Identifying persons with axial spondyloarthritis at risk of poor work outcome: results from the British Society for Rheumatology Biologics Register

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Running Head: Work in axSpA patients

Abstract

Objective: Firstly to test the hypothesis that, amongst working patients with axSpA, those who report issues with reduced productivity at work (presenteeism) are at higher risk of work absence (absenteeism), and patients who report absenteeism are at higher risk of subsequently of leaving the workforce. Secondly to identify characteristics of workers at high risk of poor work outcome.

Methods: The British Society for Rheumatology Biologics Register in Ankylosing Spondylitis has recruited patients meeting ASAS criteria for axSpA from eighty-three centres. Data collection involves clinical and patient reported measures at recruitment and annually thereafter, including the Work Productivity and Activity Impairment scale. Generalised Estimating Equations were used to identify factors associated with poor work outcomes.

Results: Of the 1188 participants in this analysis who were working at recruitment, 79% reported some presenteeism and 19% some absenteeism in the past week due to their axSpA**.** Leaving employment was most strongly associated with previous absenteeism (Risk Ratio 1.02 per % increase in absenteeism, 95% CI 1.01, 1.03) which itself was most strongly associated with previous presenteeism, a labour intensive job and peripheral joint involvement. High disease activity, fatigue, a labour intensive job and poorer physical function were all independently associated with future presenteeism.

Conclusion: Clinical and patient reported factors along with aspects of work are associated with an increased risk of axSpA patients having a poor outcome in relation to work. This study has identified modifiable factors as targets, facilitating patients with axSpA to remain productive in work.

Introduction

Axial spondyloarthritis has been demonstrated to affect the work of patients. The impact includes, at its most extreme, the necessity to stop working or to change jobs to one more suited to limitations imposed on the patient by their condition. Another important impact is the effect which having axSpA has on being able to perform one's job (presenteeism) (1). In a study of 301 patients with axSpA in a single centre in the United Kingdom which used the Work Productivity and Activity Impairment scale to measure work impact, mean levels of absenteeism due to axSpA was 5% but 22% for presenteeism (2), while similar data (absenteeism 9%, presenteeism 33%) was provided from an analysis of 105 patients in the SPondyloArthritis Caught Early (SPACE) study involving four centres in the Netherlands, Norway and Italy (3).

Patients consider that work should be a priority for research studies. The National Ankylosing Spondylitis Society (NASS), the patient organisation in the United Kingdom which represents and supports people with ankylosing spondylitis (AS), carried out a formal project in 2013 to understand the key priorities for patients in terms of research. All members were invited to respond to the question 'What kinds of issues need to be understood better to make living with and managing AS easier" and responses from 150 members fed in to a subsequent priority setting exercise using a World Café format (4) involving rheumatologists, clinicians and allied health professionals. Amongst "lifestyle" factors, the top research priority identified was to "Understand the impact of AS on employment and how people maintain employment and develop their careers while managing their AS" (https://nass.co.uk/nass/en/research).

It has been noted that "Even more than today, work will become as much a social act as an economic one. It will help define us as individuals, provide social networks, support, community and …. connection to a wider purpose" (5). This emphasises the wider importance of enabling patients with axSpa and other chronic conditions, to remain in the workplace. A key issue in doing so is to understand the pathway leading to a poor work outcome, allowing the identification of a group of "high risk" patients. We propose, firstly, to test the hypothesis that working patients with axSpA who report issues with work productivity are at higher risk of work absence, and patients who report work absence are at higher risk of subsequently of leaving the workforce. If the model is supported, we will identify characteristics of patients at risk of poor work outcome.

