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Correlates of depression, anxiety, and stress among patients with ankylosing spondylitis

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Abstract

Background The recurrent nature and prolonged course of ankylosing spondylitis (AS) impose substantial psychological disorders on patients. The aim of this study was to assess psychological disorders and analyze the overall risk of psychological disorders as well as the factors associated with depression, anxiety, and stress in ankylosing spondylitis.

Methods Patients diagnosed with AS were selected from the China Rheumatoid Arthritis Registry of Patients with Chinese Medicine (CERTAIN) database for data analysis. General demographic characteristics and disease-related features of the patients were collected. The study analyzed clinical differences between patients with and without psychological disorders. Specific clinical characteristics of depression, anxiety, and stress were statistically analyzed. Clinical factors associated with overall psychological status and specific psychological disorders (depression, anxiety and stress) were analyzed by multivariate logistic regression.

Results In our study cohort, 26.72% of AS patients were identified with psychological disorders, with 17.5% experiencing depression, 21.1% suffering from anxiety, and 7.9% reporting stress. We also observed significant overlaps among depression, anxiety, and stress in AS patients, with 53.47% experiencing multiple psychological disorders. Disease activity, health index, fatigue levels, and PGA were identified as significant factors associated with psychological disorders. Age, health index, fatigue levels, and PGA were the main influencing factors for depression; disease activity and PGA for anxiety; and disease activity, ASAS-HI, and fatigue for stress.

Conclusions The study reveals a significant prevalence of psychological disorders among individuals with AS, which correlates closely with disease activity, health index, fatigue levels, and PGA. These findings highlight the imperative for assessment of psychological conditions into the comprehensive management approach for AS patients.

Keywords Ankylosing spondylitis, Psychological disorder, Depression, Anxiety, Stress, Factors

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Background

Ankylosing spondylitis (AS) is a chronic inflammatory condition causing lower back pain, stiffness, and fatigue, potentially leading to disability and impacting daily function and health. It primarily affects young males under 30 in China [1]. Moreover, the recurrent nature and prolonged course of the disease impose substantial psychological disorders on patients and their families, often exacerbating the severity of the illness due to psychological disorders.

Anxiety and depression are two common psychological responses among patients with AS. Persistent physical discomfort and uncertainty about future health frequently lead to anxiety, while the long-term disease burden and declining quality of life can trigger depression. A systematic review by Hopkins [2] of 17 cross-sectional studies on the prevalence of depression among AS patients found rates ranging from 4.9% to 55.5%. In another study involving 296 patients, 13.5% of those with AS suffered from anxiety. Additionally, the constant stressors faced by AS patients, such as chronic pain, limited daily activities, and reduced work capabilities, can further aggravate psychological strain and impact mental health. This study aims to assess the states of anxiety, depression, and stress in patients with ankylosing spondylitis.

Methods

Study design and patients

The China Rheumatoid Arthritis Registry of Patients with Chinese Medicine (CERTAIN) is a database that stores longitudinal electronic health records data of patients. Under this data platform, we have established four specialized disease databases for rheumatoid arthritis, ankylosing spondylitis, Sjögren's syndrome and rheumatoid arthritis-associated interstitial lung disease respectively. Patients' data were collected at the initial visit and during every three-month follow-up, and subsequently entered into the database. Using the ankylosing spondylitis-specific database in the CERTAIN database, we collected baseline outpatient data from July 2022 to May 2024 for patients with AS in seven hospitals across the country.

The seven hospitals are Guang'anmen Hospital of the Chinese Academy of Traditional Chinese Medicine (Beijing), Xiyuan Hospital of the Chinese Academy of Traditional Chinese Medicine (Beijing), Southwest Hospital of the Army Medical University (Chongqing), Affiliated Hospital of Jiangxi University of Traditional Chinese Medicine (Jiangxi), Affiliated Hospital of Liaoning University of Traditional Chinese Medicine (Liaoning), Shenzhen Traditional Chinese Medicine Hospital (Shenzhen), and Guanghua Hospital of Integrated Chinese and Western Medicine (Shanghai). These hospitals are located in various regions across China, ensuring a broad representation of the Chinese population.

Patients enrolled in the database were diagnosed according to the New York Ankylosing Spondylitis Criteria, revised in 1984. For individuals who did not fully meet these criteria, the classification guidelines for axial Spondyloarthritis (ax-SpA) were referenced as supplementary diagnostic criteria. At the time of analysis, 378 patients were included. The study was approved by the institutional ethics board of the Guang'anmen Hospital of Chinese Academy of traditional Chinese medicine (2022-108-KY). All selected patients signed the informed consent form. The clinical trial registration number is ChiCTR2200058934 (2022-04-20).

Data collection

Patients were enrolled by clinical physicians from each participating center. Prior to the start of the study, all clinical physicians underwent a researcher training program to standardize the patient recruitment process and the completion of questionnaires. The training ensured uniformity in patient enrollment and questionnaire completion across all centers. This approach minimized variability between centers and ensured consistent data collection.

The following data were obtained: age, sex, body mass index, comorbidities, family history (The patient's family history reveals the presence of ankylosing spondylitis among blood relatives), human leucocyte antigen (HLA) types, employment status and pecuniary loss. In addition, laboratory data, including C-reactive protein (CRP) levels, were collected.

