

Risk Factors for Work Disability in Patients with Ankylosing Spondylitis

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ABSTRACT. Objective. To identify risk factors for work disability in patients with ankylosing spondylitis (AS).

Methods. Risk factors for permanent work disability and for receipt of disability payments were assessed using Cox regression models in a retrospective cohort study of 234 patients with AS. Candidate risk factors included age at onset of AS, sex, race, education level, marital status, the presence of comorbid conditions, smoking and drinking history, recreational activity, occupation, and physical activity at work. Risk factors for changes in the type of work performed, decrease in number of hours worked, long sick leave, and the need for help at work were assessed using logistic regression models in a prospective study of the subset of 144 patients who reported working for pay during the study. Candidate risk factors for these aspects of work disability were age, sex, race, education level, levels of functional disability, pain and stiffness, changes in functional disability, pain or stiffness over the preceding 6 months, minutes/week of recreational exercise, back exercises, freedom of movement at work, control over the pace of work, and physical activity at work.

Results. In a cohort of 234 patients with a median duration of AS of 21.4 years, 31 patients (13.2%) developed permanent work disability and 57 patients (24.3%) had received disability payments. Older age at onset of AS, less formal education, and having had jobs that were more physically active were significant risk factors for permanent work disability. These factors, along with the presence of a comorbid condition and being female, were also significantly associated with the receipt of disability payments. In a prospective study of 144 patients followed for a median of 4 years, higher levels of functional disability and pain were associated with increased risks of decreased work hours, long sick leaves, and needing help at work, while higher levels of pain were also associated with an increased risk of changing the type of work performed. Women were significantly more likely than men to change their type of work or decrease their work hours. Patients whose jobs were more physically demanding were more likely to change their type of work or need help at work.

Conclusion. Patients with AS who have physically demanding jobs are more likely to experience permanent or temporary work disability, or need to change the type of work done or receive help at work, than those with jobs that are less physically demanding. (J Rheumatol 2001;28:315–21)

Key Indexing Terms:

ANKYLOSING SPONDYLITIS WORK EMPLOYMENT DISABILITY

Work disability can be one of the major consequences of chronic disease. Loss of the ability to work often results in decreased income, disruption or loss of health insurance, decreased self-esteem, and increased reliance on family members for support. Lost income due to work disability is also the major component of indirect costs of illness. Understanding the risk factors for work disability could suggest interventions that would help people remain employed.

Because ankylosing spondylitis (AS) often begins in young adulthood, when people are beginning their careers, it has the potential to affect the work ability of a large proportion of patients. Studies have reported that about 80% of patients with AS remain employed at 20 years of illness, but there is little data on work disability beyond 20 years¹⁻⁹. Most studies were cross sectional studies of groups that varied widely in age and sex, factors that influence the proportion of patients who remain employed¹⁰. Most studies were also of patients in Europe, and many were conducted in the 1980s. Because of geographic and temporal differences in job markets and in societal responses to work disability, these results may not be widely generalizable. Few studies examined risk factors for work disability^{1,6,8,9} or examined aspects of work disability other than permanent premature retirement.

We examined risk factors both for permanent work disability and for receipt of disability payments in a retrospective cohort study of 234 patients with AS. We also

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Supported in part by the Bartman Foundation.

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Received February 10, 2000 revision accepted June 13, 2000.

examined risk factors for changes in the type of work, decreases in work hours, long sick leaves, and the need for help at work in a prospective study of 144 patients. Based on research that indicated the important contribution of the nature of work tasks to work disability in patients with rheumatic diseases¹¹⁻¹⁶, we were particularly interested in the physical demands of work as a risk factor for work loss.

MATERIALS AND METHODS

Patients. Patients in this study were participants in the Longitudinal Study of Outcomes in Ankylosing Spondylitis, an ongoing prospective study of health status, treatments, and outcomes of patients with AS¹⁷. Patients were recruited from 1992 to 1997 from the rheumatology clinics at Stanford University Medical Center and the Veteran Affairs Palo Alto Health Care System, by referral from local rheumatologists, and from the community by advertisement. To be eligible for the study, participants had to have a diagnosis of AS by the modified New York criteria¹⁸, be age 18 or older, and be able to read English. Patients with a history of inflammatory bowel disease were excluded. Two hundred forty-one patients were enrolled. For this study we excluded 7 patients who were either students or homemakers and had not worked for pay, leaving 234 patients for analysis.