Materials and Methods

The British Society for Rheumatology Biologics Register in Ankylosing Spondylitis (BSRBR-AS) is a prospective cohort study, involving 83 centres throughout Great Britain, recruiting patients meeting ASAS criteria for axial spondyloarthropathitis (axSpA) (6) and who were naïve to biologic therapy. Recruitment took place December 2012-December 2017, initially for patients meeting the ASAS imaging criteria for axSpA. Patients who met only the ASAS clinical criteria were subsequently eligible to be recruited from November 2014. There are two sub-cohorts: those about to commence a biologic agent (biologic cohort) and those continuing on other therapy (non-biologic cohort). Eligible therapies were adalimumab, etanercept and certolizumab pegol. The full study protocol has been published previously (7).Participants were required to be aged at least 16 years and be naïve to biologic therapy at the time of recruitment. All participants gave informed consent. The biologic cohort was followed up at 3 months and 6 months, and both cohorts were followed-up at 12 months and yearly thereafter up to a maximum of 5 years. If a patient in the non-biologic cohort commenced biologic therapy they switched cohort and began a new follow-up schedule. At each follow-up, in addition to clinical data obtained during rheumatology appointments, patient reported questionnaires were completed.

The primary outcome of interest for the current analysis was poor work outcome, as assessed by the Work Productivity and Activity Impairment Specific Health Problem v2.0 (WPAI:SHP) scale (8). This instrument determines work status and then, amongst those working, evaluates the impact of disease on work, and other daily activities, over the previous 7 days. The outcomes generated include a measure of the proportion of work-time missed (absenteeism), impairment whilst at work (presenteeism), overall work impairment (combination of absenteeism and presenteeism) and proportion of impairment in other activities. This instrument has been validated for use within ankylosing spondylitis patients (9). In relation to their job, respondents were also asked whether it was mainly desk-based/sedentary or physical/labour intensive.

Measures at recruitment (baseline) and at each follow-up time point, used in the current analysis as explanatory variables, include clinical data: the use of biologic therapy (yes/no), presence of extra-spinal manifestations (history of uveitis, psoriasis, inflammatory bowel disease (IBD), peripheral joint involvement and dactylitis) and the Bath Ankylosing Spondylitis Metrology Index (BASMI: scored 0 (least) - 10 (most) severe) (10). Patient reported measures of health included the Bath Ankylosing Spondylitis indices for disease activity (BASDAI), function (BASFI) and global health (BAS-G) (all scored from 0 (least) – 10 (most) severe) (11-13). Quality of life was evaluated via the Ankylosing Spondylitis Quality of Life index (ASQoL) (scored 0 (good) to 18 (poor)) (14), overall health by the European Quality

of Life – Visual Analogue Scale (EQ-VAS) (scored 0 (worst imaginable health) to 100 (best imaginable)) (15) and mental health using the Hospital Anxiety and Depression Scale (HADs) (grouped into none, borderline and clinical through standard cut-offs) (16). Spinal pain was assessed using a 10cm visual analogue scale, fatigue through the Chalder fatigue scale (scored 0 (best) – 11 (worst)) (17), and sleep disturbance by the Jenkins Sleep Evaluation Questionnaire (JSEQ) (scored 0 (no sleep problems) to 20 (poor sleep)) (18).

A measure of socio-economic status, the Index of Multiple Deprivation (IMD), was derived from the residence postcode of participants; categorised into quintiles (0 least deprived to 4 most deprived) with reference to their country of residence (19, 20).

The BSRBR-AS received ethical approval from the National Research Ethics Service (NRES) Committee North East – County Durham and Tees Valley (REC ref 11/NE/0374).

Statistical Analysis:

For the purpose of the current study, data collected at baseline and all follow-ups were utilised and the analysis uses the June 2017 version of the study database.

Differences in the characteristics of those working and not working at baseline were assessed using simple descriptive statistics, including initial absenteeism, presenteeism and overall work impairment scores. The baseline likelihood of working was further assessed using logistic regression models, adjusted for age, gender and deprivation.

To test the initial hypothesis, three separate analyses were conducted to determine the factors associated with: a) leaving work, b) absenteeism and c) presenteeism, at 12 month follow-up intervals. Participants were categorised as having left work if they were not working at a follow-up assessment but had been working 12 months prior, and they were of normal working age (females <60years and males <65 years). Factors associated with work withdrawal were explored using generalised estimating equation (GEE) models (21). GEE takes into account within-subject correlations, thus allowing the analysis of multiple observations from the same individual across multiple time-points. Thus baseline information was related to work outcome at 12 months, 12 month information was related to work outcome at 24 months and so on. The log link function was used (fitting a Poisson model) as appropriate, with an independent correlation matrix, including a robust variance estimator

(22). All models were adjusted for age, gender and deprivation, and presented as risk ratios or coefficents with 95% confidence intervals.