To assess the patient's psychological well-being, DASS-21 was utilized. DASS-21 [3] consists of three subscales that are depression, anxiety, and stress. Each subscale includes seven questions which are graded on a 4-point Likert scale from 0 to 3 (0 "Did not apply to me at all," 1 "Applied to me to some degree, or some of the time," 2 "Applied to me to a considerable degree, or a good part of time," 3 "Applied to me very much, or most of the time"). For depression, total score from 0 to 9 was considered as normal, from 10 to 13 was mild, from 14 to 20 was moderate, from 21 to 27 were considered as severe, above 28 was considered extremely severe. The anxiety subscales were considered as normal (0–7), mild (8, 9), moderate (10–14), severe (15–19), and extremely severe (20–42). The total stress subscale was considered as normal (0–14), mild (15–18), moderate (19–25), severe (26–33), and extremely severe (34–42). The presence of stress, anxiety and depression can be defined as a psychological disorder.

For fatigue assessment, the Functional Assessment of Chronic Illness Therapy—Fatigue (FACIT-F) was utilized. The FACIT-F scale [4] is a 13-item questionnaire

assessing self-reported fatigue and the total score ranges from 0 to 52. For the analysis of fatigue severity, scores were categorized into two levels: a score of 40 to 52 indicating little or no fatigue, and a score of 0 to 39 denoting significant fatigue [5].

The Assessments of SpondyloArthritis international society Health Index (ASAS-HI) was applied to measure the health status specifically in patients with ankylosing spondylitis. The ASAS-HI [6] consists of 17 items encompassing various aspects such as pain, work capability, sleep quality, emotional states, social interaction difficulties, and limited mobility. Scoring for each item is binary: 'Yes' (indicating the presence of an issue) scores 1 point, and 'No' (no issue present) scores 0. The total score ranges from 0 to 17, where higher scores indicate greater impact on the patient's health, reflecting more severe symptoms and impaired quality of life in AS.

The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) provided insights into the disease activity. BASDAI [7] is a self-assessment tool used to determine the disease activity in patients with Ankylosing Spondylitis. It measures six areas: fatigue, spinal pain, joint pain/swelling, areas of localized tenderness, morning stiffness duration, and morning stiffness severity. Each area is scored on a 10 cm Visual Analogue Scale (VAS), with the overall score calculated as the average of the six scores, ranging from 0 (no activity) to 10 (maximum activity). Scores were categorized into two grades: disease activity was defined as a BASDAI score of 4 or greater, while disease remission was characterized by a BASDAI score of less than 4.

The Patient Global Assessment (PGA) reflects the patient's perspective on their condition, incorporating factors like pain, functionality, and overall well-being. Patients rate their overall health status or disease activity using a 10 cm VAS, where 0 represents excellent health and 10 indicates extremely poor health.

The Bath Ankylosing Spondylitis Functional Index (BASFI) was used to evaluate physical functioning. BASFI [7] has 10 items. Eight items concerning activities referring to the functional anatomy of the patients (bending, reaching, changing position, standing, turning, and climbing steps), and 2 items assessing the patients' ability to cope with everyday life. Responses are recorded on a VAS (0–10 cm), anchored by the descriptors "easy" and "impossible".

Statistical analyses

Continuous parameters are summarized as the median and IQR and categorical parameters are presented as absolute and relative frequencies. Chi-square test, and/or Mann-Whitney U test were used to evaluate the difference between continuous and categorical variables in the psychological disorders patients with AS and non- psychological disorders patients with AS. We utilized multivariate logistic regression models to explore risk factors associated with several psychological conditions: psychological disorders in general, depression (with total scores of 10 or higher), anxiety (with total scores of 8 or higher), and stress (with total scores of 15 or higher). Statistical analysis was performed using R software. P-values less than 0.05 were considered as statistically significant.

Result

Patient characteristics stratified by psychological disorders

The main demographic, disease-related characteristics are presented in Table 1. This study included 378 patients with AS. The median age of the participants was 36 years, with the majority of them, accounting for 72%, being under the age of 44 and within the working-age population. In terms of sex distribution, 80.42% of the participants were male, while 19.58% were female. Body mass index (BMI) was recorded for all participants, with 52.91% falling into the overweight or obese category. Regarding smoking history, 34.39% of the patients reported a history of smoking. Among the patients with psychological disorders, 51.49% were smokers, compared to only 28.16% of smokers among those without psychological disorders. This difference was statistically significant ($P < 0.001$). Additionally, comorbid conditions were also taken into account. 5.56% of the patients had hypertension, and 2.65% had a diagnosis of diabetes. These factors collectively provided a comprehensive overview of the patient demographic and health status in our study.

In this study, the median disease duration for patients was 10 years. Those with psychological disorders experienced longer disease durations, averaging 14 years, significantly longer than the 9-year average in patients without psychological disorders ($P < 0.001$). Regarding extra articular manifestation, 16.67% of patients had uveitis, 7.41% had inflammatory bowel disease (IBD). A substantial 22.75% of the cohort reported a family history of ankylosing spondylitis. The median BASDAI score was 1.98, with a higher proportion of patients with psychological disorders (38.61%) in an active disease state compared to those without (13.72%). Similarly, the median BASFI score was 0.9, increasing to 3.0 in patients with psychological disorders, significantly higher than the 0.4 in those without ($P < 0.001$). The ASAS-HI also followed this trend, with a median score of 5 overall, but 10 in patients with psychological disorders, versus 4 in those without ($P < 0.001$).

Significant fatigue was observed in 31.68% of patients with psychological disorders, markedly higher than the 5.42% in patients without psychological disorders ($P < 0.001$). The median PGA score was 5, rising to 7 in those with psychological disorders and falling to 4 in those without ($P < 0.001$).

