



**Is the work ability index useful to evaluate absence days in ankylosing spondylitis patients? A cross-sectional study.**

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Complete List of Authors:	Meyer, Katharina; University Hospital, Physiotherapy Niedermann, Karin; School of Health Professions, Institute of Physiotherapy Tschopp, Alois; University Zurich, Biostatistics Unit, Institute of Social and Preventive Medicine Klipstein, Andreas; Center of Occupational Health, ; University Hospital Zurich, Rheumatology
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Manuscripts

Work ability index, ankylosing spondylitis

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4 **Is the work ability index useful to evaluate absence days in ankylosing**  
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6 **spondylitis patients? A cross-sectional study.**  
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11 **Katharina Meyer MPH<sup>1</sup>, Karin Niedermann PhD<sup>2</sup>, Alois Tschopp PhD<sup>3</sup>,**  
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13 **Andreas Klipstein MD Msc<sup>1, 4</sup>**  
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16  
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18  
19 1) Institute of Physical Medicine, University Hospital Zurich, Zurich, Switzerland  
20

21 2) Zurich University of Applied Sciences, School of Health Professions, Institute of  
22  
23 Physiotherapy, Winterthur, Switzerland  
24

25  
26 3) Biostatistics Unit, Institute of Social and Preventive Medicine, University Zurich, Zurich,  
27  
28 Switzerland  
29

30 4) Center of Occupational Health, Militärstrasse 76, 8004 Zurich, Switzerland  
31  
32  
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34  
35 **Corresponding author:**

36  
37 Katharina Meyer

38  
39 University Hospital Zurich, U OST 153, Gloriastr. 25, 8091 Zurich, Switzerland  
40

41 E-mail: Katharina.Meyer@usz.ch, Phone: +41 44 255 36 17, Fax: +41 44 255 43 88  
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## Abstract

### Objectives:

Background: The work incapacity of ankylosing spondylitis (AS) ranges between 3-50% in Europe. Due to a lack of central registers in many countries, work incapacity is difficult to quantify. The Work Ability Index (WAI) is applied to measure the work ability in workers, but it is not well investigated in patients.

Aims: To investigate the work incapacity in terms of absence days in patients with AS and to evaluate whether the WAI reflects the absence from work.

Hypothesis: Absence days can be estimated based on the WAI and other variables.

**Design:** Cross-sectional design.

**Setting:** In a secondary care centre in Switzerland the WAI and a questionnaire about work absence were administered in AS patients prior to a cardiovascular training.

The absence days were estimated by using multiple regression analysis.

**Participants:** 92 AS patients (58 men (63%)). Inclusion criteria: AS diagnosis, ability to cycle, age between 18 and 65 years. Exclusion criteria: Severe heart disease.

**Primary and secondary outcome measures:** Absence days.

**Results:** Of the 92 patients, 14 received a disability pension and 78 were in the working process. The median absence days per year of the 78 patients due to AS alone and including other reasons was 0 days (IQR 0-12.3) and 2.5 days (IQR 0-19), respectively. The WAI score (regression coefficient = -4.66 ( $p < 0.001$ , CI -6.1 to -3.2), "getting a disability pension" (regression coefficient = -106.8 ( $p < 0.001$ , 95% CI -141.6 to -72.0), and other not significant variables explained 70% of the variance in absence days ( $p < 0.001$ ) and therefore, may estimate the number of absence days.

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4 **Conclusions:** In groups of AS patients with absence days, the WAI and other variables  
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6 validly assesses incapacity for work. In economic evaluations, the indirect costs may be  
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8 calculated by estimating the absence days by using the WAI.  
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## Article summary:

### Article focus

- To measure the work incapacity in terms of absence days in patients with AS in Switzerland
- To evaluate whether the WAI reflects the absence from work.

### Key messages

- There is no valid measurement to assess absence days.
- This study shows that the WAI score together with specific variables can be used in ankylosing spondylitis patients to calculate absence days.
- This cost-saving method of measuring absence days may be implicated to compute indirect costs in future studies.

### Strengths and limitations of this study

- The study showed, that the WAI is not only feasible in prevention, but also in a clinical setting for patients with AS.
- We took into account that the data are skewed and checked the goodness of fit of the regression model by splitting half the group.
- Perhaps patients with a high motivation to influence their health were overrepresented in this study. This could lead to an underestimation of the absence days.

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## Introduction:

People affected with ankylosing spondylitis (AS) are impaired in their daily living activities.

This is a problem for both the patients and the society in terms of the high costs

associated with the loss of productivity. The magnitude of the disability should be

determined in order to manage AS-patients with restrictions in the work status effectively.

The range of employment in different countries varies widely from 34 to 96%, and the work

disability ranges from 3 to 50% depending on the disease duration. Prevalence of AS in

western Europe is estimated at 0.86%<sup>1 2</sup> to 1.4%<sup>3</sup>. Incapacity to work is higher in patients

affected with AS than in the general population. Mean national sick leave per working

individual annually has been measured to be between 7 and 16 days in the Netherlands,

France and Belgium<sup>4</sup>, in comparison to 12 to 46 days of sick leave per patient with AS per

year<sup>5</sup> in the same countries. In Switzerland, two studies about the work status of AS

patients show different numbers regarding the incapacity to work. In one study, 42.5%

patients reported occasional incapacity for work due to AS, whereas 13.5% were

permanently disabled and received a partial (10.2%) or full disability pension (3.3%). Days

of sick leave were not reported<sup>6</sup>. In an earlier study, the point estimate of the working

ability was measured at 97.3% and disability at 2.7 %<sup>7</sup>. This may reflect that the

evaluation of the work status is rather complicated because of the different possible

endpoints or definitions of the working ability<sup>5</sup>. In Switzerland and in most of the other

countries, reliable data about absence days do not exist<sup>8</sup>.

In various studies, information about sickness absence is gathered from the registered

data of companies<sup>9</sup> or from the civil service register<sup>10</sup>. But these measurements are not

validated. Nevertheless, there is no direct access to absence data in many countries, and

moreover, to gather such information in the daily practise is too costly and hardly feasible.

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4 In musculoskeletal rehabilitation, there is a growing demand for evaluating relevant  
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6 outcome parameters. In Switzerland, the loss of one working day costs about 600 Euro in  
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8 average <sup>11</sup>, and therefore, work loss is a significant cost factor in back and musculoskeletal  
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10 disorders. To our knowledge, no validated questionnaires exist which encompass the  
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12 complicated nature of the construct of the incapacity for work. There is however an  
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14 assessment for the working ability, the so-called "Work Ability Index" WAI <sup>12-14</sup>, which is  
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16 well investigated in the work environment and in occupational health care, where it has  
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18 been shown to be predictive<sup>14</sup> in terms of future incapacity for work and disability pension.  
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20 Its internal reliability and concurrent validity has proven to be satisfactory<sup>15</sup>. The test-retest  
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22 reliability revealed acceptable values<sup>16</sup>. Recently, it has also been used in some studies  
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24 with groups of patients, for example in workers with musculoskeletal disorders <sup>17</sup>, heart  
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26 disease, hypertension <sup>18</sup>, for groups of patients with psychiatric disorders <sup>19</sup>, rheumatoid  
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28 arthritis <sup>20</sup> or osteoarthritis <sup>21</sup>. The WAI has however not been applied to patients with AS.  
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35 The main aim of this study was to investigate how big the problem of incapacity to work is  
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37 in a subgroup of people with AS in Switzerland. A further aim was to evaluate whether the  
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39 WAI, in combination with other variables, could potentially serve as a simple instrument for  
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41 measuring absence days in AS patients.  
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## 4 **Study population and methods**

### 5 **Participants**

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9 The participants for this study were AS patients taking part in a cardiovascular training  
10 study for which the sample size was computed to detect the effect of the training. The  
11 patients were recruited from the national Ankylosing Spondylitis Association and from the  
12 Rheumatology outpatient facilities in our country in 2008/2009. The last follow-up of the  
13 intervention was in 2010. Inclusion criteria for the cardiovascular training intervention and  
14 thus this sub-study were: AS diagnosis following the modified New York criteria, the ability  
15 to cycle, sufficient German language ability (for questionnaires), age between 18 and 65  
16 years, willingness to follow the study protocol, and an informed consent. Chronic heart  
17 failure and functional NYHA Class III and IV were criteria for exclusion. The study was  
18 approved from the local Ethics Committee and the patients provided written informed  
19 consent. All patients were randomised to either the cardiovascular training or an attention  
20 control.  
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### 38 **Design**

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40 In a cross-sectional study, we investigated the dimension of the incapacity for work and  
41 the feasibility of the WAI to estimate absence days.  
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### 46 **Measurements of the WAI-study**

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48 A comprehensive assessment was conducted before cardiovascular training. The  
49 measurements of this sub-study included the WAI and additional questions about the work  
50 status (QW).  
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4 The WAI is a 13-item questionnaire about a) the work conditions, b) the perception of the  
5 present health condition, and c) the perceived prognosis for work. It is easy to use and  
6 takes about 10 minutes to fill out <sup>12 14</sup>. The scores range from 7 to 49 points, with 49 points  
7 describing the best ability to work. The rules to compute the scores are described in detail  
8 <sup>12</sup>. The scores of the WAI can be divided into four categories: 7-27 = poor, 28-36 =  
9 moderate, 37-43 = good, 44-49 = excellent ability to work.  
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17 Different substantial questions about the work ability composed a second questionnaire  
18 about work status (QW) to calculate the absence days. In contrast to the brief WAI, the  
19 comprehensive QW should reveal more accurate information on the complex construct of  
20 the incapacity for work. We selected the questions of the QW by means of another study  
21 <sup>22</sup>, addressing the disability to work, and on the basis of the clinical experience on  
22 determining the work ability. The items of the QW include working tasks (mental, physical  
23 or mixed), full or part-time work, full or partial work disability during the last year, sick days  
24 during the last year, duration of the work disability, reasons for the incapacity for work (AS  
25 versus other health reasons), and disability leading to financial support.  
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## Procedure

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41 The absence days were computed by means of the QW: The work disability for the  
42 previous year is expressed in days off work due to health reasons. Only working days are  
43 counted, weekends and holidays are not included. The work disability is composed of the  
44 number of complete sick days and of the partial presence at work due to health reasons.  
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46 For instance, 30% incapacity for work in a full time job during a distinct period is converted  
47 into the corresponding number of sick days. The numbers are adjusted for part-time work,  
48 e.g. if someone is employed for 50%, then the days of sick leave consists of only half of  
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4 the absence days of those of a full time employment. The work disability, days off work  
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6 and early retirement due to AS in contrast to other health problems were considered  
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8 separately from each other as was also done in a review<sup>5</sup>. One could argue that the WAI  
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10 contains an item that assesses self-reported sick leave over the previous twelve months;  
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12 therefore, it would not be necessary to measure the absence days with the more  
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14 complicated QW. But Radkiewicz et al. pointed out that the above mentioned item of the  
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16 WAI should be excluded from the WAI, because there is no substantial relationship  
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18 between this item and the overall score<sup>15</sup>. Furthermore, this item diminishes the internal  
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20 validity and thus, the QW was introduced to measure absence days.  
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## Statistics

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28 The data were checked for normal distribution. Appropriate parametric and non-parametric  
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30 statistics, depending on the distribution, were applied. Non-parametric statistics were used  
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32 to compare the distributions for the demographic variables and the absence days across  
33  
34 the groups. The level of significance was set at  $\alpha = 0.05$ . With regard to the main aim  
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36 of the study, descriptive statistics was used to depict demographic data, the absence days  
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38 (on the basis of the QW) and the WAI score. The WAI score and the absence days in the  
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40 QW were correlated to evaluate the relation and the concurrent validity between the two  
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42 questionnaires. Pertaining to the second aim of the study, namely to get a simple way to  
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44 measure absence days, a multiple regression analysis was performed. The regression  
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46 was applied in order to estimate the absence days as a constructed value in prospective  
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48 studies. The number of absence days calculated by the QW represents the dependent  
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50 variable in the multiple regression model. The statistical software PASW statistics (version  
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52 18) was used for the analysis.  
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## Results

Of the 182 eligible patients 77 refused to participate and 16 were excluded due to exclusion criteria. Table 1 shows the demographic variables, the work status and the mental or physical job demands of the included 92 patients in the working age. Four of these received a full pension (three patients because of AS, one patient because of other reasons) and ten a partial disability pension. The remaining 78 individuals (84.7%) were still in the working process and worked 88.9% of a full time job per year. Table 2 shows the WAI-scores and the absence days computed on the basis of the QW. Where data are skewed, median values are presented. A patient may have absence days due to a) AS alone, b) other health problems (e.g. depression), or c) both. Therefore, the median is zero for a) and b), but bigger than zero for c). There were no missing values concerning the main variables.