Factors related to a) leaving work, b) absenteeism and c) presenteeism, were assessed initially by GEE regression models as outlined above. Those factors reaching a significance threshold of $p \leq 0.20$ were offered to a forward stepwise regression process (linear GEE or Poisson GEE as appropriate) in order to determine which group of factors produced the best fitting models for the outcomes leaving work, presenteeism and absenteeism. Factors entered the model at $p \leq 0.10$ and exited at $p \geq 0.15$ with adjustment for age, gender, deprivation and relevant baseline measures (absenteeism or presenteeism as applicable).

All analysis was conducted using STATA (StataCorp LP version 15.0).

Results

At baseline, 1,921 participants returned a questionnaire and provided information on work status. Of these, 62% (n=1188) reported they were currently in paid employment and these represent the study population for the current analysis: 65% were male, with a median age of 44 years (Inter-quartile range (IQR) 35, 52 years), 55% worked in a sedentary job, 83% of those tested were HLA-B27 +ve and the median age of referral to a rheumatologist with symptoms was 33 years (IQR 26, 42 years). The likelihood of working decreased (after adjustment for age, gender and deprivation) with higher disease activity (OR 0.74 per unit increase in BASDAI, (95% CI 0.70, 0.79)), poorer physical function (BASFI 0.70/unit increase (0.66, 0.73)), poorer spinal mobility (BASMI 0.69/unit increase (0.64, 0.75)) and worse quality of life (ASQoL 0.84/unit increase (0.81, 0.86)) (Table 1). A higher proportion of those not working fulfilled the modified New York criteria for Ankylosing Spondylitis, compared to those working (15% vs. 7%). Amongst working participants, 79% reported some presenteeism, due to their axSpa, during the past week (median 30% IQR (10, 50%)), while 19% reported some absenteeism (0% (0, 0%).

Factors associated with leaving work during follow-up

The 1,188 participants working at baseline provided a total of 962 annual periods of observation (i.e. 12 month periods where both exposure and outcome information was available) when they were still

of normal working age (based on gender). In total 52 persons reported leaving work during follow-up while still of working age.

In the GEE analysis, utilizing all follow-up time points and adjusted for age, gender and deprivation, absenteeism was the only significant factor related to leaving work 12 months later (Risk Ratio 1.02 per % increase in absenteeism, 95% confidence interval 1.01, 1.03) (Table 2). There were no statistically significant or important differences between those who remained and did not remain in work in terms of whether they were receiving biologic therapy, anxiety or depression, Bath indices, quality of life, activity impairment, spinal pain, fatigue or sleep disturbance. Neither were there significant differences in presenteeism or whether they worked in a manual or sedentary job. A further stepwise model was therefore not necessary. The relationship with peripheral joint involvement or the presence of dactylitis with work withdrawal were not assessed, due to the low number of such persons (1 and 0 persons respectively).

Factors associated with future absenteeism

Utilising all follow-up time points, adjusted for age, gender and deprivation, the GEE models indicated that several factors were significantly associated with absenteeism 12 months later (Table 3). These included work factors (presenteeism: 0.14% average increase in absenteeism at follow-up for every % increase in presenteeism at baseline, (95% CI 0.07, 0.2), a labour intensive job (2.7 (0.4, 4.9)), Bath indices (BASDAI 1.2 (0.7, 1.8), BASFI 0.9 (0.4, 1.4), BAS-G 1.1 (0.6, 1.6)), quality of life (ASQoL 0.5 (0.3, 0.8)), activity impairment (0.13 (0.08, 0.2)), spinal pain (1.01 (0.5, 1.5)), fatigue (Chalder 0.4 (0.02, 0.8)) and sleep disturbance (JSEQ 0.4 (0.2, 0.6)). Although eligible for the stepwise model, both activity impairment and presenteeism were highly correlated (correlation 0.8). During the stepwise process, both factors fought for entry and a model solution could not be reached. As it was not possible to offer both factors to the model, presenteeism was chosen as it showed the strongest relationship to absenteeism during univariate analysis (Coef 0.14 vs. 0.13). Of the eligible factors offered to the stepwise model ($p \leq 0.20$, with adjustment for age, gender, deprivation and baseline absenteeism), the only ones which entered the linear regression model (in order) were presenteeism (0.1 (0.04, 0.2)), a labour intensive job (2.3 (-0.4, 5.0) and peripheral joint involvement (4.3 (-0.4, 5.0)) (Appendix Table a).

