Work Productivity is Associated With Disease Activity and Functional Ability in Chinese Patients With Axial Spondyloarthritis Using A Smart-Phone Management System: A Prospective Cohort Study

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Abstract

Background: Axial spondyloarthritis usually affects young people and often leads to disability. We used the interactive mobile health tool to evaluate clinical characteristics and loss of work efficiency in China, and to analyze the association between the clinical characteristics and work disability in patients with axial spondyloarthritis.

Methods: In total, 1187 patients with axial spondyloarthritis were included. Demographic properties, pharmacotherapy, disease activity, functionality and spinal mobility were studied and compared in both work disability and non- work disability patients. Logistic regressions were used to investigate the associations between the risk of work disability and clinical characteristics. The relationships between Work Productivity and Activity Impairment scores and clinical characteristics were assessed using Spearman correlation coefficients.

Results: Of the participants, 60 or 5.05% were unemployed. The predictive factors for the occurrence of work disability were suffering from inflammatory bowel disease, higher Physician's global assessment and higher Assessment of Spondyloarthritis International Society health index (ASASHI) scores (OR value was 3.35, 1.32 and 1.45 respectively). Absenteeism, presenteeism, overall work impairment and activity impairment in all employed patients were 10.40%, 23.53%, 30.57% and 25.35% respectively. Factors significantly associated with higher presenteeism, overall work impairment and activity impairment loss were Bath Ankylosing Spondylitis Disease Activity Index, Bath Ankylosing Spondylitis Functional Index, Ankylosing Spondylitis Disease Activity Score, ASASHI, nocturnal pain, total back pain, and Patient's global assessment ($r > 0.5$), while non-steroidal anti-inflammatory drugs treatment were significantly associated with a lower absenteeism loss. An increased ASDAS score was related to a decrease in work productivity.

Conclusions: We used a Smart-Phone Management System to determine that axial spondyloarthritis had a significant influence on working conditions in China, and that the factors related to the disease had a significant correlation with the risk and severity of lost work productivity. SpAMS is found be a time- and cost-saving disease management tool which can help patients with AS independently manage their disease and provide valuable data to their clinicians.

Background

Axial spondyloarthritis (axSpA) is a chronic rheumatic disease which causes inflammation, structural damage, and functional impairment. The patients with axSpA can be classified in two subgroups: non-radiographic and radiographic axial spondyloarthritis. Radiographic axial spondyloarthritis is also referred to as ankylosing spondylitis (AS) [1]. The disease has an early onset and is usually diagnosed in the second or third decade of life. The prevalence of AS and axSpA in China is between 0.3% and 0.5%. These rates are similar to those in the U.S. or Europe, but since 20% of the world's population is in China, there is the potential for a significant disease burden [2].

The restriction of spinal mobility in axSpA significantly impairs work performance and often leads to disability (work disabled, or WD) and leads to substantial costs to patients with AS and society at large [3]. Given the early onset of the disease and the long-term function loss, the lifetime costs and socio-economic impact for the individual patient are high [4]. Tu's (2014) study researched the annual direct and indirect costs of 257 patients with AS according to the modified New York criteria. They found that the annual estimated costs of each patient was $2714.18 while the indirect cost accounted for 64.7%, annual direct cost significantly correlated with disease activity [5]. In our study, however, we used the more recent criteria developed by Assessment of Spondyloarthritis International Society (ASAS). These criteria can identify axSpA patients earlier than the New York criteria, and with fewer radiographic changes in the sacroiliac joints. This allowed us to get more real world data drawing from a more inclusive patient population than traditional clinical trials. Real world studies can provide information from several sources such as electronic health records, product and disease registries, and personal devices and health applications.

We designed "Smart-phone Spondyloarthritis Management System" (SpAMS), an interactive mobile health tool which offers patient education, delivers advice on disease management, and improves medication adherence in China. The application consists of a patient mobile terminal (patient's portal), a physician workstation (physician's portal), and a network communication system. Our previous studies showed that patients can ask questions efficiently, which saved time and money. We used the interactive mobile health tool to evaluate clinical characteristics of Chinese patients with AS and found that SpAMS can save traffic expenses, which equaled 16% of the Chinese monthly disposable personal income [6]. We found that SpAMS is a good disease management tool that can help patients with AS perform self-management and provide valuable data to clinicians.

In this study, we collected information with the SpAMS regarding the loss of work efficiency in patients with axial spondyloarthritis. We also analyzed the association between the clinical characteristics (such as demographic properties, pharmacotherapy, disease activity, functionality and spinal mobility) and the risk of WD in patients with axSpA. Finally, we investigated the relation of the Work Productivity and Activity Impairment (WPAI) questionnaire responses to the clinical characteristics, helping us determine how many patients are unemployed due to WD in the real world. We also demonstrate that our app can provide valuable data to clinicians.