The mean of the absence days is expressed as the percentage of the working time per year, allowing a comparison of the absence days to those of other studies. The 78 patients had a mean of 17.9 absence days (SD  $\pm$ 43.7) due to AS only, which is equivalent to 8.1% work disability. Due to other health reasons, a work disability of 2.5% was calculated.

When the 14 patients receiving a disability pension were included (n=92), then the mean absence days due to all reasons was 47.9 days (SD  $\pm$ 79.1). These correspond to a disability of 21.6%. The ten patients with a partial disability pension were still partially in the working process and had a mean working time of 41% (SD  $\pm$ 31).

Sensitivity analysis: It is unknown whether patients with a full or a partial disability pension would work 88.9% of the annual working time, if they would not receive any disability pension. Hence, the percentage of the disability for this group (n=92), presuming the

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4 patients would work 100% or 80% of a full time job, was calculated. Under this  
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6 presumption the disability due to all health problems would be 19.2% and 24.0%,  
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8 respectively.  
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12 The Spearman-correlation between the WAI and the absence days on the basis of the  
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14 QW, which expresses the concurrent validity, was -0.736 ( $p < 0.001$ ) for all of the 92  
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16 patients. The scatter plot revealed an overrepresentation of cases without absence days.  
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18 However, a rang correlation should not be analysed, if there are tied ranks such as the  
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20 multiple cases with zero absence days. Therefore, the correlation was calculated for the  
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22 subgroup of AS patients which had at least one absence day per year due to all health  
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24 problems ( $n=58$ ), irrespective of getting a disability pension. The correlation reveals an  $r = -$   
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26 0.755 with a significant  $p$ -value of  $p < 0.001$  (Figure 1).  
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33 Additionally, a multiple regression analysis with the QW as dependent variable was  
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35 performed to answer the second study question. All significant baseline variables, namely  
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37 the work ability index score (WAI), the number of diagnoses ( $<3/>2$ ), age and a disability  
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39 pension (yes/no) as well as gender, were included in the model. Because age and gender  
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41 have often an influence on the health status, age and gender were introduced to check for  
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43 possible confounding. For the subgroup of patients with absence days ( $n=58$ ), multiple  
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45 regression analysis revealed that 70% of the variance in the dependent variable absence  
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47 days (measured by the complex QW) can be explained by the independent variables of  
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49 age, gender, WAI, the number of diagnoses and a disability pension (Table 3). However,  
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51 only WAI and “getting a disability pension” significantly contributed to the model. Thus, the  
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53 absence days of an AS patient can be estimated by multiple regression with the  
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4 unstandardized regression coefficients:  $y = b_1 \cdot x_1 + b_2 \cdot x_2 + \dots + b_n \cdot x_n + a$ , where  $y$  is the  
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6 estimated value of the absence days,  $n$  is the number of independent variables,  $x_1$  to  $x_n$   
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8 are the independent variables (age, gender, WAI, the number of diagnoses and getting a  
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10 disability pension), and  $a$  is a constant (Table 3). Due to the skewed distribution of the  
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12 absence days and the WAI, we verified our presented regression model by splitting the  
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14 sample into two halves. We estimated each with the shown regression model. We then  
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16 correlated the estimates and the true values of each group. The result of this was squared  
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18 and compared with the R Square of the same group (results not shown). The squared  
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20 correlation and the R Square should be similar in order to confirm that the regression  
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22 model is capable of predicting the absence days of another sample quite accurately (e.g.  
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24 the other half of the group). The differences were 0.18 for the first half and 0.05 for the  
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26 second half, indicating a good fit of the model.  
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## 4 **Discussion**

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6 Key results:  
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9 Individuals without a disability pension had an 8.1% work disability, if it was solely due to  
10 AS. The absence days increased by 2.5%, when AS patients, who have had work  
11 disability due to other health reasons, were included. The percentage of absences due to  
12 AS and other health reasons, including the individuals receiving a disability pension, was  
13 21% evaluated by the QW. Multiple regression analysis explained 70% of the variance of  
14 the absence days. The two variables 'WAI' and 'disability pension' made a significant  
15 contribution to this model. Thus, the WAI, in combination with other variables, can serve as  
16 a simple instrument for measuring absence days in the various groups of AS patients.  
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29 Discussing important differences to other studies:  
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31 The results regarding the absences of a group of AS patients who underwent a  
32 cardiovascular training are comparable to the findings of another Swiss cohort <sup>6</sup>. But the  
33 number of absence days in our study is slightly lower than in the review by Boonen <sup>5</sup>.  
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36 Higher rates of disability pension are found in other studies <sup>23-26</sup>. The differences in the  
37 ability to work in different studies are dependent on several factors such as disease  
38 duration and activity, the perceived self-efficacy to perform a job, the general health  
39 condition and the kind of job (physical/mental demands) <sup>27</sup>. However, influences from  
40 different structures of the social insurance system, the job market situation, and cultural  
41 differences in absence behaviour may also be relevant. This also has been observed in  
42 other musculoskeletal disorders <sup>28</sup>.  
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51 Our study showed much higher work disability measured in absence days than in another  
52 Swiss study <sup>7</sup>. However, in this other study the working ability of 97.3% was a point  
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measurement, and the number of patients only working part-time due to their health condition had not been identified. These distinctions in the methods and the low return rate of questionnaires in this other study could explain the difference in the results of these studies. The correlation coefficient of  $r = -0.755$  reveals a good correlation between the WAI and the QW. This supports the concurrent validity of the QW. The negative relationship means that having a low score in the WAI leads to more absence days. Implications of this study: The WAI reflected the absence days in a subgroup of AS patients with absences from work by the help of the above-mentioned regression equation. Age and gender did not confound the results. Based on the regression equation, the indirect costs can be computed by multiplying the number of estimated absence days with the costs of one absence day. This is useful for economic evaluations of groups for rehabilitation programmes. Usually, absence days are very time-consuming and difficult to measure because of part-time work, partial incapacity for work, partial or full invalidity pension and the potential incapability of the patients to recall all the subtle differences in their absences. Therefore, the WAI offers some advantages in contrast to questionnaires with a huge set of questions: it takes only 10 minutes to be completed, it reflects the subjective view of the patients and the scoring is clearly understandable.

Strength of this study: The study showed that the use of the WAI is not only feasible in a prevention setting such as occupational health care, but also in a clinical setting for patients with AS. We took into account that the data are skewed and checked the goodness of fit of the regression model by splitting the group into two halves, estimating the values of the other half and by correlating the true with the estimated values. The procedure confirmed the stability of the regression model.

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4 Weaknesses of the study: The absence days were gathered retrospectively and the results  
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6 of this study are not generalizable for other subjects than people with AS. Perhaps patients  
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8 with a high motivation to influence their health were overrepresented in this study, since  
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10 they were readily willing to undergo a cardiovascular training. Such patients may also have  
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12 been more willing to maintain their ability to work. This could lead to an underestimation of  
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14 the absence day.

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17 Since a questionnaire encompassing the complicated nature of the construct of the  
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19 incapacity for work does not exist, we made use of the new not validated QW. The  
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21 substantial correlation of the WAI and QW however implicates an acceptable concurrent  
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23 validity. The sample size is not very big to conduct a multiple regression analysis.  
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25 However, we had 11 patients per variable and this lies above the recommended number of  
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27 patients (5 to 10 times the number of included variables).  
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31 In summary, the WAI offers an innovative and cost-saving approach in studies in which  
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33 socioeconomic outcomes such as indirect costs are targeted.  
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### 37 **Conclusions:**

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39 Incapacity for work in a sample of AS patients was equal to pan-European countries. The  
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41 WAI was feasible for use in AS patients. It validly assesses incapacity for work evaluating  
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43 groups of participants suffering of AS with absence days. In the future, the indirect costs  
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45 as a part of cost benefit and cost effectiveness estimates may be calculated by computing  
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47 the absence days through a regression analysis including the WAI score as a variable.  
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51 This economic aspect may be increasingly relevant. Future research may evaluate  
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53 whether these results are replicable in patients with other health conditions than AS.  
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Work ability index, ankylosing spondylitis

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## **Conflicts of interest statement**

The authors declare no conflict of interests.

## **Funding statement**

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Work ability index, ankylosing spondylitis

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Work ability index, ankylosing spondylitis

**Table 1: Baseline variables (n=92)**

	Overall, n=92
<i>Age in years, mean (SD)</i>	46.34 (11.15)
<i>Gender:</i>	
men (%)	58 (63.0)
women (%)	34 (37.0)
<i>Duration in years since AS diagnosis</i>	
mean (SD)	14.55 (12.74)
<i>Number of current diseases</i>	
AS alone	22
+ 1-2	45
+ > 2	25
<i>Education, n (%)</i>	
<=12 years	60 (65.2)
>12 years	26 (28.3)
Not known	6 (6.5)
<i>Employment status, n (%)</i>	
Paid work	68 (73.9)
Unpaid work	6 (6.5)
Unemployed	4 (4.4)
Partial disability pension	10 (10.9)
Full disability pension	4(4.3)
<i>Job demands (n=78, no disability pension)</i>	
physical	11%

## Work ability index, ankylosing spondylitis

mental	41%
both	48%

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Work ability index, ankylosing spondylitis

**Table 2: Absence days (AD) and WAI-scores for the patients in the working age**

		All patients in the working age (n=92)	Patients without disability pension (n=78)
Absence days during the last year, Median (IQR) <sup>2)</sup>	Due to AS <sup>1)</sup> alone Other health problems AS <sup>2)</sup> and other health problems	0 (0 - 37.8) 0 (0 - 2) 4.5 (0 - 61.1)	0 (0 - 12.3) 0 (0 - 2) 2.5 (0 - 19)
WAI, Mean (SD)	-	34.18 (9.77)	35.93 (9.29)

Absence days measured by the QW

1) Ankylosing spondylitis

2) Interquartile range



Work ability index, ankylosing spondylitis

**Table 3: Multiple regression with absence days as dependent variable (n=58)**

Model Constant and independent variables	Unstandardized regression coefficients (B)	Standardized regression coefficients (Beta)	Significance p-value	95%-Confidence Interval for B Lower / Upper	
Constant	427.2	-	0.000	317.32	537.08
Disability pension <sup>1)</sup>	-106.81	-0.52	0.000	-141.60	-72.02
WAI	-4.66	-0.51	0.000	-6.13	-3.18
Age	-0.498	-0.07	0.429	-1.75	0.76
Gender	-10.71	-0.06	0.414	-36.82	15.40
N° of diagnoses <sup>2)</sup>	10.24	0.06	0.461	-17.45	37.93

1) Disability pension (yes/no)

2) Number of diagnoses (<3/>2)

R- Squared 0.724, R-squared adjusted 0.7, model is significant with p<0.001

Independent variables were simultaneously entered into the model.