Study protocol and variables. Study participation included an examination at entry and completion of mailed questionnaires at entry and every 6 months thereafter. The initial questionnaire asked information on demographic characteristics, duration of AS, comorbid medical conditions, history of tobacco and alcohol use, and work history. Patients were asked to list all jobs they had since beginning full-time work, whether (and when) they received any payments for work disability, their current work status, and dates of retirement or permanent work disability (if applicable). For each job, patients rated the degree of physical activity the job entailed (1 = little, 2 = moderate, 3 = much). We also classified the physical activity of each job using the ratings assigned by the US Department of Labor in the *Dictionary of Occupational Titles* (1 = sedentary, 2 = light, 3 = medium, 4 = heavy, 5 = very heavy)¹⁹. Patients also reported their level of recreational activity in each decade of life (1 = less active than peers, 2 = as active as peers, 3 = more active than peers).

On the initial questionnaire and each followup questionnaire, patients who were employed were asked if they had changed the type of work they did, decreased their hours of work, or needed help at work in the preceding 6 months because of their AS. We also asked the number of sick days used because of AS, and classified those who used 10 or more sick days in the preceding 6 months as having long sick leaves. We asked the degree of freedom of movement they had in their job (little or none, some, or much) and their ability to regulate the pace of work (little or none, some, or much). We also asked the proportion of a typical workday spent sitting, standing, walking, carrying, lifting, bending, kneeling, and crawling, and classified those who spent 20% or more of their workday lifting, bending, kneeling, or crawling as having a physically demanding job.

Patients also completed the Health Assessment Questionnaire (HAQ) Disability Index, and visual analog scales (VAS) for pain severity and stiffness severity on each questionnaire. The HAQ Disability Index is a 20 question self-report instrument that asks respondents to rate the degree of difficulty they have performing tasks in 8 functional areas (dressing, arising, eating, walking, hygiene, reaching, gripping, and errands and chores)²⁰. Responses to each question can range from 0 (no difficulty) to 3 (unable to do), and the scores of each functional area are averaged to compute the Disability Index (possible range 0-3). Pain was measured using the pain score of the HAQ, a 15 cm horizontal VAS labeled 0 = no pain and 3 = severe pain. Stiffness was also measured using a 15 cm horizontal VAS labeled 0 = no stiffness and 100 = severe stiffness. We asked patients to report the frequency and duration of recreational exercise done each week, from which we computed minutes/week of exercise, and also asked the number of days/week they performed back exercises.

Statistical analysis. Two sets of analyses were performed: a retrospective cohort study of risk factors for permanent work disability and for receipt of disability payments, and a prospective study of risk factors for changes in the type of work, decreases in work hours, long sick leave, and need for help at work.

In the retrospective cohort analyses, we examined the time to occurrence of either permanent work disability or first receipt of disability payments among all 234 patients, using survival analysis. The starting date for these analyses was the date of onset of AS symptoms, which was assigned as the 15th day of the month if patients provided a month and year of symptom onset, and assigned as July 1 if patients only provided the year of symptom onset. The end date for the analysis of permanent work disability was the date of permanent work disability, date of retirement without disability, or date of last followup, whichever occurred first. The end date for the analysis of receipt of disability payments was the date that payments were first received, date of retirement without receiving disability payments, or date of last followup, whichever occurred first. Patients who were still working at the last assessment, or who were working and had not yet received any disability payments, were censored in these analyses. Time to occurrence of work disability or first receipt of disability payments was estimated using the Kaplan-Meier method. Risk factors for both outcomes were tested using Cox regression models²¹. The risk factors included age at onset of AS, sex, race (white versus other), education level, marital status (married versus not married), past or current smoker (yes/no), past or current regular consumer of alcohol (yes/no), presence of any comorbid medical conditions (yes/no), average lifetime recreational activity, initial occupation (professional/manager versus other), and physical activity at work, based on either the average of patient reported activity levels for all jobs held or the average of activity levels as rated by the *Dictionary of Occupational Titles* for all jobs held. Risk factors that were significantly associated with the outcomes in univariate analyses were then tested in multivariate Cox regression models.