Table 1 Study sample characteristics of AS patients with and without psychological disorders

Variable	Total (*n* = 378)	AS without psychological disorders (*n* = 277)	AS with psychological disorders (*n* = 101)	*P*
Age	36.00 (31.00–46.00)			
≤44 years	275 (72.75)	205 (74.01)	70 (69.31)	0.643
45–59 years	85 (22.49)	59 (21.30)	26 (25.74)	
≥60 years	18 (4.76)	13 (4.69)	5 (4.95)	
Sex				
Male	304 (80.42)	220 (79.42)	84 (83.17)	0.417
Female	74 (19.58)	57 (20.58)	17 (16.83)	
BMI	24.22 (21.47–27.68)			
<18.5 kg/m^2	21 (5.56)	15 (5.42)	6 (5.94)	0.258
18.5–23.9 kg/m2	157 (41.53)	122 (44.04)	35 (34.65)	
≥24 kg/m2	200 (52.91)	140 (50.54)	60 (59.41)	
Smoke, yes	130 (34.39)	78 (28.16)	52 (51.49)	**<0.001**
Comorbid conditions				
High Blood Pressure	21 (5.56)	16 (5.78)	5 (4.95)	0.756
Diabetes	10 (2.65)	6 (2.17)	4 (3.96)	0.549
Disease Duration	10.00 (5.00–18.00)	9.00 (5.00–16.00)	14.00 (6.00–22.00)	**<0.001**
Extra articular manifestation				
Uveitis	63 (16.67)	42 (15.16)	21 (20.79)	0.194
IBD	28 (7.41)	17 (6.14)	11 (10.89)	0.118
Family History, yes	86 (22.75)	59 (21.30)	27 (26.73)	0.265
HLA B27, positive	230 (60.85)	168 (60.65)	62 (61.39)	0.897
BASDAI	1.98 (1.00–3.45)			
<4	301 (79.63)	239 (86.28)	62 (61.39)	**<0.001**
≥4	77 (20.37)	38 (13.72)	39 (38.61)	
BASFI	0.90 (0.00–2.90)	0.40 (0.00–1.70)	3.00 (1.30–4.90)	**<0.001**
ASAS HI	5.00 (2.00–10.00)	4.00 (1.00–8.00)	10.00 (8.00–13.00)	**<0.001**
FACIT-F				
Little or no fatigue	331 (87.57)	262 (94.58)	69 (68.32)	**<0.001**
Significant fatigue	47 (12.43)	15 (5.42)	32 (31.68)	
PGA	5.00 (2.00–6.00)	4.00 (1.00–6.00)	7.00 (5.00–8.00)	**<0.001**
Employed, yes	222 (58.73)	176 (63.54)	46 (45.54)	**0.002**
Pecuniary loss, yes	194 (51.32)	115 (41.52)	79 (78.22)	**<0.001**
CRP	4.50 (1.91–12.13)			
≤10 mg/L	265 (70.11)	210 (75.81)	55 (54.46)	**<0.001**
>10 mg/L	113 (29.89)	67 (24.19)	46 (45.54)	

Values are presented as median (IQR) of the mean for continuous characteristics and as percentages otherwise

P values were assessed using Mann-Whitney U test for continuous characteristics and Rao-Scott $\chi 2$ tests otherwise. *P* values < 0.05 are shown in bold

BMI Body Mass Index, *IBD* Inflammatory Bowel Disease, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *BASFI* Bath Ankylosing Spondylitis Functional Index, *ASAS-HI* Assessments of SpondyloArthritis international society Health Index, *FACIT-F* Functional Assessment of Chronic Illness Therapy – Fatigue, *PGA* patient global assessment, *CRP* C-Reactive Protein

Employment status was affected, with 58.73% of the overall patient population in the workforce, but only 45.54% of those with psychological disorders, compared to 63.54% without ($P = 0.002$). Pecuniary losses due to illness were reported by 51.32% of patients, with a significantly higher rate (78.22%) among those with psychological disorders compared to those without (41.52%) ($P < 0.001$). Finally, the median CRP level was 4.50 mg/L. Elevated CRP levels (greater than 10 mg/L) were more common in patients with psychological disorders (45.54%) compared to those without (24.19%).

Factors associated with psychological disorders in AS

The results of the multivariate logistic regression analysis, presented in Table 2 and Fig. 2(a), included significant indicators from Table 1. Furthermore, age and sex were incorporated into our model since it is a biologically meaningful parameter. The regression analysis revealed that active disease status (OR = 3.04, 95%CI = 1.46–6.33), a poor health index (OR = 1.16, 95%CI = 1.06–1.26), lower self-evaluation (OR = 1.38, 95%CI = 1.19–1.61), and a severe condition (OR = 2.80, 95%CI = 1.20–6.52) are factors associated with psychological disorders. However,

Table 2 Logistic regression analysis of factors influencing the occurrence of psychological disorders in AS patients