Methods

Patients

Patients were enrolled in the Chinese AS Prospective Imaging Cohort (CASPIC) study. The CASPIC study is a nationwide, ongoing, prospective, longitudinal, and state-funded cohort study launched in conjunction with SpAMS. SpAMS was specifically designed to conduct multicenter prospective studies on spondyloarthritis (SpA/AS) in China using real-world clinical workflows. The full study protocol can be seen in our previous study [6].

All of the patients fulfilled the ASAS classification criteria at the Chinese People's Liberation Army (PLA) General Hospital between April 2016 and until the end of April 2018.

The study protocol was approved by the Ethical Committee of the Chinese PLA General Hospital (S2016-049-02). Informed consent for participation in the study was collected from all patients before study entry.

Questionnaires

Characteristics of online registration included age, sex, height, weight, smoking status, past medical history, date of the onset of back pain, date of diagnosis, presence of AS features, and family history. Assessments for AS were categorized as patient-reported assessment or physician-reported assessment. Standardized questionnaires used for assessments included questions on the following

1. The patient's global assessment (PGA) of disease activity on a numerical rating scale of 0-10,
2. Nocturnal pain levels on an NRS of 0-10.
3. Bath Ankylosing Spondylitis Disease Activity Index (BASDAI),
4. Bath Ankylosing Spondylitis Functional Index (BASFI) [7],
5. Work Productivity and Activity Impairment (WPAI) [8],
6. Assessment of Spondyloarthritis International Society Health Index (ASAS HI) [9],
7. General pain on an NRS of 0-10,
8. Physician's global assessment (PhGA),
9. Bath Ankylosing Spondylitis Metrology Index (BASMI) [10],
10. The location of back pain, peripheral arthritis (28 joints), and enthesitis,
11. Presence of AAU, psoriasis, and a colonoscopy and pathology-confirmed diagnosis of IBD [11].

The Ankylosing Spondylitis Disease Activity Score (ASDAS) was calculated using a formula defined for assessing disease activity in patients with AS [12]. Four ASDAS categories were defined: inactive disease (ASDAS <1.3), moderate disease activity (ASDAS ≥1.3 and <2.1), high disease activity (ASDAS ≥2.1 and 3.5) and very high disease activity (ASDAS ≥3.5) [13]. Inflammatory markers (erythrocyte sedimentation rate, ESR; C-reactive protein, and CRP) and HLA-B27 status, which has the highest genetic association, were investigated [1, 14].

Work productivity

The Work Productivity and Activity Impairment (WPAI) questionnaire is used to assess the impact of axSpA on work productivity and on other daily activities. Six questions are asked regarding the past 7 days, including:

1. Patients' employment status;

a. Employed without work restriction according to the patient's own judgment;
b. Employed with work restriction according to the patient;
c. Unemployed due to work restriction;
d. Studying,
e. Doing housework;
f. Retired at age (age indicated);
g. Unemployed with other reasons.

2. Number of hours missed at work due to axSpA;
3. Number of hours missed at work due to due to other reasons;
4. Number of hours worked;
5. Degree of disease influence on work productivity;
6. Degree of disease influence on activities not related to work.

The WPAI outcomes are expressed as impairment percentages, which include four scores: absenteeism, presenteeism, work productivity loss (WPL), and activity impairment. Presenteeism represents the reduced work productivity due to disease and is calculated as the degree of disease influence on work productivity/10 (question (Q5). Absenteeism is the percentage of hours missed due to disease (and not due to other reasons) and is calculated as follows: the number of hours missed at work due to axSpA (Q2)/(number of hours missed at work due to axSpA (Q2) + number of hours worked effectively (Q4)). The work productivity loss (WPL), which gives an indication of the overall work impairment due to disease and is derived from presenteeism and absenteeism is calculated as follows: absenteeism+ ((1-Absenteeism) × (Presenteeism)). Percent activity impairment due to health: Q6/10. Greater scores indicate greater impairment. All scores are to be multiplied by 100 to be expressed as percentages.

Statistical analyses

Statistical analysis was performed using SPSS 25 software. All participants were first categorized into disabled (WD) and non-disabled (non-WD) groups. WD was defined as employed with work restrictions or unemployed due to work restrictions. The normality of distribution was analyzed by the Kolmogorov-Smirnov test and 2x2 contingency tables were formed for categorical variables and analyzed by chi-square or Fisher's exact test. The Mann-Whitney test was used to evaluate the differences between WD and non-WD. Stepwise logistic regression analysis was performed to identify the independent predictors of WD. Spearman correlation analysis was used between WPAI calculation results and other indicators. The Kruskal-Wallis test was used to evaluate the work productivity differences among the four ASDAS states. A p-value of <0.05 was considered statistically significant.