The prospective analyses were restricted to the 144 patients who were employed during at least one of the 6 month assessment periods of the study, because only these patients were at risk for a change in type of work, decrease in work hours, long sick leave, or need for help at work. Each outcome was scored as present or absent during each 6 month assessment period. Risk factors for these outcomes were also obtained at each 6 month assessment, and included age, HAQ Disability Index, change in HAQ Disability Index from the previous assessment, pain score, change in pain score from the previous assessment, stiffness severity, change in stiffness severity from the previous assessment, exercise minutes/week, days/week of back exercises, freedom of movement at work, ability to control the pace of work, and having a physically demanding job (based on spending 20% or more of the workday lifting, bending, kneeling, or crawling). We also included the time-invariant variables of sex, race (white versus other), and education level. Duration of AS was not included as a risk factor because it was collinear with age. The association between risk factors and each outcome was assessed using logistic regression models, implemented as generalized estimating equations to account for the within-patient correlation of observations²². Risk factors that were significantly associated with an outcome in univariate analyses were then tested in multivariate analyses that used a stepwise selection procedure after including age, sex, race, and education level in each model.

Comparisons between patient groups were performed using t tests, chi-square tests, or Fisher's exact tests. All hypotheses were 2 tailed, and p values < 0.05 were considered statistically significant. No adjustment was made in the criterion for a Type I error because we considered this study to be hypothesis-testing. All analyses were performed using SAS programs (SAS Institute, Cary, NC, USA).

RESULTS

Retrospective cohort study. The 234 patients were predominantly white, male, and well educated (Table 1). The initial

Table 1. Characteristics of the study patients. Plus-minus values are means \pm standard deviation. Values in parentheses after the variables are the possible ranges of scores.

	All Patients, n = 234	Patients with Permanent Work Disability, n = 31	Patients Who Received Disability Payments, n = 57
Age at onset of AS, yrs	27.4 \pm 11.0	29.5 \pm 10.6	27.0 \pm 10.6
Men, n (%)	165 (70.5)	19 (61.3)	35 (61.4)
White, n (%)	199 (85.0)	26 (83.9)	46 (80.7)
Education level, yrs	15.5 \pm 2.7	13.4 \pm 2.7***	14.2 \pm 2.7***
Married, n (%)	160 (68.4)	18 (58.1)	34 (59.6)
Current or former smoker, n (%)	126 (53.8)	23 (74.2)*	43 (75.4)*
Regular alcohol user, n (%)	118 (50.4)	15 (48.4)	30 (52.6)
Any comorbid condition, n (%)	174 (74.4)	29 (93.5)*	53 (93.0)**
Initial job as professional/manager, n (%)	106 (45.3)	7 (22.6)*	81 (31.6)*
Average work physical activity by DOT (1–5)	1.8 \pm 0.7	2.2 \pm 0.9*	2.1 \pm 0.8*
Average work physical activity by patient (1–3)	1.9 \pm 0.6	2.3 \pm 0.6***	2.1 \pm 0.6*
Average lifetime recreational activity (1–3)	1.9 \pm 0.6	1.7 \pm 0.5	1.8 \pm 0.6

DOT: *Dictionary of Occupational Titles*. Compared to the complementary subgroup: *p < 0.05, **p < 0.001, ***p < 0.0001.

job for 45% of patients was a professional or managerial job. By the ratings of the *Dictionary of Occupational Titles*, most patients had jobs that were sedentary or involved light physical activity, although patients more often rated their work activity as moderate. Over the course of their life, patients tended to move to less physically active jobs. For example, 5.5% of first jobs held by patients were rated as heavy or very heavy by the *Dictionary of Occupational Titles*, compared to 2.5% of the most recent jobs, and 36% of patients rated their first job as requiring much physical activity, compared to 20% for their most recent job. Most patients reported that their level of recreational physical activity was comparable to that of their peers. Sixty-one patients (26%) reported leaving a job because of their AS, and 18 patients (7.7%) received vocational rehabilitation.

In this group of patients with a median duration of AS of 21.4 years, 31 patients (13.2%) reported permanent work disability. At 30 years of AS, 84% of patients were still working, and at 40 years, 77% were still working (Figure 1). As a group, those who experienced permanent work

disability were less well educated than those who did not have permanent work disability, and were more likely to have comorbid medical conditions, be a smoker, have a nonprofessional job, and have jobs that required more physical activity (Table 1).