Variables	Reference	Beta	S.E	Z	*P*	OR (95%CI)
Age, 45–59 years	≤44 years	−0.28	0.38	−0.72	0.469	0.76 (0.36–1.60)
Age, ≥60 years	≤44 years	−0.78	0.84	−0.93	0.35	0.46 (0.09–2.37)
Sex	Male	0.33	0.45	0.73	0.464	1.39 (0.58–3.32)
Smoke	Yes	0.01	0.34	0.03	0.978	1.01 (0.51–1.98)
Disease duration	Per 5 years increase	0.14	0.10	1.39	0.165	1.16 (0.94–1.42)
BASDAI	<4	1.11	0.37	2.98	**0.003**	3.04 (1.46–6.33)
BASFI	Per unit	0.05	0.07	0.73	0.466	1.05 (0.92–1.21)
ASAS-HI	Per unit	0.15	0.04	3.39	**<0.001**	1.16 (1.06–1.26)
PGA	Per unit	0.32	0.08	4.16	**<0.001**	1.38 (1.19–1.61)
FACIT-F	Little or no fatigue	1.03	0.43	2.39	**0.017**	2.80 (1.20–6.52)
Employed	Yes	0.05	0.35	0.13	0.895	1.05 (0.53–2.08)
Pecuniary loss	No	0.24	0.42	0.57	0.566	1.27 (0.56–2.92)

P values < 0.05 are shown in bold

BASDAI Bath Ankylosing Spondylitis Disease Activity Index, *BASFI* Bath Ankylosing Spondylitis Functional Index, *ASAS-HI* Assessments of SpondyloArthritis international society Health Index, *FACIT-F* Functional Assessment of Chronic Illness Therapy – Fatigue, *PGA* patient global assessment

Table 3 The distribution of depression, anxiety, stress in the whole study cohort

Degree	Depression		Anxiety		Stress	
	Number	Percentage	Number	Percentage	Number	Percentage
Normal	312	82.5%	298	78.8%	348	92.1%
Abnormal	66	17.5%	80	21.1%	30	7.9%
Mild	36	9.5%	32	8.5%	20	5.3%
Moderate	22	5.8%	44	11.6%	10	2.6%
Severe	7	1.9%	2	0.5%	0	0%
Extremely Severe	1	0.3%	2	0.5%	0	0%

sex and age were not associated with psychological disorders while controlling for the other variables.

Frequency for the levels of depression, anxiety and stress

Table 3 and Fig. 1 illustrates the prevalence of depression, anxiety, and stress symptoms among the study participants. It was observed that 17.5% of respondents reported symptoms of depression, with 9.5% experiencing mild, 5.8% moderate, and 2.2% severe symptoms. Anxiety was reported by 21.1% of the participants, among whom 8.5% had mild anxiety, 11.6% moderate anxiety, and 1% severe anxiety. Stress symptoms were reported by 7.9% of respondents, with 5.3% experiencing mild stress and 2.6% moderate stress; none were in a severe state of stress. Notably, fifty-four patients had more than one type of psychological disorder.

Factors associated with depression, anxiety and stress in AS

Based on the results of the analysis of variance and the multivariate logistic regression of psychological disorders, separate multifactorial analyses of anxiety, depression, and stress were conducted to identify the factors that influence these specific psychological states. Factors associated with depression, anxiety, and stress are listed in Table 4 and Fig. 2(b, c, d).

In the multivariate analysis focusing on depression, we found a significant relationship between patient age and the risk of depression among patients with ankylosing spondylitis. Notably, patients younger than 44 years exhibited a markedly higher risk of depression. Specifically, the ASAS-HI, PGA, and FACIT-F scores were all significant factors of the depressive state in these patients and were consistent with those of patients with psychological disorders. Patients categorized under 'significant fatigue' based on their FACIT-F scores were found to have a higher rate of depression compared to those with 'little or no fatigue' (OR = 3.60, 95%CI = 1.52–8.53). Similarly, changes in PGA and ASAS-HI scores showed a significant correlation with depression, with ORs of 1.34 (95% CI = 1.12–1.61) and 1.18 (95% CI = 1.07–1.30), respectively.

Regarding anxiety and stress, both conditions were closely linked to the disease activity. Patients in an active disease state had a 4.18 times higher occurrence rate of anxiety and a 3.64 times higher occurrence rate of stress compared to those in remission. Notably, the PGA score of patients showed a high concordance with their anxiety state; an increase of one point in the PGA score was associated with a 30% increase in the rate of anxiety occurrence (OR = 1.30, 95% CI = 1.11–1.51). Similarly, both ASAS-HI (OR = 1.14, 95% CI = 1.01–1.29) and fatigue