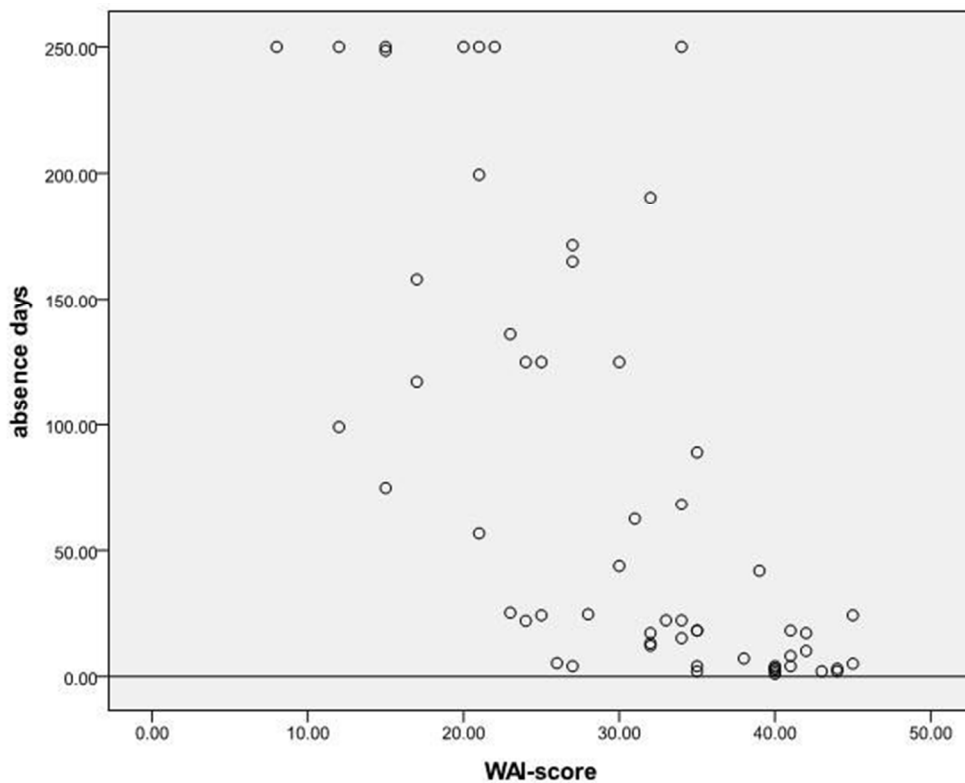
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**Figure 1** Scatterplot of the WAI and absence days for the subgroup with absence days (n=58)

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STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Was this done in the manuscript? Yes or no or explanation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	yes
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	yes
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	yes
Objectives	3	State specific objectives	yes
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	yes
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes. Exposure not applicable
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	Yes
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes. Confounders and effect modifiers not applicable, because descriptive study.
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes Only one group
Bias	9	Describe any efforts to address potential sources of bias	Discussed in the limitations
Study size	10	Explain how the study size was arrived at	Yes
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes, in the statistic section
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Yes, in the statistic section and in the results section
		(b) Describe any methods used to examine subgroups and interactions	Not applicable because of the descriptive nature of the study

		(c) Explain how missing data were addressed	There were no missing values of the total WAI-score nor the QW
		(d) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(e) Describe any sensitivity analyses	yes
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	yes
		(b) Give reasons for non-participation at each stage	yes
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes, table 1
		(b) Indicate number of participants with missing data for each variable of interest	No missing data for the two main questionnaires
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval).	Yes
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yes
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	Yes, in the discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes

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2	Generalisability	21	Discuss the generalisability (external
3			validity) of the study results
4	<hr/>		
5	<b>Other information</b>		
6	Funding	22	Give the source of funding and the role of
7			the funders for the present study and, if
8			applicable, for the original study on which
9			the present article is based
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12 \*Give information separately for exposed and unexposed groups.

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14 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and  
15 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely  
16 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at  
17 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is  
18 available at [www.strobe-statement.org](http://www.strobe-statement.org).  
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**Is the work ability index useful to evaluate absence days in ankylosing spondylitis patients? A cross-sectional study.**

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2012-002231.R1
Article Type:	Research
Date Submitted by the Author:	06-Feb-2013
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<b>Primary Subject Heading</b>:	Rehabilitation medicine
Secondary Subject Heading:	Rheumatology, Occupational and environmental medicine
Keywords:	REHABILITATION MEDICINE, RHEUMATOLOGY, OCCUPATIONAL & INDUSTRIAL MEDICINE, PAIN MANAGEMENT, questionnaire

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Manuscripts

Work ability index, ankylosing spondylitis

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4 1 **Is the work ability index useful to evaluate absence days in ankylosing**  
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7 2 **spondylitis patients? A cross-sectional study.**  
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11 4 **Katharina Meyer MPH<sup>1</sup>, Karin Niedermann PhD<sup>2</sup>, Alois Tschopp PhD<sup>3</sup>,**  
12  
13  
14 5 **Andreas Klipstein MD Msc<sup>1, 4</sup>**  
15  
16  
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18  
19 7 1) Institute of Physical Medicine, University Hospital Zurich, Zurich, Switzerland  
20

21 8 2) Zurich University of Applied Sciences, School of Health Professions, Institute of  
22  
23 9 Physiotherapy, Winterthur, Switzerland  
24

25  
26 10 3) Biostatistics Unit, Institute of Social and Preventive Medicine, University Zurich, Zurich,  
27  
28 11 Switzerland  
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30 12 4) Center of Occupational Health, Militärstrasse 76, 8004 Zurich, Switzerland  
31  
32  
33 13

34  
35 14 **Corresponding author:**  
36

37 15 Katharina Meyer  
38

39 16 University Hospital Zurich, U OST 153, Gloriastr. 25, 8091 Zurich, Switzerland  
40

41 17 E-mail: Katharina.Meyer@usz.ch, Phone: +41 44 255 36 17, Fax: +41 44 255 43 88  
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46 19 **Keywords:** Outcome assessment, incapacity for work, spondylarthropathies  
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50 21 **Word count:** 3816  
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Work ability index, ankylosing spondylitis

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4 **Abstract**

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6 **Objectives:**

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8 Background: The work incapacity of ankylosing spondylitis (AS) ranges between 3-50% in  
9  
10 Europe. In many countries, work incapacity is difficult to quantify. The Work Ability Index  
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12 (WAI) is applied to measure the work ability in workers, but it is not well investigated in  
13  
14 patients.

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17 Aims: To investigate the work incapacity in terms of absence days in patients with AS and  
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19 to evaluate whether the WAI reflects the absence from work.

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21 Hypothesis: Absence days can be estimated based on the WAI and other variables.

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24 **Design:** Cross-sectional design.

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27 **Setting:** In a secondary care centre in Switzerland the WAI and a questionnaire about  
28  
29 work absence were administered in AS patients prior to a cardiovascular training. The  
30  
31 number of absence days was collected retrospectively.

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33 The absence days were estimated using a two-part regression model.

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35 **Participants:** 92 AS patients (58 men (63%)). Inclusion criteria: AS diagnosis, ability to  
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37 cycle, age between 18 and 65 years. Exclusion criteria: Severe heart disease.

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40 **Primary and secondary outcome measures:** Absence days.

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42 **Results:** Of the 92 patients, 14 received a disability pension and 78 were in the working  
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44 process. The median absence days per year of the 78 patients due to AS alone and  
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46 including other reasons was 0 days (IQR 0-12.3) and 2.5 days (IQR 0-19), respectively.

47  
48 The WAI score (regression coefficient = -4.66 ( $p < 0.001$ , CI -6.1 to -3.2), "getting a  
49  
50 disability pension" (regression coefficient = -106.8 ( $p < 0.001$ , 95% CI -141.6 to -72.0), and  
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52 other not significant variables explained 70% of the variance in absence days ( $p < 0.001$ )  
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54 and therefore, may estimate the number of absence days.  
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Work ability index, ankylosing spondylitis

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1 **Conclusions:** Absences in our sample of AS patients were equal to pan-European  
2 countries. In groups of AS patients, the WAI and other variables are valid to estimate  
3 absence days by the help of a two-part regression model.

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Work ability index, ankylosing spondylitis

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4 **1 Article summary:**

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6 **2 Article focus**

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9 • To measure the incapacity for work in terms of absence days in patients with AS in  
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11 Switzerland  
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13 • To evaluate whether the WAI reflects the absence from work.  
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15  
16 **6 Key messages**

- 17  
18 • Incapacity for work in a Swiss cohort of AS patients is similar to the results from  
19  
20 other European studies.  
21  
22 • This study shows that the WAI score, together with specific variables, can be used  
23  
24 in ankylosing spondylitis patients to calculate their absence days.  
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26  
27 • Measuring absence days with the help of the WAI is feasible and cost saving.  
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30 **12 Strengths and limitations of this study**

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32 • The study showed, that the WAI is not only feasible in prevention, but also in a  
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34 clinical setting for patients with AS.  
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36 • We took into account that the data are skewed and checked the goodness of fit of  
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38 the regression model by splitting half the group.  
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41 • Perhaps patients with a high motivation to influence their health were  
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43 overrepresented in this study. This could lead to an underestimation of the absence  
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45 days.  
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Work ability index, ankylosing spondylitis

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## 1 **Introduction:**

2 People affected with ankylosing spondylitis (AS) are impaired in their daily living activities.

3 This is a problem for both the patients and the society in terms of the high costs

4 associated with the loss of productivity. The magnitude of the disability should be

5 determined in order to manage AS-patients with restrictions in the work status effectively.

6 The range of employment in different countries varies widely from 34 to 96%, and the

7 incapacity for work ranges from 3 to 50% depending on the disease duration. Prevalence

8 of AS in western Europe is estimated at 0.86%<sup>1,2</sup> to 1.4%<sup>3</sup>. Incapacity to work is higher in

9 patients affected with AS than in the general population. Mean national sick leave per

10 working individual annually has been measured to be between 7 and 16 days in the

11 Netherlands, France and Belgium<sup>4</sup>, in comparison to 12 to 46 days of sick leave per

12 patient with AS per year<sup>5</sup> in the same countries. In Switzerland, two studies about the

13 work status of AS patients show different numbers regarding the incapacity for work. In

14 one study, 42.5% patients reported occasional incapacity for work due to AS, whereas

15 13.5% were permanently disabled and received a partial (10.2%) or full disability pension

16 (3.3%). Days of sick leave were not reported<sup>6</sup>. In an earlier study, the point estimate of the

17 work ability was measured at 97.3% and disability at 2.7%<sup>7</sup>. This may reflect that the

18 evaluation of the work status is rather complicated because of the different possible

19 endpoints or definitions of the work ability<sup>5</sup>. In Switzerland and in most of the other

20 countries, reliable data about absence days do not exist<sup>8</sup>. But in musculoskeletal

21 rehabilitation, there is a growing demand for evaluating relevant outcome parameters.