In the univariate Cox regression analyses, the risk of permanent work disability was higher among those with onset of AS at an older age, among smokers, among those with a comorbid medical condition, and among those who had more physically active jobs (Table 2). The risk was lower among those with more years of formal education and among those whose first job was as a professional or manager. Sex, race, marital status, alcohol use, and recreational physical activity were not associated with the risk of permanent work disability in this cohort. In the multivariate analysis, only age at onset, education level, and average level of physical activity at work were significantly associated with the risk of permanent work disability. This risk increased by 5% with each year of age of onset of AS, doubled with each one-step increase in average work

Table 2. Risk factors for permanent work disability, by Cox regression analysis.

	Univariate Analysis			Multivariate Analysis		
	Hazard Ratio	95% CI	p	Hazard Ratio	95% CI	p
Age at onset of AS	1.06	1.02–1.10	0.001	1.05	1.02–1.09	0.002
Years of education	0.72	0.62–0.84	< 0.0001	0.76	0.63–0.91	0.003
Current or former smoker	2.25	1.00–5.05	0.05	1.31	0.54–3.14	0.55
Initial job as professional/manager	0.32	0.13–0.75	0.009	1.07	0.38–2.99	0.91
Any comorbid condition	4.32	1.02–18.20	0.05	2.62	0.58–11.86	0.21
Average work physical activity by DOT	2.24	1.47–3.40	< 0.0001	1.99	1.26–3.13	0.003

DOT: *Dictionary of Occupational Titles*.

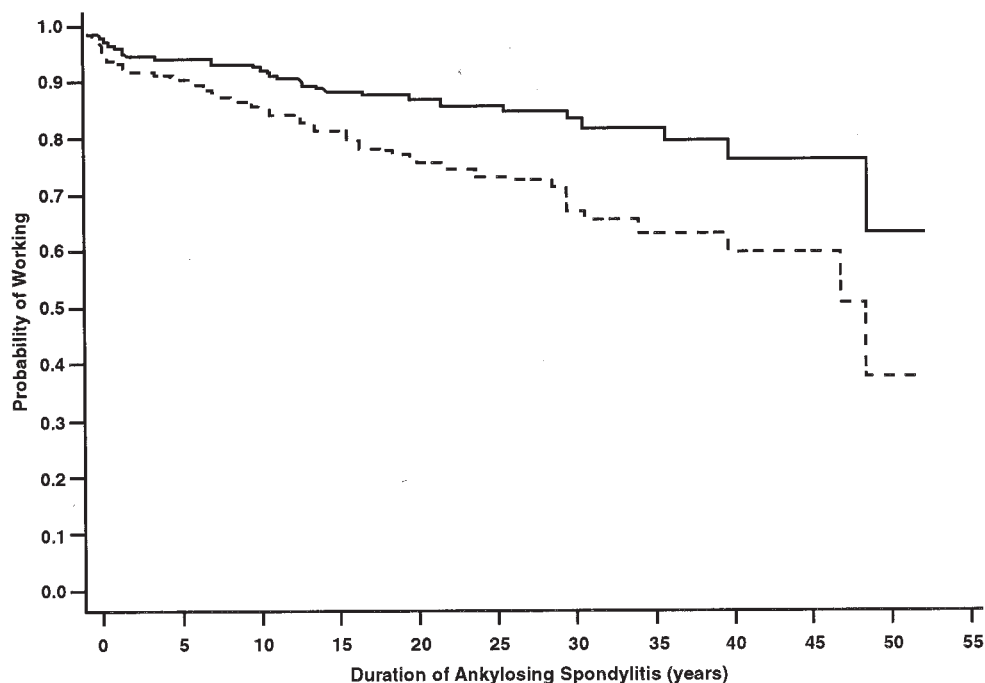


Figure 1. Probability of patients working without permanent disability (solid line) and without receiving payments for work disability (broken line), from the onset of AS.