Results

1. Baseline Clinical Characteristics and Work productivity

As of April 2018, there were 1,187 patients in the CASPIC study and 100% fulfilled the ASAS criteria for axSpA. The median age at axSpA onset was 21 (IQR 16–27 years), The median disease duration was 7.42(IQR 4-11.22 years), 979 patients (82.48%) were men and 984 patients (88.97%) were HLA-B27 positive which is the highest genetic association. 21.06% patients had AAU, 9.44% patients had IBD, 3.71% patients had psoriasis and 13.24% patients had arthritis. The median disease activity and physical functioning scores were 2 (BASDAI), 2 (ASDAS), 3□PGA□, 2 (PhGA) and 1.1 (BASFI). In total, 793 out of 1187 participants (66.81%) were employed. Other patient characteristics, including demographic, clinical, and extra-articular manifestations data, work status, and mean scores for disease activity and physical functioning are reported in Table 1.

Table 1
Baseline demographic and defining clinical characteristics of the patients

Characteristic		**N**
Demographic properties		
Age, median (IQR), years	30(24–36)	1187
Male gender, %	979(82.48%)	1187
Disease duration, median (IQR), years	7.42(4.00-11.22)	1187
Age at disease onset, median (IQR), years	21(16–27)	1187
BMI, median (IQR)	23.34(20.75–26.03)	1185
HLA-B27 positive, %	984(88.97%)	1106
Smoker, %	392(33.02%)	1187
Family history of AS, %	300(25.27%)	1187
History of extraarticular manifestations%		
Psoriasis	44(3.71%)	1187
IBD	112(9.44%)	1187
AUU	250(21.06%)	1187
Enthesitis	216(23.84%)	906
Arthritis	120(13.25%)	906
pharmacotherapy%		
NSAIDs ,	980(98.79%)	992
SSZ	251(25.30%)	992
LEF	134(13.52%)	991
MTX	34(3.43%)	992
Thal	239(24.12%)	991
TNF inhibitors	220(22.18%)	992

axSpA, axial spondyloarthritis; HLA, human leukocyte antigen ; AS: ankylosing spondylitis,IBD: inflammatory bowel disease AAU: acute anterior uveitis, NSAIDs, non-steroidal anti-inflammatory drugs; SSZ, sulfasalazine; LEF, leflunomide; MTX, methotrexate; Thal Thalidoan; TNF, tumor necrosis factor ;BASDAI: Bath Ankylosing Spondylitis Disease Activity Index;BASFI: Bath Ankylosing Spondylitis Functional Index;PGA: Patient's global assessment;ASAS HI: The Assessment of Spondyloarthritis international Society Health Index;BASMI: Bath Ankylosing Spondylitis Metrology Index; ASDAS: Ankylosing Spondylitis Disease Activity Score; PhGA: Physician's global assessment;ESR: erythrocyte sedimentation rate, CRP: C-reactive protein.

Characteristic		N
Disease activity and physical functioning		
BASDAI ,median (IQR)	2(1.10–3.30)	1185
BASFI,median (IQR)	1.1(0.30–2.40)	1185
TOTAL BACK PAIN ,median (IQR)	2(1–4)	1185
NOCTURNAL PAIN ,median (IQR)	2(1–4)	1185
PGA,median (IQR)	3(1–4)	1185
ASAS-HI,median (IQR)	5(2–8)	1185
BASMI,median (IQR)	1(0–3)	830
ASDAS,median (IQR)	2(1.38–2.73)	980
PhGA,median (IQR)	2(1–3)	1158
ESR,median (IQR),mm/hour	10(5–22)	958
CRP,median (IQR),mg/L	5.84(2.80-15.95)	921
Work status		
employed without work restriction	586(49.37%)	
employed with work restriction	207(17.44%)	
unemployed with work restriction	60(5.05%)	
Studying	169(14.24%)	
do housework	52(4.38%)	
retire at age	16(1.35%)	
unemployed with other reasons	97(8.17%)	

axSpA, axial spondyloarthritis; HLA, human leukocyte antigen ; AS: ankylosing spondylitis,IBD: inflammatory bowel disease AAU: acute anterior uveitis, NSAIDs, non-steroidal anti-inflammatory drugs; SSZ, sulfasalazine; LEF, leflunomide; MTX, methotrexate; Thal Thalidoan; TNF, tumor necrosis factor ;BASDAI: Bath Ankylosing Spondylitis Disease Activity Index;BASFI: Bath Ankylosing Spondylitis Functional Index;PGA: Patient's global assessment;ASAS HI: The Assessment of Spondyloarthritis international Society Health Index;BASMI: Bath Ankylosing Spondylitis Metrology Index; ASDAS: Ankylosing Spondylitis Disease Activity Score; PhGA: Physician's global assessment;ESR: erythrocyte sedimentation rate, CRP: C-reactive protein.