Factors associated with future presenteeism:

Utilising all follow-up time points, adjusted for age, gender and deprivation, the GEE models indicated that several factors were significantly associated with presenteeism 12 months later (Table 4). Clinical/borderline anxiety and depression (coefficient 10.7 (95% CI 7.2, 14.2) and 10.0 (5.9, 14.1) respectively), higher disease activity, poorer physical function, poorer spinal mobility and global disease status were associated with greater presenteeism (BASDAI: 4.2 (3.6, 4.9), BASFI: 3.7 (3.0, 4.3), BASMI: 1.4 (0.3, 2.5), BAS-G: 3.4 (2.8, 4.0)), as was poorer quality of life (ASQoL: 2.0 (1.7, 2.3), EQ_VAS: -0.3 (-0.4, -0.2)), activity impairment (0.4 (0.3, 0.43)), worse spinal pain (2.8 (2.2, 3.4)), fatigue (Chalder: 2.3 (1.8, 2.8)) and sleep disturbance (JSEQ: 1.1 (0.8, 1.4)). Lastly, commencing biologic therapy (6.6 (2.1, 11.1)), peripheral joint involvement (6.2 (1.9, 10.6)), a labour-intensive job (7.3 (3.8, 10.7) and greater absenteeism (0.2 (0.02, 0.3)) were also associated with subsequent presenteeism. Of the eligible factors offered to the stepwise linear regression model ($p \leq 0.20$), the only independent factors related to presenteeism at follow-up, after adjustment for age, gender, deprivation and baseline presenteeism, were (in order of entry): high disease activity (BASDAI coefficient 0.76 (95% CI -0.2, 1.8)), fatigue (Chalder 0.7 (0.1, 1.2)), a labour intensive job (3.4 (0.6, 6.1)) and poorer physical function (BASFI 0.9 (-0.03, 1.8)) (Appendix Table b). There were no interactions in this final model which were statistically significant.

Discussion

This large national prospective cohort study of patients with axSpA has demonstrated that persons of working age who are not in employment have worse disease activity and function and overall poorer quality of life. One out of five patients reported absenteeism in the past week while four out of five reported an impact on their ability to undertake tasks while at work. Our proposed pathway to leaving work was supported. It was associated with prior absenteeism, which itself was associated with prior presenteeism and having a labour intensive job. Disease activity, fatigue, poor function and a labour intensive job were the factors most strongly related to future presenteeism.

The strengths of this study include that it is amongst the largest to examine the impact of work on axSpA and specifically to identify markers of poor work outcome. It has used a validated scale (the WPAI:SHP) to assess work impact. However the scale only measures the impact of work over the past seven days and in a disease with a fluctuating course and disease “flares”, such a short period is

unlikely to adequately estimate work impact at an individual level. The resulting misclassification of work impact (and assuming that this is random) would make it more difficult to identify factors associated with poor work outcome. Developing scales more suited for use in longitudinal studies to capture (changes in) work impact in conditions like axSpA, should be a priority. The study has recruited over more than 80 centres, some are specialist centres for axSpA but most are not. Almost all patients meeting ASAS criteria were eligible to be recruited (only those who had previously started biologic therapy were not eligible) and in terms of the recruited population on biologics we have shown that they are similar to the axSpA patient population recruited to trials of biologics (23). Despite the large study population, the number of persons developing the extreme end of a poor work outcome (i.e. leaving employment) is relatively low and therefore this study, as all studies in this area, has limited power in developing statistical models for this outcome. We have conducted the statistical analysis over one year periods, examining different outcomes and therefore we are studying different patients in relation to each of the outcomes analysed rather than following patients longitudinally through presenteeism, absenteeism and job loss. The latter, more methodologically robust, approach would require a long-term and very large study of employed axSpA patients which is unlikely to be feasible.