22 In various studies, information about sickness absence is gathered from the registered

23 data of companies<sup>9</sup> or from the civil service register<sup>10</sup>. But these measurements are not

24 validated. Nevertheless, there is no direct access to absence data in many countries, and

## Work ability index, ankylosing spondylitis

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4 1 moreover, to gather such information in the daily practise is too costly and hardly feasible.  
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6 2 Absence days are a composite of full or part-time work, full or partial work disability, full or  
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8 3 partial performance because of illness. Questionnaire-based evaluations of absence days  
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10 4 are complicated, time consuming and possibly not valid. Additionally, it remains unclear,  
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12 5 whether absences are due to the disease or due to co-morbidities. An alternative is a  
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14 6 comprehensive person to person assessment. In Switzerland, the loss of one working day  
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16 7 costs about 600 Euro in average <sup>11</sup>, and therefore, work loss is a significant cost factor in  
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18 8 back and musculoskeletal disorders. To our knowledge, only one validated questionnaire  
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20 9 for patients with AS<sup>12</sup> exists that however takes into account only to a small part the above  
21  
22 10 mentioned complicated construct of the incapacity for work. The time span of this  
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24 11 questionnaire covers the past seven days. However, such a short period may not reflect  
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26 12 adequately the course of a disease such as AS. There is another assessment for the  
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28 13 working ability, the so-called "Work Ability Index" WAI <sup>13-15</sup> which is well investigated in the  
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30 14 work environment and in occupational health care, where it has been shown to be  
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32 15 predictive<sup>15</sup> in terms of future incapacity for work and disability pension. In a big study with  
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34 16 40'000 nurses its internal reliability with a Cronbach's alpha of 0.72 has been proved to be  
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36 17 satisfactory and the concurrent validity expressed by correlations to other questionnaires  
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38 18 showed consistent and expected correlation coefficients  $r$  of around  $\pm 0.5$ <sup>16</sup>. The test-  
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40 19 retest reliability revealed acceptable values with a percentage of observed agreement of  
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42 20 66% between the baseline measurement and the second measurement which was four  
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44 21 weeks later. At group level the WAI is stable and did not show any significant difference of  
45  
46 22 the mean between the points of time<sup>17</sup>. Recently, the WAI has also been used as an  
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48 23 outcome measurement in some intervention and cross-sectional studies with groups of  
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50 24 patients (instead of workers) with different diseases, e.g. musculoskeletal disorders <sup>18</sup>,

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1 heart disease, hypertension <sup>19</sup>, psychiatric disorders <sup>20</sup>, rheumatoid arthritis <sup>21</sup> or  
2 osteoarthritis <sup>22</sup>. In all these studies the WAI has been shown to be feasible and validly  
3 assesses the ability to work. So far, the WAI has not been applied to patients with AS.

4  
5 The aim of this study was to investigate how big the problem of incapacity to work is in a  
6 subgroup of people with AS in Switzerland. A secondary aim was to develop a simple  
7 method to measure absence days to avoid the use of complicated and time-consuming  
8 assessments or inaccurate registers. Therefore, the hypothesis was that the WAI, in  
9 combination with other variables, could potentially serve as a simple instrument for  
10 measuring absence days in AS patients.

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Work ability index, ankylosing spondylitis

## 1 **Study population and methods**

### 2 **Participants**

3 The participants for this study were all AS patients taking part in a cardiovascular training  
4 study for which the sample size was computed to detect the effect of the training. The  
5 patients were recruited from the national Ankylosing Spondylitis Association and from the  
6 Rheumatology outpatient facilities in our country in 2008/2009. The last follow-up of the  
7 intervention was in 2010. Inclusion criteria for the cardiovascular training intervention and  
8 thus this study were: AS diagnosis following the modified New York criteria, the ability to  
9 cycle, sufficient German language ability (for questionnaires), age between 18 and 65  
10 years, willingness to follow the study protocol, and an informed consent. Chronic heart  
11 failure and functional NYHA Class III and IV were criteria for exclusion. The study was  
12 approved from the local Ethics Committee and the patients provided written informed  
13 consent. All patients were randomised to either the cardiovascular training or an attention  
14 control.

### 16 **Design**

17 We investigated retrospectively the dimension of incapacity for work with questions about  
18 the work status (QW) and evaluated the feasibility of an estimation of absence days by the  
19 WAI and other variables. For the latter, a two-part regression model was built, including  
20 the results of the QW as dependent and the WAI with other variables as the independent  
21 variables. The WAI and the QW were administered in a cross-sectional design.

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## 1 Measurements of the WAI-study

2 A comprehensive assessment was conducted before the cardiovascular training. The  
3 measurements included the WAI and additional questions about the work status (QW)  
4 which were gathered retrospectively.

5 The WAI is a 13-item questionnaire about a) the work conditions, b) the perception of the  
6 present health condition, and c) the perceived prognosis for work. The WAI is an  
7 assessment for the general health and measures the work ability in terms of all health  
8 conditions. A part of the WAI deals with a recall period of the last 12 months. One item of  
9 the WAI collects the number of current diseases or co-morbidities. The WAI is easy to use  
10 and takes about 10 minutes to fill in<sup>13 15</sup>. The scores range from 7 to 49 points, with 49  
11 points describing the best ability to work. The rules to compute the scores are described in  
12 detail<sup>13</sup>. The scores of the WAI can be divided into four categories: 7-27 = poor, 28-36 =  
13 moderate, 37-43 = good, 44-49 = excellent ability to work.

14 Different substantial questions about the work ability composed a second questionnaire  
15 about work status (QW) to calculate the absence days. In contrast to the brief WAI, the  
16 comprehensive QW ought to reveal more accurate information on the complex construct of  
17 the incapacity for work. We selected the questions of the QW by means of another study  
18<sup>23</sup>, addressing the disability to work, and on the basis of the clinical experience on  
19 determining the work ability. The items of the QW include working tasks (mental, physical  
20 or mixed), full or part-time work, full or partial work disability during the last year, sick days  
21 during the last year, duration of the work disability, reasons for the incapacity for work (AS  
22 versus other health reasons), and disability leading to financial support.

23

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## Work ability index, ankylosing spondylitis

## 1 Procedure

2 The absence days were computed by means of the QW: The work disability for the  
3 previous year is expressed in “days off work due to health reasons”. The QW measures  
4 absence days due to the following reasons: AS alone, not AS-related health conditions or  
5 AS together with other health problems. Only working days are counted, weekends and  
6 holidays are not included. The work disability is composed of the number of complete sick  
7 days and of the partial presence at work due to health reasons. For instance, 30%  
8 incapacity for work in a full time job during a distinct period is converted into the  
9 corresponding number of sick days. The numbers are adjusted for part-time work, e.g. if  
10 someone is employed for 50%, then the days of sick leave consists of only half of the  
11 absence days of those of a full time employment. The work disability, days off work and  
12 early retirement due to AS in contrast to other health problems were considered separately  
13 from each other as was also done in a review<sup>5</sup>. One could argue that the WAI contains an  
14 item that assesses self-reported sick leave over the previous twelve months; therefore, it  
15 would not be necessary to measure the absence days with the more complicated QW. But  
16 Radkiewicz et al. pointed out that the above mentioned item of the WAI should be  
17 excluded from the WAI, because there is no substantial relationship between this item and  
18 the overall score<sup>16</sup>. Furthermore, this item diminishes the internal validity and thus, the QW  
19 was introduced to measure absence days.

20  
21 Statistics

22 The data were checked for normal distribution. Appropriate parametric and non-parametric  
23 statistics, depending on the distribution, were applied. Non-parametric statistics were used  
24 to compare the distributions for the demographic variables and the absence days across

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4 1 the groups. The level of significance was set at alpha = 0.05. With regard to the main aim  
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6 2 of the study, descriptive statistics was used to depict demographic data, the absence days  
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8 3 (on the basis of the QW) and the WAI score. The WAI score and the absence days in the  
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10 4 QW were correlated to evaluate the relation and the concurrent validity between the two  
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12 5 questionnaires. Pertaining to the second aim of the study, namely to get a simple way to  
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14 6 measure absence days, a two-part regression model was conducted. If the dependent  
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16 7 variable has many zero-values like in our study the cases without absence days, two-part  
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18 8 models are suitable to get unbiased estimators and therefore, unbiased prediction for the  
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20 9 values of the dependent variable. Firstly, we performed a logistic regression analysis to  
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22 10 assess the logarithmic odds for the predicting variables which can be used to compute the  
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24 11 probability for a patient to have absence days. The logistic regression model is:  $\text{Logit} = b_0$   
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26 12  $+ b_1X_1 + b_2X_2 + \dots + b_5X_5$ . The logit of one observation "i" for the absence days can be  
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28 13 transformed in the logarithmic odds ( $\exp(\text{Logit})$ ) and in a second step the probability for  
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30 14 absence days is computed by dividing the "odds" through (odds + 1). In a second step of  
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32 15 the two-part model we estimated with a multiple linear regression analysis the number of  
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34 16 the absence days in patients with absences. By multiplying the probability of the logistic  
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36 17 regression with the result of the linear regression an estimation of the absence days is  
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38 18 obtained. These regression models allow the estimation of the absence days as a  
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40 19 constructed value in prospective studies. The number of absence days calculated by the  
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42 20 QW represents the dependent variable in the multiple regression model. Age and gender  
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44 21 were assessed as confounding variables. The statistical software PASW statistics (version  
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46 22 18) was used for the analysis.  
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Work ability index, ankylosing spondylitis

## 1 Results

2 Of the 185 eligible patients 77 refused to participate and 16 were excluded due to  
3 exclusion criteria. Table 1 shows the demographic variables and AS-specific functional  
4 health indices like the BASDAI (perceived disease activity)<sup>24</sup>, BASFI (physical function)<sup>25</sup>,  
5 BASMI (spinal mobility)<sup>26</sup> and ASDAS<sub>(CRP)</sub> (calculated by using parameters from BASDAI  
6 and C-reactive protein values)<sup>27</sup>. Further, Table 1 shows the work status and the mental or  
7 physical job demands of the included 92 patients in the working age. Four of these  
8 received a full pension (three patients because of AS, one because of other reasons) and  
9 ten a partial disability pension. The remaining 78 individuals (84.7%) were still in the  
10 working process and worked 88.9% of a full time job per year. There were 34 (37%)  
11 people without any absence days. Table 2 shows the WAI-scores and the absence days  
12 computed on the basis of the QW. Where data are skewed, median values are presented  
13 in Table 2. A patient may have absence days due to a) AS alone, b) other health problems  
14 (e.g. depression), or c) both. Therefore, the median is zero for a) and b), but bigger than  
15 zero for c). There were no missing values in the main variables.  
16 Although the data were skewed, we calculated also the mean values for absence days,  
17 expressed as the percentage of the working time per year. This will allow a comparison of  
18 the absence days to those of other studies. The 78 patients had a mean of 17.9 absence  
19 days (SD  $\pm$ 43.7) due to AS only, which is equivalent to 8.1% incapacity for work. Due to  
20 other health reasons, an incapacity for work of 2.5% was calculated. When the 14 patients  
21 receiving a disability pension were included (n=92), then the mean absence days due to all  
22 reasons was 47.9 days (SD  $\pm$ 79.1). These correspond to a disability of 21.6%. The ten  
23 patients with a partial disability pension were still partially in the working process and had a  
24 mean working time of 41% (SD  $\pm$ 31).