2. Comparison of clinical characteristics and clinical outcome measures in those with and without WD

AxSpA usually affects young people and may lead to WD. According to the WPAI questionnaire, 586 of 1187 patients with normal working conditions were classified as the non-WD group, 207 workers with limited working ability and 60 unemployed persons were classified as the WD group. Those patients with WD had significantly higher scores on TOTAL BACK PAIN, NOCTURNAL PAIN, PGA, BASFI, BASDAI, ASAS HI, PhGA, ASDAS and ESR. More patients in WD group had used leflunomide (16.44% vs. 10.48%) and had higher presence of IBD(16.10% vs. 8.36%)and peripheral arthritis (18.31% vs. 9.80%) than non-WD groups（*P*＜0.05, Table 2）. Logistic and linear regressions were conducted to investigate associations with WD, which suggests that suffering from IBD (OR 3.35;P=0.00;95%CI 1.45–7.74), higher PhGA(OR 1.32;P = 0.03;95%CI 1.03–1.69)and higher ASAS HI scores (OR 1.45;P = 0.00;95%CI 1.31–1.61) were associated with WD.

Table 2 Comparison of clinical characteristics and clinical outcome measures in those with and without work disability

Characteristics	without WD n=586	WD n=267
Age	31(27-36	31(27-36
Male gender, %	500(85.32	219(82.02
Disease duration	8.15(4.87-11.74	8.18(4.21-12.45
Age at disease onset	22(18-27	23(18-28
BMI	23.89(21.46-26.19	23.57(20.76-26.73
SMOKE %	202(34.47%	107(40.07%
Family history of AS%	157(26.79%	64(23.97%
Psoriasis %	26(4.44%	9(3.37%
IBD%**	49(8.36%	43(16.10%
AAU %	148(25.26%	56(20.97%
Enthesitis %	104(23.16%	47(22.07%
Arthritis %**	44(9.80%	39(18.31%
NSAIDs%	489(98.59%	216(98.18%
SSZ%	125(25.15%	46(21%
LEF%*	52(10.48%	36(16.44%
MTX%	11(2.22%	9 (4.09%
Thal%	125(25.20%	61(27.85%
TNF inhibitors %	108(21.77%	52(23.64%
BASDAI**	1.70(1-2.90	2.80(1.70-4.40
BASFI**	0.80(0.13-1.80	2.40(1.20-3.80
TOTALBACKPAIN**	2(1-3)	3(2-5)
NOCTURNALPAIN**	2(1-3)	3(2-5)
PGA**	2(1-4	4(2-5
ASASHI**	4(2-6	9(6-11
BASMI**	1(0-2)	1 (0-4)
PhGA**	2(1-3	3(2-4
ASDAS**	1.93(1.29-2.57	2.42(1.71-3.21
ESR ,mm/hour*	9(4-20)	12(5-25)

CRP ,mg/L	5.80(2.80-15.30)	7.45(3.10-16.85)	
	Binary logistic regression analysis		
	OR （95% CI）	*P*	B
IBD**	3.35(1.45-7.74)	0.00	1.21
PhGA**	1.32(1.03-1.69)	0.03	0.28
ASAS HI**	1.45(1.31-1.61)	0.00	0.37
Constant**		0.00	-3.65

* Statistically significant difference between work disability and without disability of $p < 0.05$, ** Statistically significant difference of $p < 0.01$.

3. Work Restrictions Reported In Those Working

All 1187 patients completed WPAI questionnaires. 793 workers (excluding 394 patients in the "other" group and "unemployed due to work restriction" group) were able to calculate WPAI indicators. The average percentage of time absent due to illness (absenteeism), the average percentage of loss of working productivity (presenteeism), the overall work impairment, and activity impairment was calculated. Employed participants worked 37.30(± 21.15) hours and missed 3.41(± 9.28) hours per week due to axSpA. Absenteeism, presenteeism, and activity impairment were calculated only in employed patients; presenteeism was 23.53%, absenteeism 10.40%, and WPL 30.57%.