activity as rated by the *Dictionary of Occupational Titles* (1 = sedentary, 5 = very heavy), and decreased by 24% with each additional year of formal education (Table 2). These 3 risk factors were also identified as the only significant risk factors in a stepwise selection model, with nearly identical hazard ratios. There were no significant interactions between the average level of physical activity at work and either age, sex, education level, presence of comorbid conditions, or initial job as a professional or manager, indicating that the effects of heavy physical activity on work disability were similar in subgroups of patients that differed in these characteristics. Results were also similar in a model in which the average physical activity at work as reported by the patients [multivariate hazard ratio = 2.62, 95% confidence interval (CI) 1.40–4.89, $p = 0.003$] was used in place of the ratings assigned by the *Dictionary of Occupational Titles*. Use of vocational rehabilitation was associated with an increased likelihood of permanent work disability (univariate hazard ratio = 3.33, 95% CI 1.40–7.89, $p = 0.007$).

Fifty-seven patients (24.3%) had received payments because of work disability. At 30 years of AS, 68% of patients had not received disability payments, and at 40 years of AS, 61% had not (Figure 1). Twenty-six patients received payments for one year or less. The most common sources of payments were state and local governments (36%) and employers (23%). As a group, patients who received disability payments were less well educated than those who had not received payments, and were more likely

to have a comorbid medical condition, be a smoker, have a nonprofessional job, and have jobs that required more physical activity (Table 1).

In the univariate Cox regression analyses, the risk of receiving disability payments was higher among those with onset of AS at an older age, and among women, smokers, those with a comorbid medical condition, and those who had jobs that were more physically active (Table 3). The risk was lower among those with more years of formal education and among those whose first job was as a professional or manager. Race, marital status, alcohol use, and recreational physical activity were not associated with the risk of receiving disability payments. In the multivariate analysis, age at onset, sex, education level, presence of a comorbid condition, and level of physical activity at work were significantly associated with the risk of receiving of disability payments (Table 3). This risk increased by 3% with each additional year of age at onset of AS, was 89% higher among women than men, decreased by 13% with each additional year of formal education, was more than 4 times as likely among those with a comorbid condition, and increased by 92% with each one-step increase in average work activity as rated by the *Dictionary of Occupational Titles*. These same risk factors were identified in a stepwise selection model as significantly associated with the receipt of disability payments; in this model, the risk associated with the presence of a comorbid condition was slightly greater (multivariate hazard ratio = 4.99, 95% CI 1.54–16.13, $p = 0.008$) than in the full multivariate model.

Table 3. Risk factors for receipt of payments for work disability, by Cox regression analysis.

	Univariate Analysis			Multivariate Analysis		
	Hazard Ratio	95% CI	p	Hazard Ratio	95% CI	p
Age at onset of AS	1.03	1.00–1.06	0.02	1.03	1.00–1.06	0.04
Women	1.72	1.00–2.94	0.05	1.89	1.03–3.45	0.04
Years of education	0.82	0.73–0.91	< 0.0001	0.87	0.76–0.99	0.04
Current or former smoker	2.60	1.41–4.76	0.002	1.74	0.92–3.28	0.09
Initial job as professional/manager	0.50	0.28–0.89	0.02	1.10	0.55–2.20	0.79
Any comorbid condition	4.31	1.55–11.92	0.005	4.07	1.23–13.43	0.03
Average work physical activity by DOT	1.83	1.29–2.60	0.0006	1.92	1.29–2.85	0.002

DOT: Dictionary of Occupational Titles.

There were no significant interactions between either the presence of a comorbid condition or heavy physical activity at work and either age, sex, or education level, indicating that the effects of comorbid conditions and physical activity were similar in these patient subgroups. In a model in which the average physical activity at work as reported by the patients was substituted for ratings of work activity by the *Dictionary of Occupational Titles*, only physical activity at work (multivariate hazard ratio = 1.85, 95% CI 1.18–2.91, $p = 0.008$), years of education (multivariate hazard ratio = 0.87, 95% CI 0.76–0.99, $p = 0.03$), and presence of a comorbid condition (multivariate hazard ratio = 2.93, 95% CI 1.03–8.29, $p = 0.05$) were significantly associated with the receipt of disability payments.