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Sensitivity analysis: It is unknown whether patients with a full or a partial disability pension would work 88.9% of the annual working time, if they would not receive any disability pension. Hence, the percentage of the disability for this group (n=92), presuming the patients would work 100% or 80% of a full time job, was calculated. Under this presumption the disability due to all health problems would be 19.2% and 24.0%, respectively.

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The Spearman-correlation between the WAI and the absence days on the basis of the QW, which expresses the concurrent validity, was -0.736 ( $p < 0.001$ ) for all of the 92 patients. The scatter plot revealed an overrepresentation of cases without absence days. However, a rang correlation should not be analysed, if there are tied ranks such as the multiple cases with zero absence days. Therefore, the correlation was calculated for the subgroup of AS patients which had at least one absence day per year due to all health problems (n=58), irrespective of getting a disability pension. The correlation reveals an  $r = -0.755$  with a significant p-value of  $p < 0.001$  (Figure 1).

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## Secondary study aim

The results of the logistic regression analysis to estimate the logarithmic odds for a person with AS to have absence days are shown in Table 3. The variables "age" and "WAI" were found to be significant predictors in this multiple logistic regression model. The assumption of linearity of the logits has been met and the residual statistics showed acceptable values. A multiple linear regression analysis with the QW as dependent variable was performed. All significant baseline variables, namely the work ability index score (WAI), the "number of

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4 1 additional co-morbidities” that were collected by the WAI (split into values up to 2/>2), age  
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6 2 and disability pension (yes/no) as well as gender, were included in the model. The multiple  
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8 3 regression analysis revealed that 70% of the variance in the dependent variable absence  
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10 4 days (measured by the complex QW) can be explained by the independent variables of  
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12 5 age, gender, WAI, the number of diagnoses and a disability pension (Table 3). However,  
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14 6 only WAI and “getting a disability pension” significantly contributed to the model. Thus, the  
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16 7 absence days of an AS patient can be estimated by multiple regression with the  
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18 8 unstandardized regression coefficients:  $y = b_1 \cdot x_1 + b_2 \cdot x_2 + \dots + b_n \cdot x_n + a$ , where y is the  
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20 9 estimated value of the absence days, n is the number of independent variables, x1 to xn  
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22 10 are the independent variables (age, gender, WAI, the number of diagnoses and getting a  
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24 11 disability pension), and a is a constant (Table 3). Due to the skewed distribution of the  
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26 12 absence days and the WAI, we verified our presented regression model by splitting the  
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28 13 sample into two halves. We estimated each with the shown regression model. We then  
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30 14 correlated the estimates and the true values of each group. The result of this was squared  
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32 15 and compared with the R Square of the same group (results not shown). The squared  
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34 16 correlation and the R Square should be similar in order to confirm that the regression  
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36 17 model is capable of predicting the absence days of another sample quite accurately (e.g.  
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38 18 the other half of the group). The differences were 0.18 for the first half and 0.05 for the  
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40 19 second half, indicating a good fit of the model.  
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## 1 Discussion

### 2 Key results:

3 Individuals without a disability pension had an 8.1% incapacity for work, if it was solely due  
4 to AS. The absence days increased by 2.5%, when AS patients who have had incapacity  
5 for work due to other health reasons, were included. The percentage of absences due to  
6 AS and other health reasons, including the individuals receiving a disability pension, was  
7 21% evaluated by the QW. Multiple regression analysis explained 70% of the variance of  
8 the absence days. The two variables 'WAI' and 'disability pension' made a significant  
9 contribution to this model. Thus, the WAI, in combination with other variables, can serve as  
10 a simple instrument for measuring absence days in the various groups of AS patients.

11

### 12 Discussing important differences to other studies:

13 The results regarding the absences of a group of AS patients who underwent a  
14 cardiovascular training are comparable to the findings of another Swiss cohort <sup>6</sup>. But the  
15 number of absence days in our study is slightly lower than in the review by Boonen <sup>5</sup>.  
16 Higher rates of disability pension are found in other studies <sup>28-31</sup>. The differences in the  
17 ability to work in different studies are dependent on several factors such as disease  
18 duration and activity, the perceived self-efficacy to perform a job, the general health  
19 condition and the kind of job (physical/mental demands) <sup>32</sup>. However, influences from  
20 different structures of the social insurance system, the job market situation, and cultural  
21 differences in absence behaviour may also be relevant. This also has been observed in  
22 other musculoskeletal disorders <sup>33</sup>.  
23 Our study showed much higher incapacity for work measured in absence days than in  
24 another Swiss study <sup>7</sup>. However, in this other study the working ability of 97.3% was a

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1 point measurement, and the number of patients only working part-time due to their health  
2 condition had not been identified. These distinctions in the methods and the low return rate  
3 of questionnaires in this other study could explain the difference in the results of these  
4 studies. The correlation coefficient of  $r = -0.755$  reveals a good correlation between the  
5 WAI and the QW. This supports the concurrent validity of the QW. The negative  
6 relationship means that having a low score in the WAI leads to more absence days.  
7 Implications of this study: The WAI reflected the absence days in a group of AS patients by  
8 the help of a two-part regression model. In the future, absence days may be estimated by  
9 multiplying the probability of the logistic regression with the results of the linear regression.  
10 This may be useful for some aspects of economic evaluations to quantify the productivity  
11 loss<sup>34</sup>. Age and gender did not confound the results. Usually, absence days are very time-  
12 consuming and difficult to measure because of part-time work, partial incapacity for work,  
13 partial or full invalidity pension and the potential incapability of the patients to recall all the  
14 subtle differences in their absences. Therefore, the WAI offers some advantages in  
15 contrast to questionnaires with a huge set of questions: it takes only 10 minutes to be  
16 completed, it reflects the subjective view of the patients and the scoring is clearly  
17 understandable.

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19 Strength of this study: The study showed that the use of the WAI is not only feasible in a  
20 prevention setting such as occupational health care, but also in a clinical setting for  
21 patients with AS. We took into account that the data are skewed and checked the  
22 goodness of fit of the regression model by splitting the group into two halves, estimating  
23 the values of the other half and by correlating the true with the estimated values. The  
24 procedure confirmed the stability of the regression model.



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Weaknesses of the study: The absence days were gathered retrospectively. The precision of people's memory to report the number of absence days of the previous year is questionable<sup>35</sup> and therefore, the absence days computed by the QW may not be accurate. Severens et al. postulated that a 64% agreement between self-reported and register gathered absence days are resulting, if a three days discrepancy of absence days is regarded as acceptable. The results of this study are not generalizable for other subjects than people with AS. Perhaps patients with a high motivation to influence their health were overrepresented in this study, since they were readily willing to undergo a cardiovascular training. Such patients may also have been more willing to maintain their ability to work. This could lead to an underestimation of the absence day. Since a questionnaire encompassing the complicated nature of the construct of the incapacity for work does only exist to report absence days over a very short time span, we made use of the new not validated QW. The substantial correlation between the WAI and the QW implicates an acceptable concurrent validity. The sample size is not very big to conduct a multiple regression analysis. However, we had 11 patients per variable and this lies above the recommended number of patients (5 to 10 times the number of included variables). In summary, statistical models using the WAI for estimating absence days offers an innovative and time-saving approach for studies where incapacity for work has to be measured.

**Conclusions:**

Incapacity for work in a sample of AS patients was equal to pan-European countries. The WAI was feasible for use in AS patients. It validly assesses incapacity for work evaluating



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4 1 groups of participants suffering of AS. In the future, absence days may be calculated by  
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6 2 computing the absence days through a regression analysis including the WAI score as a  
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8 3 variable. Further research may evaluate whether these results are replicable in patients  
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10 4 with other health conditions than AS.  
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15  
16  
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## 31 **Conflicts of interest statement**

32  
33 14 The authors declare no conflict of interests.  
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39  
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41 17 There was no funding.  
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## 45 **Contributorship**

46  
47 20 K. Meyer, K. Niedermann and A. Klipstein conceived the idea of the study and were  
48  
49 21 responsible for the design of the study. K. Meyer and A. Tschopp were responsible for  
50  
51 22 undertaking for the data analysis and produced the tables and graphs. K. Niedermann and  
52  
53 23 A. Klipstein provided input into the data analysis. The initial draft of the manuscript was  
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55 24 prepared by K. Meyer and then circulated repeatedly among all authors for critical revision.  
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1 K. Niedermann and K. Meyer was responsible for the acquisition of the data and all  
2 authors contributed to the interpretation of the results.  
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Work ability index, ankylosing spondylitis

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## Work ability index, ankylosing spondylitis

1 **Table 1: Baseline variables (n=92)**

	Overall, n=92
<i>Age in years, mean (SD)</i>	46.34 (11.15)
<i>Gender:</i>	
men (%)	58 (63.0)
women (%)	34 (37.0)
<i>Duration in years since AS diagnosis</i>	
mean (SD)	14.55 (12.74)
<i>BASDAI (0-10), mean (SD)</i>	3.45 (2.0)
<i>BASFI (0-10), mean (SD)</i>	2.4 (2.0)
<i>BASMI (0-10), mean (SD)</i>	2.85 (2.0)
<i>ASDAS<sub>(CRP)</sub>, mean (SD)</i>	6.95 (9.25)
<i>Number of current diseases</i>	
AS alone	22
+ 1-2	45
+ > 2	25
<i>Education, n (%)</i>	
<=12 years	60 (65.2)
>12 years	26 (28.3)
Not known	6 (6.5)
<i>Employment status, n (%)</i>	
Paid work	68 (73.9)
Unpaid work	6 (6.5)
Unemployed	4 (4.4)



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Partial disability pension	10 (10.9)
Full disability pension	4(4.3)
<i>Job demands</i> (n=78, no disability pension)	
physical	11%
mental	41%
both	48%

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- 1 BASDAI= Bath AS Disease Activity Index, BASFI=The Bath AS Functionl Index, BASMI=  
2 Bath AS Metrology Index, ASDAS<sub>(CRP)</sub> = Ankylosing Spondylitis Disease Activity Score  
3  
4 (calculated with C-reactive protein values)

## Work ability index, ankylosing spondylitis

1 **Table 2: Absence days (AD) and WAI-scores for the patients in the working age**

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	People with > 0 absence days, n=58 (63%)	Due to	All patients in the working age (n=92)	Patients without disability pension (n=78)
Absence days during the last year, Median (IQR) <sup>2)</sup>	24 (6.5-127.7)	<ul style="list-style-type: none"> <li>• AS<sup>1)</sup> alone</li> <li>• Other health problems</li> <li>• AS<sup>2)</sup> and other health problems</li> </ul>	0 (0 - 37.8)  0 (0 - 2)  4.5 (0 - 61.1)	0 (0 - 12.3)  0 (0 - 2)  2.5 (0 - 19)
WAI, Mean (SD)	-	-	34.18 (9.77)	35.93 (9.29)

3

4 Absence days measured by the QW

5 1) Ankylosing spondylitis

6 2) Interquartile range

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## Work ability index, ankylosing spondylitis

1 **Table 3: Two-part model: multiple logistic and multiple linear regression analysis**

Model	Independent variables	B coefficients	Standardized regression coefficients (Beta)	Significance p-value	95%-Confidence Interval for B Lower / Upper	
Multiple logistic regression Predicted variable: Absence days <sup>#</sup>	Constant	11.039		0.000	6.14	15.93
	Age	-0.065		0.013	-0.116	-0.014
	WAI	-0.203		0.000	-0.293	-0.113
Multiple linear Regression Predicted variable: number of absence days	Constant	427.2*	-	0.000	317.32	537.08
	Disability pension <sup>1)</sup>	-106.81*	-0.52	0.000	-141.60	-72.02
	WAI	-4.66*	-0.51	0.000	-6.13	-3.18
	Age	-0.498*	-0.07	0.429	-1.75	0.76
	Gender	-10.71*	-0.06	0.414	-36.82	15.40
N° of diagnoses <sup>2)</sup>	10.24*	0.06	0.461	-17.45	37.93	