We analyzed the association between the clinical characteristics and the WPAI outcomes in patients with axSpA. Higher numbers of presenteeism, WPL, and activity impairment were highly positively correlated with measures of disease activity and function, such as PGA, BASDAI, BASFI, ASAS HI, TOTAL BACK PAIN SCORES, NOCTURNAL PAIN SCORES and ASDAS (Pearson’s $r > 0.5$ in each case). However, such indices were weakly positively correlated with absenteeism (Pearson’s $r < 0.3$ in each case). Interestingly the patients who are much higher and heavier had less WPAI indicators (Pearson’s $r>-0.1$). Using NSAIDs and absenteeism were weakly negatively correlated (Pearson’s $r=-0.11$). There was no correlation between the use of tumor necrosis factor inhibitor and the loss of work ability. In addition, this study found that the use of LEF in this database is related to the decrease of work efficiency (Pearson’s $r = 0.1$) (Table 3).

Table 3
Correlation of clinical characteristics and clinical outcome measures with work productivity loss of 739 patients with axSpA

	Presenteeism		Absenteeism		Overall Work Impairment		Activity Impairment	
	r	P	r	P	r	P	r	P
AGE	0.02	0.60	0.08*	0.04	0.02	0.59	0.03	0.34
Male	0.01	0.77	0.10**	0.01	0.07	0.05	0.02	0.60
Disease duration	0.08*	0.02	0.00	0.92	0.04	0.23	0.08*	0.03
Age at disease onset	-0.04	0.26	0.05	0.16	-0.02	0.63	-0.03	0.48
BMI	-0.03	0.45	-0.05	0.19	-0.04	0.23	-0.04	0.24
HEIGHT	-0.11**	0.00	-0.10**	0.00	-0.14**	0.00	-0.07	0.05
WEIGHT	-0.07*	0.04	-0.08*	0.04	-0.10*	0.01	-0.07*	0.04
HLA-B27	0.05	0.21	-0.03	0.43	0.02	0.52	0.01	0.73
Smoker	0.08*	0.02	0.02	0.57	0.06	0.10	0.07*	0.04
Family history of AS	0.01	0.75	0.00	0.91	0.02	0.55	-0.01	0.71
Psoriasis	-0.01	0.83	0.01	0.71	0.00	0.91	-0.01	0.84
IBD	0.07*	0.04	0.05	0.17	0.09*	0.01	0.05	0.13
AUU	0.02	0.65	-0.03	0.44	-0.02	0.67	-0.02	0.63
Enthesitis	0.10*	0.01	0.09*	0.03	0.12**	0.00	0.09*	0.03
Arthritis	0.16**	0.00	0.13**	0.00	0.18**	0.00	0.19**	0.00
NSAIDs	-0.04	0.28	-0.11**	0.01	-0.04	0.30	-0.04	0.33
MTX	0.02	0.70	-0.04	0.31	-0.01	0.81	0.04	0.29
LEF	0.09*	0.02	0.01	0.74	0.06	0.15	0.07	0.08
TNFi	0.01	0.76	0.03	0.52	0.03	0.42	0.03	0.44
BASDAI	0.65**	0.00	0.24**	0.00	0.59**	0.00	0.68**	0.00
BASFI	0.67**	0.00	0.25**	0.00	0.62**	0.00	0.69**	0.00
TOTAL BACK PAIN	0.59**	0.00	0.18**	0.00	0.53**	0.00	0.62**	0.00

	Presenteeism		Absenteeism		Overall Work Impairment		Activity Impairment	
NOCTURNAL PAIN	0.57**	0.00	0.20**	0.00	0.52**	0.00	0.57**	0.00
PGA	0.61**	0.00	0.19**	0.00	0.55**	0.00	0.64**	0.00
ASASHI	0.58**	0.00	0.28**	0.00	0.57**	0.00	0.62**	0.00
BASMI	0.24**	0.00	0.09*	0.04	0.24**	0.00	0.28**	0.00
ASDAS	0.58**	0.00	0.16**	0.00	0.50**	0.00	0.58**	0.00
PhGA	0.31**	0.00	0.12**	0.00	0.28**	0.00	0.35**	0.00
ESR	0.25**	0.00	0.07	0.09	0.24**	0.00	0.29**	0.00
CRP	0.25**	0.00	0.03	0.44	0.20**	0.00	0.23**	0.00

* Statistically significant difference between work disability and without disability of $p < 0.05$, ** Statistically significant difference of $p < 0.01$.