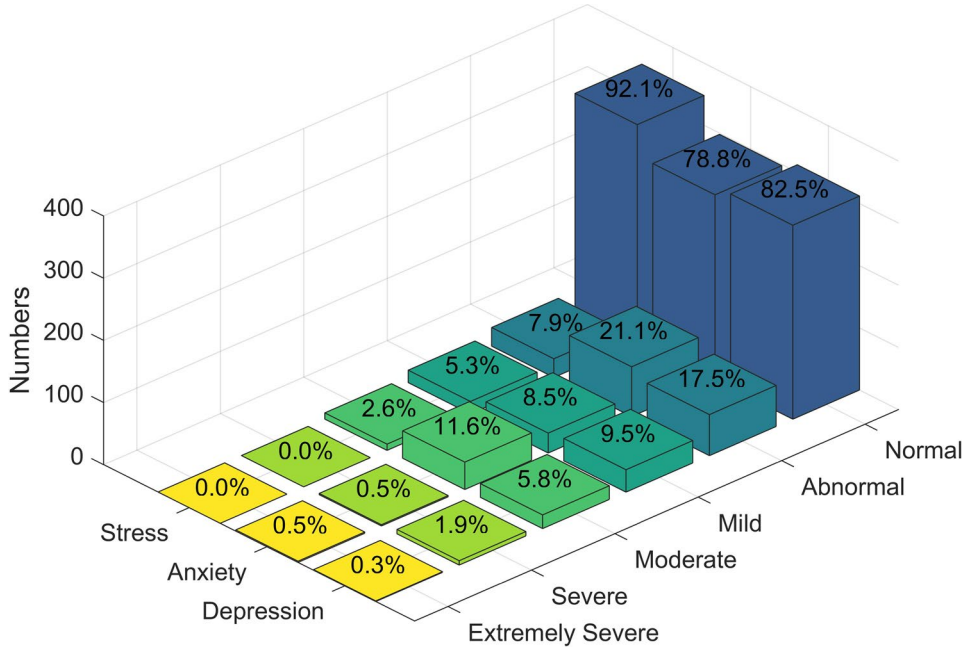

Fig. 1 The distribution of depression, anxiety, stress in the whole study cohort

rank (OR = 3.64, 95% CI = 1.39–9.51) were significantly correlated with the state of stress in patients.

Discussion

Psychological disorders are prevalent in AS [8], yet they garner relatively less attention in comparison to rheumatoid arthritis. However, anxiety and depression are fundamental characteristics of AS [9]. A study conducted on a group of AS patients in Singapore revealed that 27.4% of patients were in an anxious state, while 21.2% experienced depression [10]. Similarly, research in the UK population showed that 32.0% of AS patients suffered from depression [11], and Kamini's study found that 38% of AS patients exhibited anxiety symptoms [12]. Patients with psychological disorders often have diminished capacity to cope with physical illnesses and experience a negative impact on their quality of life [13], highlighting the importance of addressing mental health in the management of AS. Due to the recurrent nature of back pain and health-related anxieties in AS, patients often endure uncontrollable, long-term emotional stress and persistent psychological tension, aspects frequently overlooked in previous studies. In our research, we utilized the DASS-21 scale to assess the psychological state of patients. Originally developed by Lovibond and Lovibond in 1995 for assessing depression, anxiety, and stress levels in college students, DASS-21's structure and content have universal applicability, allowing its widespread use across different populations and settings [3, 14]. DASS-21 not only succinctly and effectively captures the severity of symptoms but also includes a stress scale, providing a comprehensive assessment of the patient's psychological state.

In our study of 378 Chinese AS patients, we found that 26.72% had psychological disorders, with 17.5% exhibiting depression, 21.1% experiencing anxiety, and 7.9% facing stress. Compared to current research, the rate of psychological disorders in the Chinese population is relatively lower. This could be attributed to the stigma associated with mental health issues in China, leading patients to possibly underreport these problems during assessments. Additionally, in the more reserved cultural context of China, patients might tend to emphasize physical symptoms over psychological ones. Research indicates that anxiety and depression often overlap and coexist within the same patient, exacerbating each other [15]. Our study observed similar clinical manifestations, with 53.47% of patients having two or more psychological disorders. Persistent anxiety can lead to excessive psychological and physical stress, thereby aggravating symptoms of depression. Conversely, a state of depression with reduced vitality and enthusiasm can intensify anxiety and perceived stress. Comparative analysis between groups with and without psychological disorders revealed significant differences, including disease duration, disease activity, health index, fatigue level, PGA, employment status, and pecuniary loss ($P < 0.05$). These findings underscore the pivotal role of these factors in the development and progression of AS. This justifies their inclusion in our analysis of factors influencing psychological disorders.

Table 4 Logistic regression analysis of factors influencing the occurrence of depression, anxiety, stress in AS patients