2 1) Disability pension (yes/no)

3 2) Number of diagnoses (up to 2/&gt;2)

4 \* Unstandardized regression coefficients (B)

5 The logistic regression has a Nagelkerke R=0.458, the Hosmer and Lemeshow test was  
6 not significant (p=0.09), the Omnibus test was very small (p= 0.000)

7 For the multiple regression the R- Squared was 0.724, R-squared adjusted 0.7, the model is  
8 significant with p<0.001

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1 **Figure 1** Scatterplot of the WAI and absence days for the subgroup with absence days (n=  
2 58)

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4 1 **Is the work ability index useful to evaluate absence days in ankylosing**  
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7 2 **spondylitis patients? A cross-sectional study.**  
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11 4 **Katharina Meyer MPH<sup>1</sup>, Karin Niedermann PhD<sup>2</sup>, Alois Tschopp PhD<sup>3</sup>,**  
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14 5 **Andreas Klipstein MD Msc<sup>1, 4</sup>**  
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19 7 1) Institute of Physical Medicine, University Hospital Zurich, Zurich, Switzerland  
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21 8 2) Zurich University of Applied Sciences, School of Health Professions, Institute of  
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23 9 Physiotherapy, Winterthur, Switzerland  
24

25  
26 10 3) Biostatistics Unit, Institute of Social and Preventive Medicine, University Zurich, Zurich,  
27  
28 11 Switzerland  
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30 12 4) Center of Occupational Health, Militärstrasse 76, 8004 Zurich, Switzerland  
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35 14 **Corresponding author:**  
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37 15 Katharina Meyer  
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39 16 University Hospital Zurich, U OST 153, Gloriastr. 25, 8091 Zurich, Switzerland  
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41 17 E-mail: Katharina.Meyer@usz.ch, Phone: +41 44 255 36 17, Fax: +41 44 255 43 88  
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46 19 **Keywords:** Outcome assessment, incapacity for work, **spondylarthropathies**  
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## 1 **Abstract**

### 2 **Objectives:**

3 Background: The work incapacity of ankylosing spondylitis (AS) ranges between 3-50% in  
4 Europe. In many countries, work incapacity is difficult to quantify. The Work Ability Index  
5 (WAI) is applied to measure the work ability in workers, but it is not well investigated in  
6 patients.

7 Aims: To investigate the work incapacity in terms of absence days in patients with AS and  
8 to evaluate whether the WAI reflects the absence from work.

9 Hypothesis: Absence days can be estimated based on the WAI and other variables.

10 **Design:** Cross-sectional design.

11 **Setting:** In a secondary care centre in Switzerland the WAI and a questionnaire about  
12 work absence were administered in AS patients prior to a cardiovascular training. The  
13 number of absence days was collected retrospectively.

14 The absence days were estimated using a two-part regression model.

15 **Participants:** 92 AS patients (58 men (63%)). Inclusion criteria: AS diagnosis, ability to  
16 cycle, age between 18 and 65 years. Exclusion criteria: Severe heart disease.

17 **Primary and secondary outcome measures:** Absence days.

18 **Results:** Of the 92 patients, 14 received a disability pension and 78 were in the working  
19 process. The median absence days per year of the 78 patients due to AS alone and  
20 including other reasons was 0 days (IQR 0-12.3) and 2.5 days (IQR 0-19), respectively.

21 The WAI score (regression coefficient = -4.66 ( $p < 0.001$ , CI -6.1 to -3.2), "getting a  
22 disability pension" (regression coefficient = -106.8 ( $p < 0.001$ , 95% CI -141.6 to -72.0), and  
23 other not significant variables explained 70% of the variance in absence days ( $p < 0.001$ )  
24 and therefore, may estimate the number of absence days.

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4 1 **Conclusions:** Absences in our sample of AS patients were equal to pan-European  
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6 2 countries. In groups of AS patients, the WAI and other variables are valid to estimate  
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8 3 absence days by the help of a two-part regression model.  
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## 1 Article summary:

### 2 Article focus

- 3 • To measure the **incapacity for work** in terms of absence days in patients with AS in  
4 Switzerland
- 5 • To evaluate whether the WAI reflects the absence from work.

### 6 Key messages

- 7 • **Incapacity for work in a Swiss cohort of AS patients is similar to the results from  
8 other European studies.**
- 9 • **This** study shows that the WAI score, together with specific variables, can be used  
10 in ankylosing spondylitis patients to calculate their absence days.
- 11 • **Measuring absence days with the help of the WAI is feasible and cost saving.**

### 12 Strengths and limitations of this study

- 13 • The study showed, that the WAI is not only feasible in prevention, but also in a  
14 clinical setting for patients with AS.
- 15 • We took into account that the data are skewed and checked the goodness of fit of  
16 the regression model by splitting half the group.
- 17 • Perhaps patients with a high motivation to influence their health were  
18 overrepresented in this study. This could lead to an underestimation of the absence  
19 days.



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## 1 Introduction:

2 People affected with ankylosing spondylitis (AS) are impaired in their daily living activities.  
3 This is a problem for both the patients and the society in terms of the high costs  
4 associated with the loss of productivity. The magnitude of the disability should be  
5 determined in order to manage AS-patients with restrictions in the work status effectively.  
6 The range of employment in different countries varies widely from 34 to 96%, and the  
7 **incapacity for work** ranges from 3 to 50% depending on the disease duration. Prevalence  
8 of AS in western Europe is estimated at 0.86%<sup>1,2</sup> to 1.4%<sup>3</sup>. Incapacity to work is higher in  
9 patients affected with AS than in the general population. Mean national sick leave per  
10 working individual annually has been measured to be between 7 and 16 days in the  
11 Netherlands, France and Belgium<sup>4</sup>, in comparison to 12 to 46 days of sick leave per  
12 patient with AS per year<sup>5</sup> in the same countries. In Switzerland, two studies about the  
13 work status of AS patients show different numbers regarding the incapacity **for** work. In  
14 one study, 42.5% patients reported occasional incapacity for work due to AS, whereas  
15 13.5% were permanently disabled and received a partial (10.2%) or full disability pension  
16 (3.3%). Days of sick leave were not reported<sup>6</sup>. In an earlier study, the point estimate of the  
17 work ability was measured at 97.3% and disability at 2.7 %<sup>7</sup>. This may reflect that the  
18 evaluation of the work status is rather complicated because of the different possible  
19 endpoints or definitions of the work ability<sup>5</sup>. In Switzerland and in most of the other  
20 countries, reliable data about absence days do not exist<sup>8</sup>. **But in musculoskeletal**  
21 **rehabilitation, there is a growing demand for evaluating relevant outcome parameters.**  
22 In various studies, information about sickness absence is gathered from the registered  
23 data of companies<sup>9</sup> or from the civil service register<sup>10</sup>. But these measurements are not  
24 validated. Nevertheless, there is no direct access to absence data in many countries, and

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4 1 moreover, to gather such information in the daily practise is too costly and hardly feasible.  
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6 2 Absence days are a composite of full or part-time work, full or partial work disability, full or  
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8 3 partial performance because of illness. Questionnaire-based evaluations of absence days  
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10 4 are complicated, time consuming and possibly not valid. Additionally, it remains unclear,  
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12 5 whether absences are due to the disease or due to co-morbidities. An alternative is a  
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14 6 comprehensive person to person assessment. In Switzerland, the loss of one working day  
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16 7 costs about 600 Euro in average <sup>11</sup>, and therefore, work loss is a significant cost factor in  
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18 8 back and musculoskeletal disorders. To our knowledge, only one validated questionnaire  
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20 9 for patients with AS<sup>12</sup> exists that however takes into account only to a small part the above  
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22 10 mentioned complicated construct of the incapacity for work. The time span of this  
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24 11 questionnaire covers the past seven days. However, such a short period may not reflect  
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26 12 adequately the course of a disease such as AS. There is another assessment for the  
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28 13 working ability, the so-called "Work Ability Index" WAI <sup>13-15</sup> which is well investigated in the  
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30 14 work environment and in occupational health care, where it has been shown to be  
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32 15 predictive<sup>15</sup> in terms of future incapacity for work and disability pension. In a big study with  
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34 16 40'000 nurses its internal reliability with a Cronbach's alpha of 0.72 has been proved to be  
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36 17 satisfactory and the concurrent validity expressed by correlations to other questionnaires  
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38 18 showed consistent and expected correlation coefficients  $r$  of around  $\pm 0.5$ <sup>16</sup>. The test-  
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40 19 retest reliability revealed acceptable values with a percentage of observed agreement of  
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42 20 66% between the baseline measurement and the second measurement which was four  
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44 21 weeks later. At group level the WAI is stable and did not show any significant difference of  
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46 22 the mean between the points of time<sup>17</sup>. Recently, the WAI has also been used as an  
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48 23 outcome measurement in some intervention and cross-sectional studies with groups of  
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50 24 patients (instead of workers) with different diseases, e.g. musculoskeletal disorders <sup>18</sup>,

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1 heart disease, hypertension <sup>19</sup>, psychiatric disorders <sup>20</sup>, rheumatoid arthritis <sup>21</sup> or  
2 osteoarthritis <sup>22</sup>. In all these studies the WAI has been shown to be feasible and validly  
3 assesses the ability to work. So far, the WAI has not been applied to patients with AS.

4  
5 The aim of this study was to investigate how big the problem of incapacity to work is in a  
6 subgroup of people with AS in Switzerland. A secondary aim was to develop a simple  
7 method to measure absence days to avoid the use of complicated and time-consuming  
8 assessments or inaccurate registers. Therefore, the hypothesis was that the WAI, in  
9 combination with other variables, could potentially serve as a simple instrument for  
10 measuring absence days in AS patients.

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## 1 **Study population and methods**

### 2 Participants

3 The participants for this study were **all** AS patients taking part in a cardiovascular training  
4 study for which the sample size was computed to detect the effect of the training. The  
5 patients were recruited from the national Ankylosing Spondylitis Association and from the  
6 Rheumatology outpatient facilities in our country in 2008/2009. The last follow-up of the  
7 intervention was in 2010. Inclusion criteria for the cardiovascular training intervention and  
8 thus this study were: AS diagnosis following the modified New York criteria, the ability to  
9 cycle, sufficient German language ability (for questionnaires), age between 18 and 65  
10 years, willingness to follow the study protocol, and an informed consent. Chronic heart  
11 failure and functional NYHA Class III and IV were criteria for exclusion. The study was  
12 approved from the local Ethics Committee and the patients provided written informed  
13 consent. All patients were randomised to either the cardiovascular training or an attention  
14 control.

### 16 Design

17 **We investigated retrospectively the dimension of incapacity for work with questions about**  
18 **the work status (QW) and evaluated the feasibility of an estimation of absence days by the**  
19 **WAI and other variables. For the latter, a two-part regression model was built, including**  
20 **the results of the QW as dependent and the WAI with other variables as the independent**  
21 **variables. The WAI and the QW were administered in a cross-sectional design.**

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## 1 Measurements of the WAI-study

2 A comprehensive assessment was conducted before the cardiovascular training. The  
3 measurements included the WAI and additional questions about the work status (QW)  
4 which were gathered retrospectively.