4. Comparison of work productivity loss among axSpA patients with different disease activities

Through the above statistical analysis, we found that higher ASDAS, which is the physician-reported assessment, was associated with greater levels of presenteeism and productivity loss among those who remained in work. We compared the decrease in work productivity among SpA patients with different disease activities (ASDAS scores). Of 1187 cases, 651 patients completed WPAI and ASDAS scores at the same time. Presenteeism(Fig. 1a), absenteeism(Fig. 1b), WPL(Fig. 1c), and activity impairment (Fig. 1d) were significantly increased in patients with active disease (ASDAS ≥ 1.3) compared to patients with inactive disease (ASDAS < 1.3). Patients with very high disease activity had a higher presenteeism ($p = 0.00$, Fig. 1e), absenteeism ($p = 0.01$, Fig. 1f), WPL ($p = 0.00$, Fig. 1g) and activity impairment ($p = 0.00$, Fig. 1h) than patients with moderate disease activity.

Discussion

AxSpA is a chronic disease, which usually leads to functional limitations and has an important impact on participation in the labor force [14]. Scholars point out that the increase in healthcare expenses related to axSpA patients in the public healthcare system is significant and noticeable [15, 16]. Besides the cost of medical care itself, the cost of productivity loss due to inefficiency in disease-related work, which accounts for 53–73% of total cost, also needs attention [3]. In addition, the lack of patient self-management support also increases the cost of disease. The SpAMS can make real-world healthcare economically and offer patients a chance to self-manage their disease [6]. The SpAMS is also a good tool for researchers to answer these questions about how disability affects workers, and what productivity is being lost due to disease relevant to broad populations of patients. In this study we determined that axial spondyloarthritis had a significant influence on working conditions in China in the real world. Beyond this

we evaluated clinical characteristics and loss of work efficiency, finding that suffering from IBD and having higher ASAS HI scores are both predictive factors for work disability. Factors including disease activity, functionality, ASAS HI score, nocturnal pain, total back pain, and PGA were all related to the disease and had a significant correlation with work productivity.

1187 patients were included in our study. We found the employment rate in patients with axSpA in China is 66.81% is higher than the rate in England, which was 62% [17]. The patients in our research were much younger than those in the English study. This rate is lower, however, than the rate of employment for patients with chronic low back pain and previously unrecognized axSpA in Netherlands; the employment rate in that instance was 72.2% [18]. Patients with axSpA with income-earning jobs in China worked 3.5 hours/week more than axSpA patients in Italy [19]. In Italy, the presenteeism is 23.53%, the absenteeism is 10.40%, and the WPL is 30.57%. A British study of 490 axSpA patients reported a 22% presenteeism and 23.2% WPL [20],While data in the Dutch and Italian studies 33% presenteeism and 36% WPL were provided [21]. The differences may be due to the average age, the disease duration, and factors specific to the country in question. The socioeconomic environment may also play an important role. Each study demonstrated that axSpA had a significant impact on work productivity.

We next evaluated which factors can predict the existence of work disability. Work disability was defined as people who were employed with work restrictions and unemployed due to work restrictions using patient-self assessment. For axSpA there are two major tools to assess disease activity, the BASDAI and the ASDAS, one for function, the BASFI, and several mobility measures including the BASMI. In our study, the above index cannot be used to predict the occurrence of the work disability. The ASAS HI, which measures functioning and health across 17 aspects of health and 9 environmental factors in patients with SpA[22], was used to evaluate the impact of SpA and its treatment on functioning and health [22]. We found that ASAS HI and PhGA were the significant predictor of WD, with higher ASAS HI and PhGA scores indicating higher risk of WD by assessing functioning, disability, and overall health. One study found that ASAS HI could be used to represent the health status of SpA in a systematic way [23]. Combined with our work, this indicates that the ASAS HI and PhGA should be regularly surveyed in employed patients with axSpA. We also found that IBD functioned as another WD predictor. A follow-up study found that newly developed IBD was associated with a higher disease activity score, worse physical function, and worse global patient well-being [24]. Early recognition of IBD in patient with axSpA might prevent adverse work outcomes, more study should be researched.

The WPAI questionnaire offers important information about work productivity and daily activities. We investigated work productivity and daily activities and their relationships with demographic, clinical and extra-articular manifestations data, past medical history, disease activity, physical functioning, and mobility measures. Our study found that PGA, BASDAI, BASFI, ASAS HI, ASDAS, TOTAL BACK PAIN, and NOCTURNAL PAIN scores were moderately correlated with work productivity and daily activities, and the correlation coefficient was higher than ESR and CRP. As anticipated, we found that the BASFI is the most relevant to WPL in China. BASFI was used to assess the patient function; it was generally found that worse function led to worse work ability, so this index indicated the severity of work productivity loss.