Prospective cohort study. The 144 patients who had worked during the prospective study period were followed for a median of 4 years (total of 564.5 person-years of followup). On 79% of assessments, patients reported working 40 hours/week or more. The mean HAQ Disability Index over all assessments was 0.42 ± 0.47 (on a 0–3 scale), the mean pain score was 0.99 ± 0.71 (on a 0–3 scale), and the mean stiffness score was 43 ± 22 (on a 0–100 scale). Recreational exercise averaged 148 minutes/week, and on 37% of assessments patients reported doing back exercises at least 5 days/week. On 82% of assessments, patients reported much freedom of movement at work, and on 59% of assessments reported much control over the pace of work. Patients reported physically demanding work on 18% of assessments.

Between 14% and 31% of patients either changed their type of work, decreased their work hours, had a long sick leave, or needed help at work during the study, but these changes occurred infrequently (Table 4). In univariate analyses, a change in the type of work was more common among women and those with less formal education, and in periods with higher HAQ Disability Indexes, an increase in Disability Index over the preceding 6 months, higher pain scores, more severe stiffness, and physically demanding work. A decrease in work hours was more common among women and in periods with higher HAQ Disability Indexes,

Table 4. Proportion of patients and proportion of assessments with changes in work characteristics. The proportion of patients indicates the proportion who ever reported the change in work characteristic. Each assessment corresponded to each 6 month questionnaire interval to which patients contributed information during longitudinal followup.

	Proportion of Patients, %	Proportion of Assessments, %
Change in type of work	16.7	3.3
Decrease in work hours	30.6	12.5
Long sick leave	14.6	3.3
Need for help at work	24.3	7.0

an increase in Disability Index over the preceding 6 months, higher pain scores, and more severe stiffness. Long sick leaves were more common among women and in periods with higher HAQ Disability Indexes, higher pain scores, and more severe stiffness. The need for help at work was more common among women, whites, and those with less formal education, and in periods with higher HAQ Disability Indexes, higher pain scores, more severe stiffness, less freedom of movement at work, and physically demanding work. Age, changes in pain or stiffness severity, recreational exercise, back exercise, and control over the pace of work were not associated with any of these measures of work disability. In the multivariate analyses, only sex, the level of HAQ Disability Index, pain score, and heavy physical activity at work were significantly associated with any of these measures of work disability (Table 5). Women were more likely than men to change their type of work or decrease their work hours. The risk of a decrease in work hours increased more than 3 times with each 1 point increase in the HAQ Disability Index, while the risk of a long sick leave or the need for help at work increased more than 5 times with each 1 point increase. The risk of each outcome more than doubled with each 1 point increase in pain score. Finally, the risk of a change in the type of work or the need for help at work was 2 to 3 times greater during periods of physically demanding work.

Table 5. Risk factors for change in type of work, decrease in work hours, long sick leave, and need for help at work, by multivariate logistic regression analysis. All models were adjusted for age, sex, race, and education level. Physically demanding work was based on patient reports that at least 20% of a typical work day was spent lifting, bending, kneeling, or crawling.

	Change in Type of Work			Decrease in Work Hours		
	OR	95% CI	p	OR	95% CI	p
Women	2.78	1.35–5.71	0.006	1.78	1.15–2.75	0.01
HAQ Disability Index	—			3.06	1.95–4.81	< 0.0001
Pain score	3.60	2.22–5.81	< 0.0001	2.29	1.67–3.14	< 0.0001
Physically demanding work	2.39	1.13–5.01	0.03	—		

	Long Sick Leave			Need for Help at Work		
	OR	95% CI	p	OR	95% CI	p
Women	—			—		
HAQ Disability Index	5.17	2.34–11.43	< 0.0001	5.40	2.69–10.81	< 0.0001
Pain score	2.12	1.17–3.84	0.02	2.06	1.26–3.36	0.004
Physically demanding work	—			2.84	1.47–5.48	0.002

HAQ: Health Assessment Questionnaire.

DISCUSSION

In this cohort, permanent work disability was not common, but temporary work disability or changes in the nature or structure of work due to AS occurred in up to 30% of patients. The prevalences of permanent work disability and changes in type of work were similar to those reported in previous studies^{1,3,5,7,8}. Important risk factors for permanent work disability were an older age at onset of AS, less formal education, and a history of jobs requiring more physical activity. Having a comorbid condition was an additional risk factor for receipt of disability payments. Women were more likely than men to receive disability payments for AS, change their type of work, or report the need for help at work. Patients with more severe or more active AS, as reflected in functional disability or pain measures, were also more likely to either change their type of work, decrease work hours, have a long sick leave, or need help from others. Having a job that involved more physical activity was also a risk factor for change in the type of work and need for help at work. A range of other factors, including race, occupational category, health habits, recreational activity, short term changes in symptoms, and freedom of movement at work were not associated with work disability.