5 The WAI is a 13-item questionnaire about a) the work conditions, b) the perception of the  
6 present health condition, and c) the perceived prognosis for work. The WAI is an  
7 assessment for the general health and measures the work ability in terms of all health  
8 conditions. A part of the WAI deals with a recall period of the last 12 months. One item of  
9 the WAI collects the number of current diseases or co-morbidities. The WAI is easy to use  
10 and takes about 10 minutes to fill in<sup>13 15</sup>. The scores range from 7 to 49 points, with 49  
11 points describing the best ability to work. The rules to compute the scores are described in  
12 detail<sup>13</sup>. The scores of the WAI can be divided into four categories: 7-27 = poor, 28-36 =  
13 moderate, 37-43 = good, 44-49 = excellent ability to work.

14 Different substantial questions about the work ability composed a second questionnaire  
15 about work status (QW) to calculate the absence days. In contrast to the brief WAI, the  
16 comprehensive QW ought to reveal more accurate information on the complex construct of  
17 the incapacity for work. We selected the questions of the QW by means of another study  
18<sup>23</sup>, addressing the disability to work, and on the basis of the clinical experience on  
19 determining the work ability. The items of the QW include working tasks (mental, physical  
20 or mixed), full or part-time work, full or partial work disability during the last year, sick days  
21 during the last year, duration of the work disability, reasons for the incapacity for work (AS  
22 versus other health reasons), and disability leading to financial support.

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## 1 Procedure

2 The absence days were computed by means of the QW: The work disability for the  
3 previous year is expressed in “days off work due to health reasons”. The QW measures  
4 absence days due to the following reasons: AS alone, not AS-related health conditions or  
5 AS together with other health problems. Only working days are counted, weekends and  
6 holidays are not included. The work disability is composed of the number of complete sick  
7 days and of the partial presence at work due to health reasons. For instance, 30%  
8 incapacity for work in a full time job during a distinct period is converted into the  
9 corresponding number of sick days. The numbers are adjusted for part-time work, e.g. if  
10 someone is employed for 50%, then the days of sick leave consists of only half of the  
11 absence days of those of a full time employment. The work disability, days off work and  
12 early retirement due to AS in contrast to other health problems were considered separately  
13 from each other as was also done in a review<sup>5</sup>. One could argue that the WAI contains an  
14 item that assesses self-reported sick leave over the previous twelve months; therefore, it  
15 would not be necessary to measure the absence days with the more complicated QW. But  
16 Radkiewicz et al. pointed out that the above mentioned item of the WAI should be  
17 excluded from the WAI, because there is no substantial relationship between this item and  
18 the overall score<sup>16</sup>. Furthermore, this item diminishes the internal validity and thus, the QW  
19 was introduced to measure absence days.

## 21 Statistics

22 The data were checked for normal distribution. Appropriate parametric and non-parametric  
23 statistics, depending on the distribution, were applied. Non-parametric statistics were used  
24 to compare the distributions for the demographic variables and the absence days across

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4 1 the groups. The level of significance was set at  $\alpha = 0.05$ . With regard to the main aim  
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6 2 of the study, descriptive statistics was used to depict demographic data, the absence days  
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8 3 (on the basis of the QW) and the WAI score. The WAI score and the absence days in the  
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10 4 QW were correlated to evaluate the relation and the concurrent validity between the two  
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12 5 questionnaires. Pertaining to the second aim of the study, namely to get a simple way to  
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14 6 measure absence days, a two-part regression model was conducted. If the dependent  
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16 7 variable has many zero-values like in our study the cases without absence days, two-part  
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18 8 models are suitable to get unbiased estimators and therefore, unbiased prediction for the  
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20 9 values of the dependent variable. Firstly, we performed a logistic regression analysis to  
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22 10 assess the logarithmic odds for the predicting variables which can be used to compute the  
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24 11 probability for a patient to have absence days. The logistic regression model is:  $\text{Logit} = b_0$   
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26 12  $+ b_1X_1 + b_2X_2 + \dots + b_5X_5$ . The logit of one observation "i" for the absence days can be  
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28 13 transformed in the logarithmic odds ( $\exp(\text{Logit})$ ) and in a second step the probability for  
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30 14 absence days is computed by dividing the "odds" through (odds + 1). In a second step of  
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32 15 the two-part model we estimated with a multiple linear regression analysis the number of  
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34 16 the absence days in patients with absences. By multiplying the probability of the logistic  
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36 17 regression with the result of the linear regression an estimation of the absence days is  
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38 18 obtained. These regression models allow the estimation of the absence days as a  
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40 19 constructed value in prospective studies. The number of absence days calculated by the  
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42 20 QW represents the dependent variable in the multiple regression model. Age and gender  
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44 21 were assessed as confounding variables. The statistical software PASW statistics (version  
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46 22 18) was used for the analysis.  
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## 1 Results

2 Of the 185 eligible patients 77 refused to participate and 16 were excluded due to  
3 exclusion criteria. Table 1 shows the demographic variables and AS-specific functional  
4 health indices like the BASDAI (perceived disease activity)<sup>24</sup>, BASFI (physical function)<sup>25</sup>,  
5 BASMI (spinal mobility)<sup>26</sup> and ASDAS<sub>(CRP)</sub> (calculated by using parameters from BASDAI  
6 and C-reactive protein values)<sup>27</sup>. Further, Table 1 shows the work status and the mental or  
7 physical job demands of the included 92 patients in the working age. Four of these  
8 received a full pension (three patients because of AS, one because of other reasons) and  
9 ten a partial disability pension. The remaining 78 individuals (84.7%) were still in the  
10 working process and worked 88.9% of a full time job per year. There were 34 (37%)  
11 people without any absence days. Table 2 shows the WAI-scores and the absence days  
12 computed on the basis of the QW. Where data are skewed, median values are presented  
13 in Table 2. A patient may have absence days due to a) AS alone, b) other health problems  
14 (e.g. depression), or c) both. Therefore, the median is zero for a) and b), but bigger than  
15 zero for c). There were no missing values in the main variables.  
16 Although the data were skewed, we calculated also the mean values for absence days,  
17 expressed as the percentage of the working time per year. This will allow a comparison of  
18 the absence days to those of other studies. The 78 patients had a mean of 17.9 absence  
19 days (SD ±43.7) due to AS only, which is equivalent to 8.1% incapacity for work. Due to  
20 other health reasons, an incapacity for work of 2.5% was calculated. When the 14 patients  
21 receiving a disability pension were included (n=92), then the mean absence days due to all  
22 reasons was 47.9 days (SD ±79.1). These correspond to a disability of 21.6%. The ten  
23 patients with a partial disability pension were still partially in the working process and had a  
24 mean working time of 41% (SD ±31).



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6 2 Sensitivity analysis: It is unknown whether patients with a full or a partial disability pension  
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8 3 would work 88.9% of the annual working time, if they would not receive any disability  
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10 4 pension. Hence, the percentage of the disability for this group (n=92), presuming the  
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12 5 patients would work 100% or 80% of a full time job, was calculated. Under this  
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14 6 presumption the disability due to all health problems would be 19.2% and 24.0%,  
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16 7 respectively.  
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21 9 The Spearman-correlation between the WAI and the absence days on the basis of the  
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23 10 QW, which expresses the concurrent validity, was -0.736 ( $p < 0.001$ ) for all of the 92  
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25 11 patients. The scatter plot revealed an overrepresentation of cases without absence days.  
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27 12 However, a rang correlation should not be analysed, if there are tied ranks such as the  
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29 13 multiple cases with zero absence days. Therefore, the correlation was calculated for the  
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31 14 subgroup of AS patients which had at least one absence day per year due to all health  
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33 15 problems (n=58), irrespective of getting a disability pension. The correlation reveals an  $r = -$   
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35 16 0.755 with a significant p-value of  $p < 0.001$  (Figure 1).  
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#### 43 18 Secondary study aim

44 19 The results of the logistic regression analysis to estimate the logarithmic odds for a person  
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46 20 with AS to have absence days are shown in Table 3. The variables "age" and "WAI" were  
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48 21 found to be significant predictors in this multiple logistic regression model. The assumption  
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50 22 of linearity of the logits has been met and the residual statistics showed acceptable values.

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53 23 A multiple linear regression analysis with the QW as dependent variable was performed.

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55 24 All significant baseline variables, namely the work ability index score (WAI), the "number of  
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4 1 additional co-morbidities” that were collected by the WAI (split into values up to 2/>2), age  
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6 2 and disability pension (yes/no) as well as gender, were included in the model. The multiple  
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8 3 regression analysis revealed that 70% of the variance in the dependent variable absence  
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10 4 days (measured by the complex QW) can be explained by the independent variables of  
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12 5 age, gender, WAI, the number of diagnoses and a disability pension (Table 3). However,  
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14 6 only WAI and “getting a disability pension” significantly contributed to the model. Thus, the  
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16 7 absence days of an AS patient can be estimated by multiple regression with the  
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18 8 unstandardized regression coefficients:  $y = b_1 \cdot x_1 + b_2 \cdot x_2 + \dots + b_n \cdot x_n + a$ , where y is the  
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20 9 estimated value of the absence days, n is the number of independent variables, x1 to xn  
21  
22 10 are the independent variables (age, gender, WAI, the number of diagnoses and getting a  
23  
24 11 disability pension), and a is a constant (Table 3). Due to the skewed distribution of the  
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26 12 absence days and the WAI, we verified our presented regression model by splitting the  
27  
28 13 sample into two halves. We estimated each with the shown regression model. We then  
29  
30 14 correlated the estimates and the true values of each group. The result of this was squared  
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32 15 and compared with the R Square of the same group (results not shown). The squared  
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34 16 correlation and the R Square should be similar in order to confirm that the regression  
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36 17 model is capable of predicting the absence days of another sample quite accurately (e.g.  
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38 18 the other half of the group). The differences were 0.18 for the first half and 0.05 for the  
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40 19 second half, indicating a good fit of the model.  
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## 1 Discussion

### 2 Key results:

3 Individuals without a disability pension had an 8.1% incapacity for work, if it was solely due  
4 to AS. The absence days increased by 2.5%, when AS patients who have had incapacity  
5 for work due to other health reasons, were included. The percentage of absences due to  
6 AS and other health reasons, including the individuals receiving a disability pension, was  
7 21% evaluated by the QW. Multiple regression analysis explained 70% of the variance of  
8 the absence days. The two variables 'WAI' and 'disability pension' made a significant  
9 contribution to this model. Thus, the WAI, in combination with other variables, can serve as  
10 a simple instrument for measuring absence days in the various groups of AS patients.