Presenteeism and WPL were both associated with higher disease activity [20, 25]. There is also a significant correlation between persistent high disease activity trajectories (higher ASDAS values) and work outcomes [26]. We compared the loss of work productivity in patients with different disease activity (disease inactivity group, moderate activity group, high activity group, and extremely high activity group according to ASDAS score (which is assessed by a physician and is therefore more objective) at baseline in China. The loss of work productivity showed the most obvious differences between the disease activity and inactivity groups. We also found that the higher the disease activity, the worse physical function, mobility measures, and patient assessment were. This correlated with a greater loss of work productivity.

Non-steroidal anti-inflammatory drugs relieve inflammatory symptoms effectively and are presently the first line drug treatment [27]. As anticipated, this functions as a protective factor and helped retain the ability to work. TNF inhibitors (TNFi) are also effective therapies for axSpA [28]. Studies reported significant improvements in work disability after commencement of TNFi therapy [29, 30]. However, there was no correlation between TNFi used and loss of work ability in our study. The reasons were as follows: the study was an observational study, and long-term follow-up studies are needed in the future to observe the long-term work ability of patients with axSpA prognosis. Additional research should be done regarding TNFi, since the cost of the treatment means that fewer patients used it, reducing our sample size.

In this study, the SpAMS was used to collect clinical characteristics and work disability of patients with axSpA in China. We then assessed the status of work and work productivity impairment, as well as the related factors, to provide a clinical basis for the risk and severity of work disability. In the future, longitudinal research should be carried out. The process of disease and its relationship with work productivity will also be studied, so that we can fully explore the causes of adverse work outcomes in axSpA patients.

Conclusions

In summary, our survey of axSpA shows that a high incidence of Chinese patients with axSpA who are unable to work or who must work with restrictions due to their disability. SpAMS is a disease management tool that can help patients with AS perform self-management and provide valuable data to clinicians. We found that the ASAS Health Index, PhGA and IBD are good indicators for predicting the WD of axSpA. We also found that when disease activity, physical function, mobility measures, and patient assessments were worse, which lead to a greater loss of work productivity. NSAIDs as a protective factor affect the loss of work ability.

Abbreviations

AAU: acute anterior uveitis

AS: ankylosing spondylitis

ASAS HI: The Assessment of Spondyloarthritis international Society Health Index

ASDAS: Ankylosing Spondylitis Disease Activity Score

axSpA: axial spondyloarthritis

BASDAI: Bath Ankylosing Spondylitis Disease Activity Index

BASFI: Bath Ankylosing Spondylitis Functional Index

BASMI: Bath Ankylosing Spondylitis Metrology Index

CRP: C-reactive protein.

ESR: erythrocyte sedimentation rate

HLA: human leukocyte antigen

IBD: inflammatory bowel disease

LEF, leflunomide

MTX, methotrexate

NSAIDs, non-steroidal anti-inflammatory drugs

PGA: Patient's global assessment

PhGA: Physician's global assessment

SSZ, sulfasalazine

Thal Thalidoan

TNF, tumor necrosis factor

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Ethical Committee of the Chinese PLA General Hospital (S2016-049-02). Informed consent for participation in the study was collected from all patients before study entry.

Consent for publication

All patients provided informed consent to publish the data.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

Conception or design of the work: YW, FH. Data collection: XJ, SM, WC. Data analysis and interpretation: YW. XL, JT, Drafting the article: YW.XL, Critical revision of the article: YW, FH, Final approval of the version to be published: FH