Similar to the results of studies of patients with other rheumatic diseases^{11–16}, heavy physical activity at work was a risk factor for several different aspects of work disability in our cohort. The likelihood of permanent work disability and receipt of disability payments increased with the average physical activity rating of jobs held by patients over their lifetime. Results were similar using either ratings of work activity assigned to specific jobs by the US Department of Labor, or ratings by patients of their recalled levels of work activity. Having a job that required prolonged lifting, bending, kneeling, or crawling was also associated

with an increased risk of a change in the type of work or the need for help at work. Only 2 studies examined the nature of work tasks as a possible risk factor for work disability in AS. Lehtinen reported that patients employed in heavy manual labor were more likely to become permanently work disabled or to change jobs than patients whose jobs did not involve heavy labor¹. Guillemain and colleagues reported that employment in jobs that required prolonged standing was a risk factor for work disability, although having a physically demanding job was not⁶. Heavy work may worsen musculoskeletal symptoms, or require flexibility or endurance that patients with AS cannot always match. Patients may retain employment if they are able to modify the work tasks to ones they can accomplish, change their type of work, or receive help intermittently, but permanent work disability may result if these accommodations are not possible.

Patients with less formal education were also more likely to have permanent work disability or receive disability payments^{8,9}. These associations were present despite adjustment for the physical demands of work, indicating that work loss among less well educated patients was not solely attributable to their involvement in jobs requiring more physical activity. Patients with less formal education or of lower socioeconomic status may have fewer available employment options, or fewer options that can accommodate their impairments. They may be less able or less apt to retrain and learn new skills that would permit them to remain employed. Similar factors may contribute to the increased risk of work disability with an older age at onset of AS. Patients who develop AS after becoming established in their careers may be more likely to retire if no longer able to do their work than to learn a new set of work skills. Vocational rehabilitation did not help patients avoid work disability,

possibly because it was used too late in the disablement process. Previous studies have not reported sex differences in work disability among patients with AS, although Gran and colleagues found the prevalence of work disability to be somewhat higher among women^{4,9}. Women in our study were no more likely than men to have permanent work disability, but they were almost twice as likely to receive disability payments, a marker of temporary work disability. Many of these payments to women occurred within the first year of AS, suggesting that AS may have a more pronounced effect on women. This finding is also supported by other results from this cohort that indicate women are more likely than men to have severe fatigue, pain, and functional limitations²³. Even after adjusting for sex differences in pain and functional disability, women were more likely to change their type of work or decrease their work hours. That women were more likely to make these adaptations, yet no more likely to have permanent work disability, indicates that these strategies were largely effective in allowing them to remain employed.

Not unexpectedly, patients were more likely to experience changes in the nature or structure of their work during periods of more pain and higher levels of functional disability. These factors may also influence the likelihood of the longterm outcomes of permanent work disability or receipt of disability payments, but we did not have prospective data on pain, stiffness, or functional disability to assess this association. We also did not examine associations with physical limitations, such as reduced lumbar flexibility or peripheral arthritis, because the onset of these limitations could not be accurately ascribed in our retrospective study. The risk factors examined in the retrospective study were those that did not vary over time or ones that could be reliably ascertained by patient recall. Our study participants were predominantly white, well educated, and from one geographic area, which limits the representativeness of our cohort. Because the risk of work disability varies with the level of formal education, the prevalence of work disability would likely be higher in groups of patients with more diverse educational or socioeconomic backgrounds. Nonetheless, we were able to demonstrate differences in the risks of work disability among patients with different levels of formal education.

Given the association between physical activity at work and work disability, patients with AS should be counseled to avoid jobs that require heavy physical activity. For patients who have not yet begun full-time work, education or training for less physically demanding jobs offers better prospects for lifelong employment. To be effective, efforts at retraining those with physically demanding jobs for lighter work may need to begin long before physical impairment develops.

ACKNOWLEDGMENT

We thank Cheryl Kallmann for expert technical assistance.

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