Variables	Reference	Beta	S.E	Z	*P*	OR (95%CI)
Depression						
Age, 45–59 years	≤44 years	−0.98	0.46	−2.13	**0.033**	0.38 (0.15–0.92)
Age, ≥60 years	≤44 years	−1.02	0.92	−1.10	0.272	0.36 (0.06–2.22)
Gender	Male	0.25	0.52	0.48	0.629	1.29 (0.46–3.59)
Smoke	Yes	−0.21	0.40	−0.52	0.602	0.81 (0.37–1.78)
Disease duration	Per 5 years increase	0.20	0.12	1.66	0.096	1.22 (0.97–1.53)
BASDAI	<4	0.71	0.44	1.61	0.108	2.03 (0.86–4.79)
BASFI	Per unit	0.08	0.08	1.06	0.287	1.09 (0.93–1.27)
ASAS-HI	Per unit	0.16	0.05	3.22	**0.001**	1.18 (1.07–1.30)
PGA	Per unit	0.29	0.09	3.14	**0.002**	1.34 (1.12–1.61)
FACIT-F	Little or no fatigue	1.28	0.44	2.91	**0.004**	3.60 (1.52–8.53)
Employed	Yes	0.21	0.41	0.51	0.613	1.23 (0.55–2.77)
Pecuniary loss	No	0.57	0.54	1.05	0.295	1.76 (0.61–5.10)
Anxiety						
Age, 45–59 years	≤44 years	−0.60	0.39	−1.53	0.126	0.55 (0.25–1.18)
Age, ≥60 years	≤44 years	−0.28	0.77	−0.36	0.715	0.75 (0.17–3.42)
Gender	Male	0.82	0.43	1.88	0.06	2.27 (0.97–5.31)
Smoke	Yes	0.34	0.35	0.97	0.334	1.40 (0.71–2.79)
Disease duration	Per 5 years increase	0.15	0.11	1.46	0.144	1.17 (0.95–1.43)
BASDAI	<4	1.43	0.37	3.86	**<0.001**	4.18 (2.02–8.63)
BASFI	Per unit	0.03	0.07	0.37	0.708	1.03 (0.89–1.18)
ASAS-HI	Per unit	0.09	0.04	1.95	0.051	1.09 (1.00–1.19)
PGA	Per unit	0.26	0.08	3.28	**0.001**	1.30 (1.11–1.51)
FACIT-F	Little or no fatigue	0.66	0.41	1.61	0.108	1.93 (0.87–4.30)
Employed	Yes	0.02	0.36	0.06	0.954	1.02 (0.51–2.05)
Pecuniary loss	No	0.24	0.44	0.54	0.589	1.27 (0.54–2.97)
Stress						
Age, 45–59 years	≤44 years	−0.23	0.54	−0.42	0.674	0.80 (0.27–2.31)
Age, ≥60 years	≤44 years	−0.88	1.13	−0.78	0.434	0.41 (0.05–3.78)
Sex	Male	0.45	0.60	0.75	0.454	1.57 (0.48–5.12)
Smoke	Yes	−0.07	0.50	−0.14	0.887	0.93 (0.35–2.48)
Disease duration	Per 5 years increase	0.10	0.15	0.67	0.504	1.10 (0.83–1.46)
BASDAI	<4	1.29	0.50	2.57	**0.01**	3.64 (1.36–9.73)
BASFI	Per unit	0.01	0.10	0.10	0.92	1.01 (0.83–1.22)
ASAS-HI	Per unit	0.13	0.06	2.10	**0.036**	1.14 (1.01–1.29)
PGA	Per unit	0.09	0.11	0.84	0.403	1.10 (0.89–1.35)
FACIT-F	Little or no fatigue	1.29	0.49	2.63	**0.009**	3.64 (1.39–9.51)
Employed	Yes	0.19	0.52	0.37	0.711	1.21 (0.44–3.37)
Pecuniary loss	No	−0.05	0.67	−0.07	0.945	0.96 (0.26–3.55)

P values < 0.05 are shown in bold

BASDAI Bath Ankylosing Spondylitis Disease Activity Index, *BASFI* Bath Ankylosing Spondylitis Functional Index, *ASAS-HI* Assessments of SpondyloArthritis international society Health Index, *FACIT-F* Functional Assessment of Chronic Illness Therapy – Fatigue, *PGA* patient global assessment

Our multivariate logistic regression analysis of psychological disorders in AS patients revealed a significant association between disease activity and psychological disorders. Consistent with prior research [13, 16], we found that patients in an active phase of the disease are more prone to psychological disorders. This correlation appears to be significantly influenced by the presence of chronic back pain, a prevalent symptom in active ankylosing spondylitis, and its impact on mental well-being [17]. Therefore, reducing disease activity is a crucial aspect of treatment. The 2019 EULAR guidelines underscore that achieving clinical remission should be the primary goal in the management of Ankylosing Spondylitis [1]. This approach is not only beneficial for physical symptoms but also imperative for improving mental health outcomes in AS patients, highlighting the importance of addressing both physical and psychological aspects of the disease in a comprehensive treatment strategy.