### 12 Discussing important differences to other studies:

13 The results regarding the absences of a group of AS patients who underwent a  
14 cardiovascular training are comparable to the findings of another Swiss cohort <sup>6</sup>. But the  
15 number of absence days in our study is slightly lower than in the review by Boonen <sup>5</sup>.  
16 Higher rates of disability pension are found in other studies <sup>28-31</sup>. The differences in the  
17 ability to work in different studies are dependent on several factors such as disease  
18 duration and activity, the perceived self-efficacy to perform a job, the general health  
19 condition and the kind of job (physical/mental demands) <sup>32</sup>. However, influences from  
20 different structures of the social insurance system, the job market situation, and cultural  
21 differences in absence behaviour may also be relevant. This also has been observed in  
22 other musculoskeletal disorders <sup>33</sup>.  
23 Our study showed much higher incapacity for work measured in absence days than in  
24 another Swiss study <sup>7</sup>. However, in this other study the working ability of 97.3% was a

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1 point measurement, and the number of patients only working part-time due to their health  
2 condition had not been identified. These distinctions in the methods and the low return rate  
3 of questionnaires in this other study could explain the difference in the results of these  
4 studies. The correlation coefficient of  $r = -0.755$  reveals a good correlation between the  
5 WAI and the QW. This supports the concurrent validity of the QW. The negative  
6 relationship means that having a low score in the WAI leads to more absence days.  
7 Implications of this study: The WAI reflected the absence days in a group of AS patients by  
8 the help of a two-part regression model. In the future, absence days may be estimated by  
9 multiplying the probability of the logistic regression with the results of the linear regression.  
10 This may be useful for some aspects of economic evaluations to quantify the productivity  
11 loss<sup>34</sup>. Age and gender did not confound the results. Usually, absence days are very time-  
12 consuming and difficult to measure because of part-time work, partial incapacity for work,  
13 partial or full invalidity pension and the potential incapability of the patients to recall all the  
14 subtle differences in their absences. Therefore, the WAI offers some advantages in  
15 contrast to questionnaires with a huge set of questions: it takes only 10 minutes to be  
16 completed, it reflects the subjective view of the patients and the scoring is clearly  
17 understandable.

18  
19 Strength of this study: The study showed that the use of the WAI is not only feasible in a  
20 prevention setting such as occupational health care, but also in a clinical setting for  
21 patients with AS. We took into account that the data are skewed and checked the  
22 goodness of fit of the regression model by splitting the group into two halves, estimating  
23 the values of the other half and by correlating the true with the estimated values. The  
24 procedure confirmed the stability of the regression model.

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1 Weaknesses of the study: The absence days were gathered retrospectively. The precision  
2 of people's memory to report the number of absence days of the previous year is  
3 questionable<sup>35</sup> and therefore, the absence days computed by the QW may not be  
4 accurate. Severens et al. postulated that a 64% agreement between self-reported and  
5 register gathered absence days are resulting, if a three days discrepancy of absence days  
6 is regarded as acceptable. The results of this study are not generalizable for other subjects  
7 than people with AS. Perhaps patients with a high motivation to influence their health were  
8 overrepresented in this study, since they were readily willing to undergo a cardiovascular  
9 training. Such patients may also have been more willing to maintain their ability to work.  
10 This could lead to an underestimation of the absence day.  
11 Since a questionnaire encompassing the complicated nature of the construct of the  
12 incapacity for work does only exist to report absence days over a very short time span, we  
13 made use of the new not validated QW. The substantial correlation between the WAI and  
14 the QW implicates an acceptable concurrent validity. The sample size is not very big to  
15 conduct a multiple regression analysis. However, we had 11 patients per variable and this  
16 lies above the recommended number of patients (5 to 10 times the number of included  
17 variables).  
18 In summary, statistical models using the WAI for estimating absence days offers an  
19 innovative and time-saving approach for studies where incapacity for work has to be  
20 measured.

## 21 22 **Conclusions:**

23 Incapacity for work in a sample of AS patients was equal to pan-European countries. The  
24 WAI was feasible for use in AS patients. It validly assesses incapacity for work evaluating

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1 groups of participants suffering of AS. In the future, absence days may be calculated by  
2 computing the absence days through a regression analysis including the WAI score as a  
3 variable. Further research may evaluate whether these results are replicable in patients  
4 with other health conditions than AS.

## 6 Acknowledgements

7 We wish to thank Professor Heike A. Bischoff-Ferrari, Professor Beat A. Michel and  
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11 patients who took part in this study.

## 13 Conflicts of interest statement

14 The authors declare no conflict of interests.

## 16 Funding statement

17 There was no funding.

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Work ability index, ankylosing spondylitis

1 **Table 1: Baseline variables (n=92)**

	Overall, n=92
<i>Age in years, mean (SD)</i>	46.34 (11.15)
<i>Gender:</i>	
men (%)	58 (63.0)
women (%)	34 (37.0)
<i>Duration in years since AS diagnosis</i>	
mean (SD)	14.55 (12.74)
<b>BASDAI (0-10), mean (SD)</b>	<b>3.45 (2.0)</b>
<b>BASFI (0-10), mean (SD)</b>	<b>2.4 (2.0)</b>
<b>BASMI (0-10), mean (SD)</b>	<b>2.85 (2.0)</b>
<b>ASDAS<sub>(CRP)</sub>, mean (SD)</b>	<b>6.95 (9.25)</b>
<i>Number of current diseases</i>	
AS alone	22
+ 1-2	45
+ > 2	25
<i>Education, n (%)</i>	
<=12 years	60 (65.2)
>12 years	26 (28.3)
Not known	6 (6.5)
<i>Employment status, n (%)</i>	
Paid work	68 (73.9)
Unpaid work	6 (6.5)
Unemployed	4 (4.4)

## Work ability index, ankylosing spondylitis

Partial disability pension	10 (10.9)
Full disability pension	4(4.3)
<i>Job demands</i> (n=78, no disability pension)	
physical	11%
mental	41%
both	48%

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2 BASDAI= Bath AS Disease Activity Index, BASFI=The Bath AS Functionl Index, BASMI=

3 Bath AS Metrology Index, ASDAS<sub>(CRP)</sub> = Ankylosing Spondylitis Disease Activity Score

4 (calculated with C-reactive protein values)

## Work ability index, ankylosing spondylitis

1 **Table 2: Absence days (AD) and WAI-scores for the patients in the working age**

2

	People with > 0 absence days, n=58 (63%)	Due to	All patients in the working age (n=92)	Patients without disability pension (n=78)
Absence days during the last year, Median (IQR) <sup>2)</sup>	24 (6.5-127.7)	<ul style="list-style-type: none"> <li>AS<sup>1)</sup> alone</li> <li>Other health problems</li> <li>AS<sup>2)</sup> and other health problems</li> </ul>	0 (0 - 37.8) 0 (0 - 2) 4.5 (0 - 61.1)	0 (0 - 12.3) 0 (0 - 2) 2.5 (0 - 19)
WAI, Mean (SD)	-	-	34.18 (9.77)	35.93 (9.29)

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4 Absence days measured by the QW

5 1) Ankylosing spondylitis

6 2) Interquartile range

7

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## Work ability index, ankylosing spondylitis

1 **Table 3: Two-part model: multiple logistic and multiple linear regression analysis**

Model	Independent variables	B coefficients	Standardized regression coefficients (Beta)	Significance p-value	95%-Confidence Interval for B Lower / Upper	
Multiple logistic regression Predicted variable: Absence days <sup>#</sup>	Constant	11.039		0.000	6.14	15.93
	Age	-0.065		0.013	-0.116	-0.014
	WAI	-0.203		0.000	-0.293	-0.113
Multiple linear Regression Predicted variable: number of absence days	Constant	427.2*	-	0.000	317.32	537.08
	Disability pension <sup>1)</sup>	-106.81*	-0.52	0.000	-141.60	-72.02
	WAI	-4.66*	-0.51	0.000	-6.13	-3.18
	Age	-0.498*	-0.07	0.429	-1.75	0.76
	Gender	-10.71*	-0.06	0.414	-36.82	15.40
	N° of diagnoses <sup>2)</sup>	10.24*	0.06	0.461	-17.45	37.93

2 1) Disability pension (yes/no)

3 2) Number of diagnoses (up to 2/&gt;2)

4 \* Unstandardized regression coefficients (B)

5 The logistic regression has a Nagelkerke R=0.458, the Hosmer and Lemeshow test was  
6 not significant (p=0.09), the Omnibus test was very small (p= 0.000)

7 For the multiple regression the R- Squared was 0.724, R-squared adjusted 0.7, the model is  
8 significant with p<0.001

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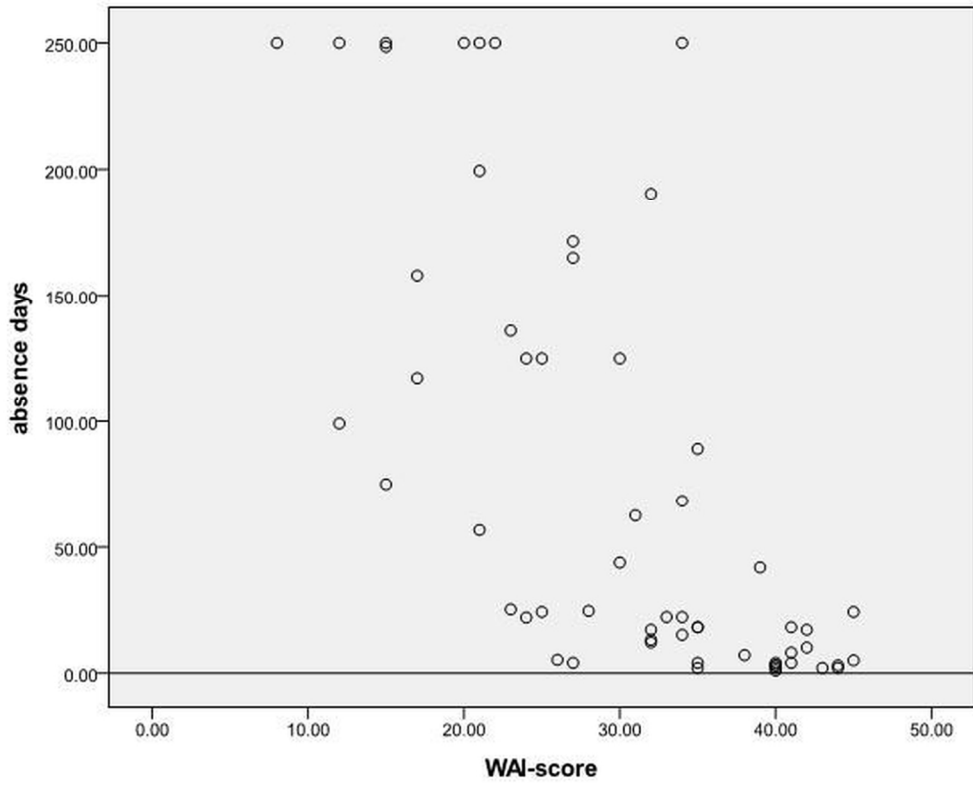
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1 **Figure 1** Scatterplot of the WAI and absence days for the subgroup with absence days (n=  
2 58)

For peer review only



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Peer Review Only

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Was this done in the manuscript? Yes or no or explanation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	yes
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	yes
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	yes
Objectives	3	State specific objectives	yes
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	yes
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Yes. Exposure not applicable
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	Yes
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Yes. Confounders and effect modifiers not applicable, because descriptive study.
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Yes Only one group
Bias	9	Describe any efforts to address potential sources of bias	Discussed in the limitations
Study size	10	Explain how the study size was arrived at	Yes
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Yes, in the statistic section
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Yes, in the statistic section and in the results section
		(b) Describe any methods used to examine subgroups and interactions	Not applicable because of the descriptive nature of the study

		(c) Explain how missing data were addressed	There were no missing values of the total WAI-score nor the QW
		(d) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(e) Describe any sensitivity analyses	yes
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	yes
		(b) Give reasons for non-participation at each stage	yes
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Yes, table 1
		(b) Indicate number of participants with missing data for each variable of interest	No missing data for the two main questionnaires
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval).	Yes
		(b) Report category boundaries when continuous variables were categorized	Not applicable
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Yes
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	Yes, in the discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Yes
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Yes

Generalisability	21	Discuss the generalisability (external validity) of the study results	Yes
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**Other information**

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No funding was done
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\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).