There is relatively little data on the effect of specific aspects of work and its influence on axSpA or indeed the effect of axSpA on the ability to undertake certain jobs. The prospective study DEvenir des Spondyloarthrites Indifférenciées Récentes (DESIR) examined trajectories of disease and factors associated with these. They noted that “white collar work” was associated with the trajectory “persistent inactive” disease (24). Ramiro et al (25) reported in a longitudinal analysis of 136 patients that the relationship between disease activity and radiographic progression was significantly and independently modified by job type. In 'blue-collar' workers versus 'white-collar' workers, every additional unit of ASDAS resulted in an increase of 1.2 v. 0.2 in the modified Stoke Ankylosing Spondylitis Spine Score (mSASSS) units/2-years. These results could be interpreted as supporting the hypothesis that physically demanding jobs increase levels of inflammation. However they may also reflect confounding. Job category (blue collar v. white collar) is very closely linked to income and socio-economic status (SES), and also smoking status. The latter specifically has been linked to disease activity and radiographic progression (26).

In a study of 72 employed patients recruited in one centre of the Netherlands, 12% had sick leave over a period of 2 weeks and 53% experienced an adverse influence of ankylosing spondylitis (AS) on work productivity while at work, emphasising, as has been found in this current much larger study, the

importance of considering presenteeism when assessing work impact in axSpA (27). The relationship between high disease activity and work impact has previously been reported in cross-sectional studies. For example, a small study of 51 Italian patients recruited to the SPACE study showed an association with absenteeism, presenteeism and overall work productivity, relationships also evident with poor function (28). Bakland et al (29) recruited 360 patients, registered with AS in a single hospital in Norway, to a cross-sectional study. Work disability was related to current poor function (BASFI) and mobility (BASMI), co-morbidities, as well as older age, female sex and lower levels of education. All these data are cross-sectional, and while giving important insights do not allow us to understand the pathways to work disability and cannot disentangle factors leading to work disability from consequences of work disability. For example the observation that patients with rheumatoid arthritis who remain in employment have better health–related quality of life (30) could be interpreted as employment having positive effects on quality of life or that those with higher quality of life and lower disease severity are more able to stay in employment.

A longitudinal analysis of 720 patients with axSpA in Sweden, found that poor quality of life, worse disease activity, decreased physical function, lower self-efficacy, higher scores of anxiety, depression, smoking and low education were related to work disability two and a half years later (31). An important longitudinal analysis of 105 participants in the previously noted SPACE study demonstrated that improvements in disease activity were related to improvement in work productivity. Specifically a decrease in Ankylosing Spondylitis Disease Activity Score (ASDAS) of one unit was associated with a 5% and 17% improvement in absenteeism and presenteeism respectively (3). We have previously shown within the BSRBR-AS, using propensity score matching, that biologic therapy is associated with a significantly greater improvement in presenteeism 12 months later, in comparison to patients continuing on other therapies (-14.3%; 95% CI -24.7%, -4.0%) (32). Similarly in a cohort of axSpA patients in Sweden starting anti-TNFi therapy, their number of sick days decreased from 3 times to 2 times that of the general population over the subsequent 2 years (33). Taken together with the current results, this body of evidence is suggestive of a direct relationship between disease activity and presenteeism.