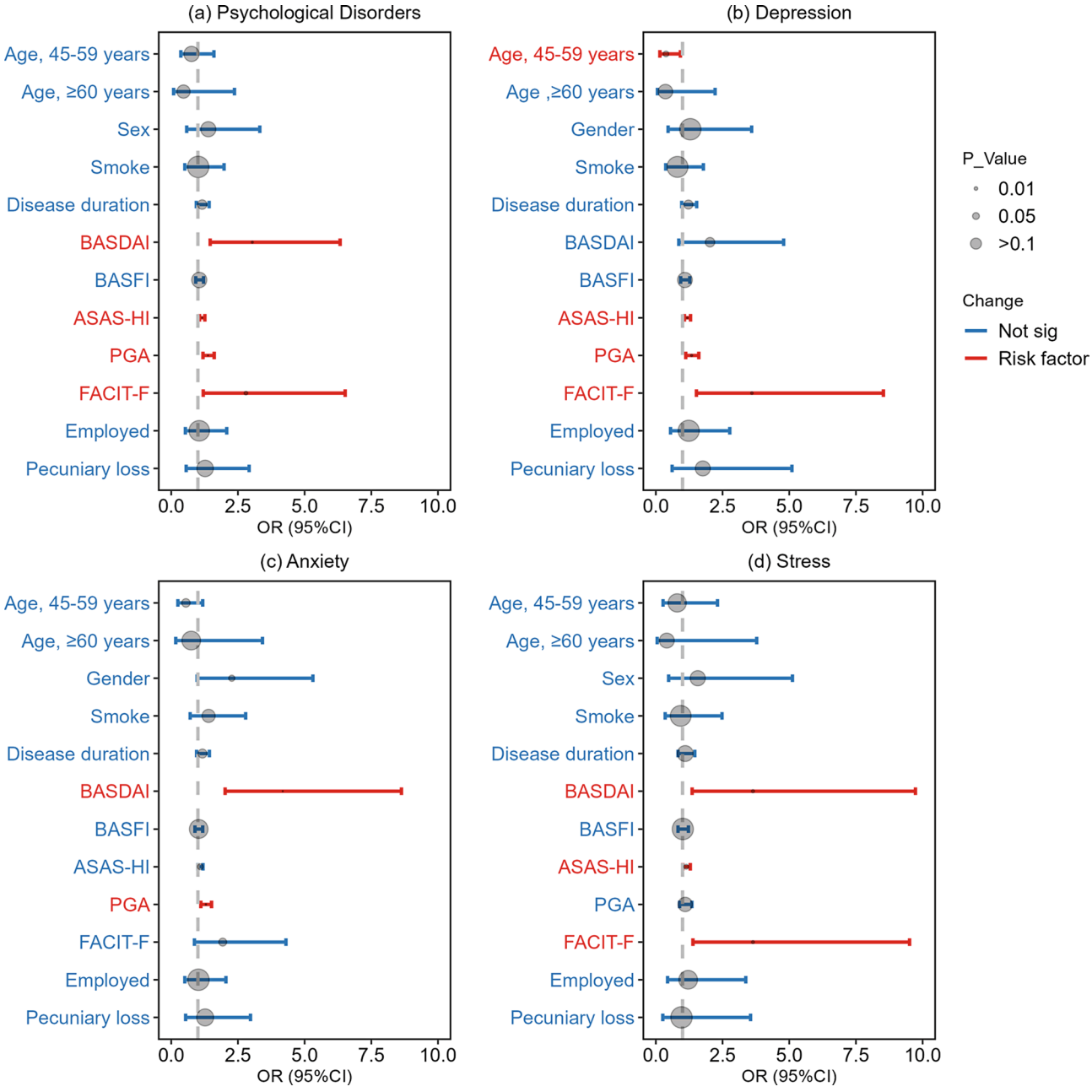

Fig. 2 The x-axis represents OR (95%CI), and the y-axis represents variables. The diameter of the circle represents the size of the *p*-value, the smaller the *p*-value, the smaller the circle. Logistic regression analysis of factors influencing the occurrence of psychological disorders (**a**), depression (**b**), anxiety (**c**) and stress (**d**) in AS patients

In our analysis of the factors influencing depression, anxiety, and stress in AS patients, we observed high consistency across various subscales (Table 4). These findings align closely with significant factors impacting psychological disorders, all correlating with disease activity, ASAS-HI, PGA, and FACIT-F. This may be attributed to the reliance on self-reported scales, which are subject to individual social expectations and thereby underline the importance of recognizing and intervening in patients' psychological states. Additionally, this suggests that assessing AS patients' mental health should consider multiple psychological states, rather than focusing solely on depression or anxiety.

Our data revealed that AS patients under the age of 44, who often are at pivotal stages of their career and family life, are at higher risk for depression [18]. This demographic, representing 72.75% of our study population, experiences significant life impacts due to the disease, influencing their work capacity and quality of life. The depression and psychological disorders impact factors

in ASAS-HI, PGA, and FACIT-F show high consistency. Focusing on these common factors to develop unified psychological intervention strategies could reduce symptoms of depression while also mitigating the risk of other psychological disorders.

Disease activity plays a significant role in the occurrence of anxiety and stress states, with physical discomfort caused by active disease being a primary source of anxiety for patients. In the progressively long course of the disease, patients are likely to experience prolonged tension, leading to psychological stress. Poorer PGA scores increase the likelihood of anxiety, while poorer ASAS-HI scores and significant fatigue levels raise the incidence of stress. PGA reflects patients' subjective assessment of their overall health condition. When patients perceive their health status as poor, it can lead to uncertainty and concern, thereby triggering or exacerbating anxiety. Anxiety is often linked to concerns about the future and expected negative outcomes, which are closely linked to what is assessed in the PGA. It may also stem from worries about disease progression, where a higher PGA score could reflect apprehensions about worsening conditions. ASAS-HI and FACIT-F, measuring health status and fatigue levels respectively, are likely linked to long-term psychological and physical stress. Chronic health issues and fatigue can lead to a persistent sense of stress, aligning with the characteristics of the stress state.

In summary, clinical practice should not only focus on the physical symptoms of AS patients but also prioritize their mental health. Assessments of BASDAI, PGA, ASAS-HI, and FACIT-F provide crucial information about potential depression, anxiety, and stress states in patients. Early identification of factors that may trigger anxiety or stress allows physicians to intervene sooner, offering necessary psychological support and interventions.

Our study is limited in a number of ways: Our study is limited in several ways: firstly, the use of a cross-sectional design prevents the establishment of causal relationships between disease activity and psychological disorders in AS patients. Secondly, the reliance on self-reported measures may introduce reporting biases, as patients might underreport or overreport psychological symptoms due to cultural factors. Thirdly, only the collection of AS-related comorbidities was carried out in this study and not the collection of comorbid conditions such as fibromyalgia, psoriasis-related skin lesions, and sedentary lifestyle, which may have an impact on our results. Lastly, the lack of data on potential confounders, such as medication use and socioeconomic status, may affect the accuracy of the findings.

Conclusion

The prevalence of psychological disorders is high among patients with ankylosing spondylitis. Disease activity status, high PGA scores and ASAS-HI scores and significant fatigue status are important influences on psychological disorders. The interrelatedness among the influencing factors of depression, anxiety, and stress suggests the importance of adopting unified psychological intervention strategies to mitigate these symptoms and reduce the risk of other psychological disorders. In clinical practice, it is important to assess not only the physical symptoms but also the mental health of patients with AS. These findings suggest that careful assessment of patients' psychological status is necessary as part of an AS management strategy to help improve the prognosis of AS.

