigue assessed by BASDAI fatigue question. With regard the demographic variables; there was significant relationship between sex and the fatigue with $P = 0.004$. However, there was no significant relationship between age and the fatigue ($r = -0.086$, $P = 0.375$).

Tables 4 show block regression models with the fatigue items of the BASDAI score and the total MAF score as dependent variables. Block 1, the demographic variables (age and sex), explained 8.3 and 6.3% of the variance in the BASDAI fatigue model and the total MAF model, respectively. The disease-specific variables (block 2), covering morning stiffness, number of nocturnal awakenings, pain, disease duration, BASDAI, BASFI, contributed significantly with both BASDAI fatigue and MAF as dependent variables, accounting for an additional 71.3% and 65.6% of the variance, respectively. The other variables related with fatigue (sleep disturbance and psychological status) (block 3) contributed significantly 5% and 6.4% in fatigue scores of BASDAI and MAF. The variables related with medications (NAIDS and others) (block 3) contributed significantly 10% and 3% in fatigue scores of BASDAI and MAF.

In the final model (blocks 1–4), 81.2% of the variation was explained with the BASDAI fatigue as the dependent variable, whereas the final model accounted for 78.7% of the variation with the MAF as the dependent variable.

In order to determine the most powerful predictor of fatigue, the stepwise hierarchical regression analysis was performed with the variables obtained from disease activity explained 75.1% of the variance in fatigue assessed by BASDAI fatigue question and 58.7% of variance in fatigue with MAF. The contribution of the depression to the fatigue was 24.9% with BASDAI fatigue question, 41.1% of variance in fatigue with MAF, and the anxiety was 18.4% with BASDAI fatigue question, 31.5% of variance in fatigue with MAF. The contribution of the sleep disturbance to the fatigue was 15.4% with BASDAI fatigue question, 20.5% of variance in fatigue with MAF.

Discussion

Fatigue has been described as a major symptom in AS, with up to 65% of the patients reporting it [18–21]. In the present study, 66.4% of all patients experienced fatigue, defined as a BASDAI fatigue score of >5.0.

We assessed the properties of both the single-item BASDAI fatigue question and a multidimensional assessment of fatigue questionnaire, the MAF. The advantage of a single question is that it is easy to complete. Important disadvantages are that detailed information is lost with

Table 3 Differences between F + group and F − group with respect to the disease-specific measures, subscales of MAF, depression, anxiety and sleep disturbance

Questionnaire	F+ group ($n = 73$)	F− group ($n = 37$)	P
MAF total[a]	33.02 ± 8.27	14.59 ± 11.34	<0.0001
MAF1[a] Severity of fatigue	7.08 ± 2.06	2.78 ± 2.28	<0.0001
MAF2[a] Severity of fatigue	7.02 ± 2.12	2.78 ± 2.59	<0.0001
MAF3[a] Distress	6.65 ± 2.43	2.75 ± 2.53	<0.0001
MAF4[a] Degree of interference in activities of daily living	6.43 ± 2.30	3.05 ± 2.54	<0.0001
MAF5[a] Timing	5.78 ± 1.30	3.21 ± 2.42	<0.0001
Fatigue item of BASDAI[a]	7.12 ± 1.86	2.27 ± 1.46	<0.0001
BASDAI[a]	5.75 ± 2.14	1.82 ± 1.08	<0.0001
BASFI[a]	6.40 ± 2.79	3.80 ± 2.88	<0.0001
BASMI[a]	5.50 ± 3.57	3.91 ± 3.39	0.028
BAS-G[a]	71.45 ± 22.15	40.20 ± 22.31	<0.0001
Axial pain[a] (VAS)	51.11 ± 27.65	34.05 ± 24.65	0.002
Joint pain[a] (VAS)	36.80 ± 35.51	10.94 ± 20.94	<0.0001
Duration stiffness[a] min	57.01 ± 47.83	16.81 ± 20.15	<0.0001
The number of nocturnal awakenings[a]	1.86 ± 1.47	0.72 ± 0.99	<0.0001
HAD depression[a]	10.37 ± 5.57	6.64 ± 4.16	0.001
HAD Anxiety[a]	10.77 ± 5.16	7.35 ± 4.25	0.001
The female percentage[b]	36.1	21.6	0.05
Positive ESR[b]	67	29	<0.0001
Positive CRP[b]	89	78	0.142

[a] Mean ± SD, [b] %

VAS visual analog scale, *BASDAI* Bath ankylosing spondylitis disease activity index, *BASFI* Bath ankylosing spondylitis functional index, *BASMI* Bath ankylosing spondylitis metrology index, *BAS-G* Bath ankylosing spondylitis global score, *HAD* hospital anxiety and depression scale, *MAF* multidimensional assessment of fatigue, *ESR* erythrocyte sedimentation rate, *CRP* C-reactive protein

respect to the type of fatigue, and that it does not take into account differences in fatigue experience [22]. The advantage of a MAF in our experience is that it deals with different aspects of fatigue, i.e., it provides to identify fatigue reported by AS patients in more details.