The current analysis shows an important association between high levels of fatigue and presenteeism and this has been noted in some previous studies. In the cross-sectional study of Espahbodi et al (2) high levels of fatigue in patients with axSpA were associated with work productively loss and absenteeism. In rheumatoid arthritis (RA) where fatigue has been demonstrated as an important influence on poor quality of life and employment (34, 35), improvement in physical function and relief

from fatigue and pain have been associated with increased productivity at work amongst patients treated with certolizumab pegol (36). However drug therapy (including biologics) only modestly improves fatigue in RA (37). Results from preliminary studies of non-pharmacological management (cognitive behaviour therapy) in RA give cause for optimism (Dures et al (38)) and randomised controlled trials are currently underway to assess the effectiveness of physical activity or cognitive behaviour therapy in improving fatigue both in RA and across inflammatory rheumatic disorders ((39) http://www.arthritisresearchuk.org/research/grant-tracker-items/2016/lessening-the-impact-of-fatigue-therapies-for-inflammatory-rheumatic-diseases-lift.aspx). Amongst workers, such approaches are unlikely to achieve optimal results unless they are at least partly focussed on work place issues (40).

In conclusion, this analysis of a national disease register has shown that high disease activity, fatigue, poor function and undertaking a physically demanding job, are associated with patients reporting presenteeism at work. Presenteeism and undertaking a physically demanding job increases the risk of absenteeism which is then associated with leaving work altogether. These results characterise workers at high risk of a poor outcome but also identify targets which could improve such outcomes. While biologic therapy, targeting disease activity, has been shown to effect modest improvements in fatigue, providing non-pharmacological therapies which includes specific focus on the workplace is likely to be necessary to observe the improvements which patients seek.

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Contribution: GJM, KWB and GTJ conceived the idea for the analysis, GJM wrote the analysis plan which was undertaken by LED with input from JS. The results were reviewed by GJM, GTJ, JS and EP. The manuscript was drafted by GJM together with LED. All authors critically reviewed the manuscript.

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Table 1: Baseline characteristics of the BSRBR-AS population		
	Working (n=1188)	**Not working (n=733)**
*****Age (median, IQR)***	43.7 (34.6, 52.3)	62.2 (48.1, 68.3)
*****Age at rheumatology referral (median, IQR)***	33 (26, 42)	41 (29, 52)
****Gender (N., %)***	Male: 797 (65%)	Male: 529 (72%)
*****Classification criteria (N., %) –*** *ASAS clinical*	635 (53%)	237 (32%)
ASAS imaging	475 (40%)	383 (52%)
Modified New York	78 (7%)	113 (15%)
*****HLA B27 status (N., %) –*** *Positive*	684 (83%)	337 (75%)
Negative	145 (17%)	115 (25%)
Job Type *(N., %) -* *Sedentary*	715 (55%)	-
Labour intensive	592 (45%)	-
Absenteeism *(%)* ***(median, IQR)***	0% (0, 0%)	-
Presenteeism *(%)* ***(median, IQR)***	30% (10, 50%)	-
Overall Work impairment *(%)* ***(median, IQR)***	30% (10, 53%)	-
*****Activity impairment*** *(%)* ***(median, IQR)***	30% (10, 60%)	60% (30, 80%)
	Logistic Regression (adjusted for age, gender and deprivation)	
Likelihood of working	**Odds Ratio**	**95% Confidence Interval**
*****BASDAI*** *(scored: 0 best -10 worst)*	0.74	0.70, 0.79
*****BASFI*** *(scored: 0 best -10 worst)*	0.70	0.66, 0.73
*****BASMI*** *(scored: 0 best -10 worst)*	0.69	0.64, 0.75
*****ASQoL*** *(scored: 0 best -18 poorest)*	0.84	0.81, 0.86

* statistically significant difference between work and not working of p<0.05

** statistically significant difference between work and not working of p<0.01

BASDAI – Bath Ankylosing Spondylitis Disease Activity Index, BASFI – Bath Ankylosing Spondylitis Functional Index, BASMI – Bath Ankylosing Spondylitis Metrology Index, ASQoL – Ankylosing Spondylitis Quality of Life questionnaire,