Abbreviations

AS	Ankylosing spondylitis
CERTAIN	China Rheumatoid Arthritis Registry of Patients with Chinese Medicine
ax-SpA	Axial Spondyloarthritis
BMI	Body mass index
IBD	Inflammatory bowel disease
DASS-21	Depression Anxiety Stress Scales
BASDAI	Bath Ankylosing Spondylitis Disease Activity Index
BASFI	Bath Ankylosing Spondylitis Functional Index
HLA	Human leucocyte antigen
VAS	Visual Analogue Scale
PGA	Patient Global Assessment
ASAS-HI	Assessments of SpondyloArthritis international society Health Index
FACIT-F	Functional Assessment of Chronic Illness Therapy—Fatigue
CRP	C-reactive protein

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Author contributions

K Y was responsible for data collation and article writing. YF G was responsible for the initial collation of included data. ZY G and XH X were responsible for the collection of clinical data. SY Y provided guidance related to the statistical and analytical approach of the article. HR Z was responsible for guidance on the data analysis approach and graphing of the article. Q J was responsible for the source of the clinical patients, and HX L was responsible for constructing the framework of the article and supervising the work during the implementation of the article. All authors reviewed the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with the ethical standards of the Guang'anmen Hospital of Chinese Academy of traditional Chinese medicine. Ethical approval was granted by the Ethics Committee of Guang'anmen Hospital of Chinese Academy of traditional Chinese medicine, approval number [2022-108-KY].

Consent for publication
All participants provided written informed consent before participation.

Competing interests
The authors declare no competing interests.

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References

1. Ward MM, Deodhar A, Gensler LS, et al. 2019 update of the American College of Rheumatology/Spondylitis Association of America/Spondyloarthritis Research and Treatment Network recommendations for the treatment of ankylosing spondylitis and nonradiographic axial spondyloarthritis. Arthritis Care Res 2019;71:1285–99.
2. Hopkins C, Moulton C. The prevalence of depression and its correlates in ankylosing spondylitis: a systematic review and meta-analysis. Eur Psychiatry. 2016;33:S166–S166.
3. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behav Res Ther. 1995;33(3):335–43.
4. Yellen SB, Cella DF, Webster K, et al. Measuring fatigue and other anemia-related symptoms with the Functional Assessment of Cancer Therapy (FACT) measurement system. J Pain Symptom Manage 1997;13:63–74.
5. Wagan AA, Raheem A, Bhatti A, et al. Fatigue assessment by FACIT-F scale in Pakistani cohort with Rheumatoid Arthritis (FAF-RA) study. Pak J Med Sci 2021;37:1025–30.
6. Kiltz U, van der Heijde D, Boonen A, et al. Development of a health index in patients with ankylosing spondylitis (ASAS HI): final result of a global initiative based on the ICF guided by ASAS. Ann Rheumatic Dis 2015;74:830–35.
7. Zochling J. Measures of symptoms and disease status in ankylosing spondylitis: ankylosing Spondylitis Disease Activity Score (ASDAS), Ankylosing Spondylitis Quality of Life Scale (ASQoL), Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Functional Index (BASFI), Bath Ankylosing Spondylitis Global Score (BAS-G), Bath Ankylosing Spondylitis Metrology Index (BASMI), Dougados Functional Index (DFI), and Health Assessment Questionnaire for the Spondylarthropathies (HAQ-S). Arthritis Care Res. 2011;63(S11):S47–58.
8. Omar M, Ben-Shabat N, Tsur AM, et al. The association between ankylosing spondylitis and psychiatric disorders: insights from a population based cross-sectional database. J Affect Disorders. 2023;323:788–92.
9. Barlow JH, Macey SJ, Struthers GR. Gender, depression, and ankylosing spondylitis. Arthritis Care Res. 1993;6(1):45–51.
10. Chung DXY, Loo YE, Kwan YH, et al. Association of anxiety, depression and resilience with overall health and functioning in axial spondyloarthritis (axSpA): a cross-sectional study. BMJ Open 2023;13:e071944.
11. Healey EL, Haywood KL, Jordan KP, et al. Impact of ankylosing spondylitis on work in patients across the UK. Scand J Rheumatol 2011;40:34–40.
12. Reddy KN, Sabu N, Pandey N, et al. Anxiety and depression among patients with axial spondyloarthritis. Eur J Rheumatol 2022;9:8–13.
13. Baysal O, Durmuş B, Ersoy Y, et al. Relationship between psychological status and disease activity and quality of life in ankylosing spondylitis. Rheumatol Intl 2011;31:795–800.
14. Osman A, Wong JL, Bagge CL, et al. The Depression Anxiety Stress Scales-21 (DASS-21): further examination of dimensions, scale reliability, and correlates. J Clin Psychol 2012;68:1322–38.
15. Sloan DM, Marx BP, Bradley MM, et al. Examining the high-end specificity of the beck depression inventory using an anxiety sample. Cogn Ther Res 2002;26:719–27.
16. Martindale J, Smith J, Sutton CJ, et al. Disease and psychological status in ankylosing spondylitis. Rheumatology (Oxford, England) 2006;45:1288–93.
17. Pincus T, Burton AK, Vogel S, et al. A systematic review of psychological factors as predictors of chronicity/disability in prospective cohorts of low back pain. Spine 2002;27:E109–E120.
18. Matsumoto WK, Munhoz AM, Okada A, et al. Influence of advanced age on postoperative outcomes and total loss following breast reconstruction: a critical assessment of 560 cases. Rev Col Bras Cir 2018;45:e1616.

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