It was determined that fatigue was associated with disease-specific parameters, as well as psychological status and sleep disturbance. It was found that the disease activity was the most powerful predictor of fatigue, and in addition psychological status also had an effect.

Fatigue is a frequent complaint reported by patients with AS and is still largely ignored in terms of clinical care, education, and research. Fatigue represents the third most common complaint after pain and stiffness, the major symptoms of AS [3]. In some studies, fatigue was reported as the main symptom by 50–65% of patients [20, 21].

In studies where BASDAI fatigue questions were used and threshold value for fatigue taken as ≥5, the frequency was reported as 53–63% [9, 23, 24]. In our research, 66.4% of all patients experienced fatigue, defined as a BASDAI fatigue score of ≥5.

In this study, fatigue levels of the patients were found to be related to disease-specific variables and psychological status and level of sleep disturbance. Similar relationships between fatigue and measures of self-reported disease activity, limitations in functional abilities, stiffness, and pain have also been reported by others [9, 18, 20, 24, 25].

The relationship among fatigue, sleep disturbances, and mental health status has not been investigated as much. Mental health status has not typically been examined as a potential determinant of fatigue in AS. Mental health status is emerging as an important factor linked to fatigue in other arthritic conditions, such as rheumatoid arthritis and systemic lupus erythematosus [26, 27]. The association between fatigue and worse mental health may in part be explained by overlapping symptoms (e.g., overlapping symptoms of depression and fatigue). However, there is evidence to suggest that although fatigue and depression frequently occur together, fatigue is neither sensitive nor specific to the diagnosis of depression [28–30]. Studies have also shown that fatigue can be measured independent of depression [31, 32]. Prospective studies are needed to elucidate underlying mechanisms between fatigue and mental health in patients with AS. In our study, 55.5% of the patients had depression and 60% had anxiety, which is higher than the literature data. The estimates of the prevalence of emotional problems were from 20 to 31% [21, 33, 34]. Calin and colleagues compared groups of AS patients

Table 4 Results of hierarchical multiple regression analysis with BASDAI fatigue item and MAF total score as the dependent variables

Independent variables	Dependent variables									
	BASDAI fatigue item					MAF				
	β (95% CI)	P^a	R^2 change	P	R^2	β (95% CI)	P^a	R^2 change	P	R^2
Block 1: demographic variables			0.083	0.010	0.083			0.063	0.031	0.063
Age	−0.023 (−0.033, 0.022)	0.704				0.089 (−0.041, 0.222)	0.174			
Sex (Femal)	−0.078 (−1.157, 0.185)	0.153				−0.092 (−5.697, 0.646)	0.117			
Block 2: disease-specific variables			0.713	0.000	0.797			0.656	0.000	0.719
Disease duration	−0.085 (−0.073, 0.013)	0.171				−0.190 (−0.501, −0.094)	0.005			
Axial pain (VAS)	−0.005 (−0.022, 0.001)	0.049				−0.055 (−0.076, 0.026)	0.328			
Joint pain (VAS)	−0.015 (−0.025, −0.002)	0.021				−0.015 (−0.114, −0.008)	0.026			
Morning stiffness	−0.006 (−0.008, 0.007)	0.916				0.037 (−0.025, 0.046)	0.551			
The number of nocturnal awakenings	−0.128 (−0.502, −0.015)	0.038				−0.201(−2.955, −0.065)	0.003			
BASDAI	0.959 (0.858, 1.249)	0.000				2.720 (2.588, 4.439)	0.000			
BASFI	0.154 (0.021, 0.269)	0.022				0.873 (0.555, 1.723)	0.000			
Block 3: other variables related with fatigue			0.005	0.458	0.802			0.064	0.000	0.784
Depression	0.089 (−0.033, 0.128)	0.243				0.205 (0.105, 0.866)	0.013			
Anxiety	0.049 (−0.046, 0.101)	0.456				0.194 (0.139, 0.833)	0.007			
Sleep disturbance	−0.047 (−0.381, 0.180)	0.477				−0.088 (−2.166, 0.484)	0.211			
Block 4: treatment			0.010	0.097	0.812			0.003	0.529	0.787
NAIDS	−0.027 (1.184, 0.704)	0.615				−0.063 (−6.949, 1.978)	0.272			
Disease-modifying antirheumatic drugs	−0.120 (−1.382, −0.053)	0.035				−0.041 (−4.223, 2.059)	0.496			