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Figures

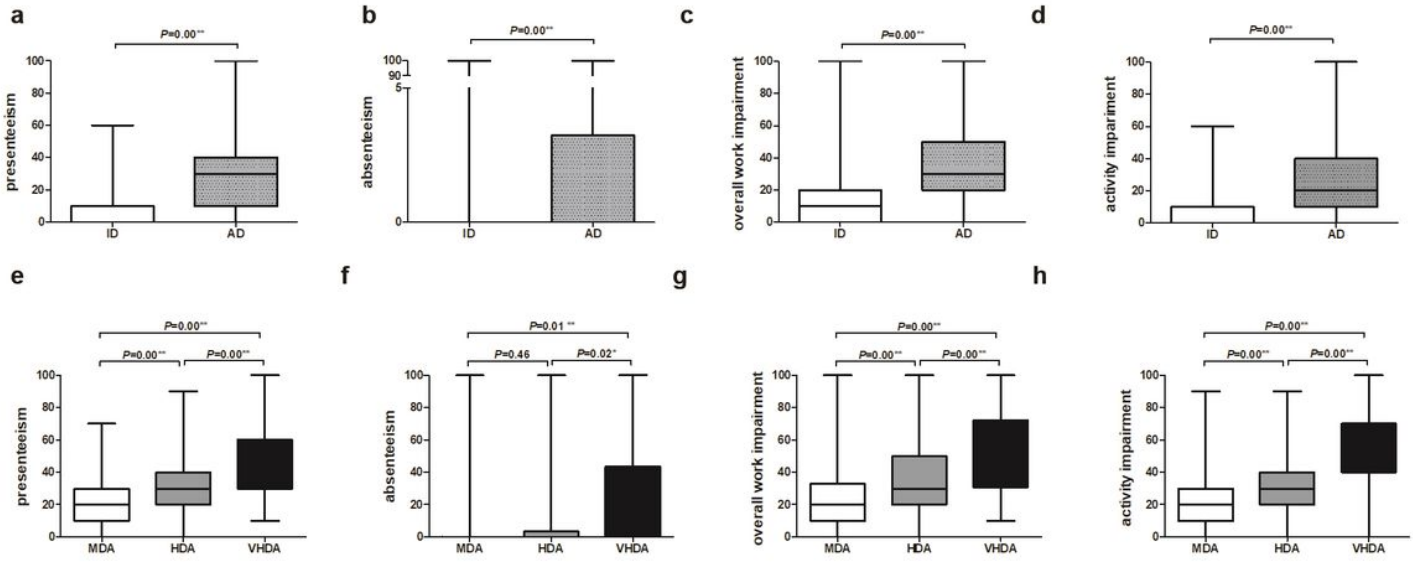
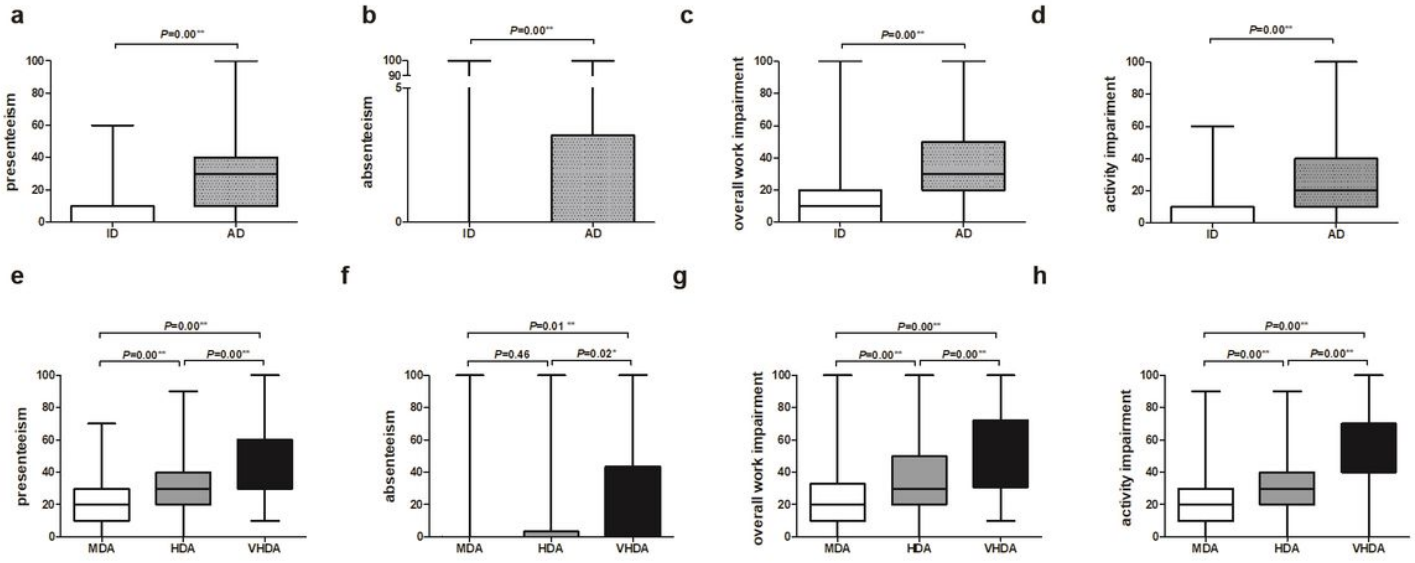


Figure 1

Comparison of work productivity loss among axSpA patients with different disease activities. (A) Two ASDAS categories were defined: AD: active disease (ASDAS ≥1.3); ID: inactive disease (ASDAS <1.3). (B) Three ASDAS categories were defined: MDA: moderate disease activity (ASDAS ≥1.3 and <2.1), HDA: high disease activity (ASDAS ≥2.1 and 3.5), and VHDA: very high disease activity (ASDAS ≥3.5). * Statistically significant difference between work disability and without disability of $p < 0.05$, ** Statistically significant difference of $p < 0.01$.



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