Table 2: Factors associated with no longer working 12 months later			
		GEE Poisson Regression (adj. for age, gender and deprivation)	
Baseline factors		**Risk Ratio**	**95% Confidence Interval**
Work:	**Job Type** *(labour intensive vs. sedentary)*	1.4	(0.8, 2.5)
	Absenteeism *(%)*	1.02	(1.01, 1.03)
	Presenteeism *(%)*	1.0003	(0.99, 1.01)
Clinical:	**Commencing biologic** *(yes vs. no)*	1.01	(0.5, 2.3)
	Uveitis *(yes vs. no)*	0.5	(0.2, 1.3)
	Psoriasis *(yes vs. no)*	1.2	(0.5, 3.1)
	Inflammatory Bowel Disease *(yes vs. no)*	0.99	(0.3, 2.8)
	Dactylitis *(yes vs. no)*	low number of observations	
	Peripheral Joint Involvement *(yes vs. no)*	low number of observations	
	BASDAI *(score 0-10)*	0.96	(0.8, 1.1)
	BASFI *(score 0-10)*	1.02	(0.9, 1.1)
	BASMI *(score 0-10)*	1.1	(0.9, 1.5)
	BAS-G *(score 0-10)*	1.1	(0.9, 1.2)
Patient:	**ASQoL** *(score 0-18)*	1.03	(0.97, 1.1)
	EQ-VAS *(score 0-100)*	0.99	(0.98, 1.01)
	Activity Impairment *(%)*	1.01	(0.99, 1.02)
	Spinal Pain *(score 0-10)*	1.001	(0.9, 1.1)
	Chalder fatigue *(score 0-11)*	0.97	(0.9, 1.1)
	Sleep Disturbance *(score 0-20)*	0.99	(0.95, 1.04)
	HADS Anxiety *(clinical/border vs. none)*	1.04	(0.6, 1.8)
	HADS Depression *(clinical/border vs. none)*	1.5	(0.8, 2.7)

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 Index, ASQoL – Ankylosing Spondylitis Quality of Life questionnaire, EQ-VAS – EuroQol Group visual analogue scale,

Table 3: Factors associated with absenteeism score 12 months later			
		GEE Linear Regression (adj. for age, gender and deprivation)	
Baseline factors		**Coefficient**	**95% Confidence Interval**
Work:	**Job type** *(labour intensive vs. sedentary)*	2.7	(0.4, 4.9)*
	Presenteeism *(%)*	0.14	(0.07, 0.2)*
Clinical:	**Commencing biologic** *(yes vs. no)*	2.8	(-1.1, 6.7)*
	Uveitis *(yes vs. no)*	-1.4	(-4.0, 1.1)
	Psoriasis *(yes vs. no)*	2.7	(-2.6, 8.0)
	Inflammatory Bowel Disease *(yes vs. no)*	1.1	(-4.3, 6.4)
	Dactylitis *(yes vs. no)*	3.4	(-6.4, 13.1)
	Peripheral Joint Involvement *(yes vs. no)*	3.4	(-0.7, 7.5)*
	BASDAI *(score 0-10)*	1.2	(0.7, 1.8)*
	BASFI *(score 0-10)*	0.9	(0.4, 1.4)*
	BASMI *(score 0-10)*	-0.2	(-0.9, 0.4)
	BAS-G *(score 0-10)*	1.1	(0.6, 1.6)*
Patient:	**ASQoL** *(score 0-18)*	0.5	(0.3, 0.8)*
	EQ-VAS *(score 0-100)*	-0.1	(-0.2, -0.04)*
	Activity Impairment *(%)*	0.13	(0.08, 0.2)*
	Spinal Pain *(score 0-10)*	1.01	(0.5, 1.5)*
	Chalder fatigue *(score 0-11)*	0.4	(0.02, 0.8)*
	Sleep Disturbance *(score 0-20)*	0.4	(0.2, 0.6)*
	HADS Anxiety *(clinical/border vs. none)*	2.5	(0.06, 4.9)*
	HADS Depression *(clinical/border vs. none)*	3.2	(0.07, 6.4)*

*eligible for forward stepwise model (p≤0.2)