* See Table 1 for acronym definitions

by main symptoms (i.e., pain, stiffness, and fatigue) and found that patients reporting primarily fatigue or pain scored significantly higher on depression and anxiety compared with stiffness cohort [18]. Similarly, in our study patients who had hight fatigue levels had higher depression and anxiety scores as well.

Sleep disturbance is often reported by the patients with AS (86–91%), with wakenings produced by inflammatory pain [20] and [9]. However, it's may also be due to psychological disorders. Patients complaining of important fatigue were more likely to have more than 3 wakenings in one night and to feel tired in the morning. Gunaydin and et al. found that 54.8% of the patients had sleep disturbance [5]. In another study, the fatigue + group reported more sleep disturbance, with 41% (compared to 26% of the fatigue group). In our research, it was observed that 72.2% of the patients had disturbance of sleep quality in fatigue group+ (compared to 51.4% of the fatigue− group) [20]. This studies suggests that a positive relation is established between fatigue and sleep problems.

As a result of multi-variable hierarchical regression analysis, it was observed that disease-specific variables have a considerable effect on both BASDAI fatigue question and fatigue which is assessed by MAF, while demographic variables and other variables associated with fatigue (depression, anxiety, sleep disturbance, and medication of AS) have less effect. Disease activity and mental health explained more than 70% of change in fatigue. In a similar study by Dagfinrud et al., it was reported that self-reported disease activity and mental health explained almost half of the change in fatigue [23]. In the study of van Tubergen et al., fatigue implicitly appeared to be related to disease activity, functional ability, global well-being, mental health status, and age, explained 52% of the variance [9].

In our study, the disease-specific variables contributed significantly with both BASDAI fatigue and MAF as dependent variables, accounting for 71.3 and 65.6% of the variance, respectively. The contribution of the depression, anxiety, and sleep disturbance to the fatigue were 24.9, 18.4 and 15.4%, respectively.

In the other hand, the variables related with medications (NAIDS and others) (block 4) contributed significantly 10 and 3% in fatigue scores of BASDAI and MAF. Use of

nonsteroidal anti-inflammatory drugs (NSAID) and analgesics are relatively effective in reducing fatigue. Patients with AS and fatigue felt that the medication they took for their disease (NSAID) reduced their fatigue [20]. A recent study by Dernis–Labous et al. [21] showed that nonsteroidal antiinflammatory drug therapy strongly reduced pain and functional impairment in a group of AS patients, whereas the change in fatigue level was of lower magnitude. Anti-TNF therapy has demonstrated efficacy in patients with active AS including probably a specific effect on fatigue. In the Heiberg et al. study, 3-month anti-TNF therapy reduced the level of fatigue by more than 55% [38]. In other studies, however, fatigue was not influenced by this treatment [39]. Thus, the relationship between fatigue and inflammatory markers is unclear, and more clinical trials are needed to explore whether interventions, such as disease-modifying drugs and physical activity, influence self-reported fatigue.

Our study has some limitations. Firstly, our sample size was small. Secondary, we did not have healthy control group in order to compare the frequency of the fatigue and the others factors related fatigue. Thirdly, we did not consider other factors that might explain the unexplained variance in fatigue. Exercise habits of the patients, the number of tasks at home or work, availability of caregiver at home, marital status, and satisfaction in work and/or life might have affected their fatigue levels. Studies which are followed for a long time, which have more patients and include other variables that may affect fatigue, may be a better guide in terms of fatigue process and determining the factors associated with it.

In conclusion, fatigue is a major symptom in the majority of patients with AS, in particular those with more severe disease. This study confirms that the Moroccans AS were active and severe [35–37], and states the importance of fatigue and psychological disorders in AS patients. Even though disease activity was the most powerful predictor of fatigue, the effects of psychogenic factors and sleep disturbance, should be taken into consideration in the management of AS.

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Conflict of interest None.

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