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 Index, ASQoL – Ankylosing Spondylitis Quality of Life questionnaire, EQ-VAS – EuroQol Group visual analogue scale,

Table 4: Factors associated with presenteeism score 12 months later			
		GEE Linear Regression (adj. for age, gender and deprivation)	
Baseline predictors		**Coefficient**	**95% Confidence Interval**
Work:	**Job type** *(labour intensive vs. sedentary)*	7.3	(3.8, 10.7)*
	Absenteeism *(%)*	0.2	(0.02, 0.3)*
Clinical:	**Commencing biologic** *(yes vs. no)*	6.6	(2.1, 11.1)*
	Uveitis *(yes vs. no)*	-0.5	(-4.5, 3.6)
	Psoriasis *(yes vs. no)*	3.8	(-2.6, 10.2)
	Inflammatory Bowel Disease *(yes vs. no)*	1.3	(-3.95, 6.5)
	Dactylitis *(yes vs. no)*	6.4	(-4.9, 17.7)
	Peripheral Joint Involvement *(yes vs. no)*	6.2	(1.9, 10.6)*
	BASDAI *(score 0-10)*	4.2	(3.6, 4.9)*
	BASFI *(score 0-10)*	3.7	(3.0, 4.3)*
	BASMI *(score 0-10)*	1.4	(0.3, 2.5)*
	BAS-G *(score 0-10)*	3.4	(2.8, 4.0)*
Patient:	**ASQoL** *(score 0-18)*	2.0	(1.7, 2.3)*
	EQ-VAS *(score 0-100)*	-0.3	(-0.4, -0.2)*
	Activity Impairment *(%)*	0.4	(0.3, 0.43)
	Spinal Pain *(score 0-10)*	2.8	(2.2, 3.4)*
	Chalder fatigue *(score 0-11)*	2.3	(1.8, 2.8)*
	Sleep Disturbance *(score0-20)*	1.1	(0.8, 1.4)*
	HADS Anxiety *(clinical/border vs. none)*	10.7	(7.2, 14.2)*
	HADS Depression *(clinical/border vs. none)*	10.0	(5.9, 14.1)*

*eligible for stepwise model

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 Index, ASQoL – Ankylosing Spondylitis Quality of Life questionnaire, EQ-VAS – EuroQol Group visual analogue scale,

Appendix (or web supplementary material)

Table a: Independent factors associated with absenteeism 12 months later			
		GEE Linear Regression	
Variables in order of model entry:		**Coefficient**	**95% Confidence Interval**
Presenteeism *(effect per % of presenteeism)*		0.12	(0.04, 0.20)
Profession *(labour intensive vs. sedentary)*		2.30	(-0.42, 5.03)
Peripheral Joint Involvement *(yes vs. no)*		4.31	(-0.42, 5.03)
Adjusting variables:	*Age (year)*	*0.13*	*(0.005, 0.25)*
	Gender (female vs. male)	*3.6*	*(0.45, 6.75)*
	Deprivation (increasing quintile)	*0.09*	*(-0.76, 0.94)*
	Baseline absenteeism (%)	*0.11*	*(-0.04, 0.25)*

Table b: Independent factors associated with presenteeism 12 months later			
		GEE Linear Regression	
Variables in order of model entry:		**Coefficient**	**95% Confidence Interval**
BASDAI *(score 0-10)*		0.76	(-0.23, 1.78)
Chalder fatigue *(score 0-11)*		0.65	(0.12, 1.18)
Profession *(labour intensive vs. sedentary)*		3.36	(0.61, 6.10)
BASFI *(score 0-10)*		0.86	(-0.03, 1.75)
Adjusting variables:	*Age (year)*	*-0.001*	*(-0.12, 0.12)*
	Gender (female vs. male)	*2.52*	*(-0.42, 5.47)*
	Deprivation (increasing quintile)	*0.79*	*(-0.12, 1.70)*
	Baseline presenteeism (%)	*0.37*	*(0.27, 0.47)*
BASDAI – Bath Ankylosing Spondylitis Disease Activity Index, BASFI – Bath Ankylosing Spondylitis Functional Index			