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Clinically relevant deficits in performance tests in patients with axial spondyloarthritis

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Abstract

Objectives: To assess the association between self-reported and performance-based physical functioning and to evaluate which performance tests are most frequently impaired in patients with axSpA.

Methods: Consecutive axSpA patients underwent standardized assessments including patient and disease characteristics, patient-reported outcomes for disease activity, functioning, depression, mobility and physical activity and performance tests. Patients were defined as being impaired if they were not able to perform ≥ 1 of the performance tests. Validated cut-offs were used to define impaired physical performance. Impairment of performance tests as well as discrimination between subgroups were analyzed.

Results: A total of 200 patients (r-axSpA 65.5%, nr-axSpA 34.5%) was included: 69% males, mean age 44.3 (SD 12.5) years and mean symptom duration 17.9 (12.6) years. The two most frequently impaired performance tests were the repeated chair stand test (n=75, 37.5%) and putting on socks (n=44, 22%). An impairment in ≥ 1 performance test was seen in 91 patients (45.5%). Patients with impairments were older (48.9 vs. 40.8 years), had a higher body mass index (28.7 vs. 26.1 kg/m^2), a more active disease (ASDAS 3.0 vs. 2.1), higher BASFI (5.7 vs. 2.8), BASMI (4.3 vs. 2.8) and ASAS HI scores (9.6 vs. 5.0), and higher depression screen values (PHQ 12.1 vs. 6.3), all $p<0.01$.

Conclusions: Many patients with axSpA had impairments in physical performance tests. Importantly, this was frequently seen in tasks requiring coordination and muscle power of the lower extremity. Performance tests provide qualitatively different information than BASFI and BASMI assessments in patients with axSpA.

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Introduction

A fundamental component in the management of patients with axial spondyloarthritis (axSpA) is the assessment of physical function [1]. Since pain, stiffness and decreased spinal mobility are very common in ax SpA patients, regular assessment of physical function and mobility is highly recommended [2,3]. Limitations in physical function and impairments in activities of daily living (ADL) occur more frequently in axSpA patients compared to the normal population [4]. Longer disease duration and increased age are associated with decreased physical function, whereas back exercise and higher levels of social support contribute to improved physical function [5]. In axSpA, physical function usually deteriorates slowly over time, with both reversible (e.g. inflammation) and irreversible changes (e.g. structural changes) occurring during the variable disease process [6]. Beside pathophysiological changes, physical activity (PA) and performance need to be considered to understand impairments in physical function. Educating patients about starting and maintaining regular exercise as well as PA are important components of education programs / recommendations for patients with inflammatory arthritis [7]. [7]. However, several factors such as presence of depressive symptoms might negatively influence PA and physical function in axSpA[8,9]. [8].

In routine care for patients with axSpA, physical function is usually evaluated by disease specific assessments such as self-reported questionnaires, mobility tests and, rarely, also performance tests. Most commonly used assessments are the Bath AS Functioning Index (BASFI) and the Bath AS Metrology Index (BASMI) [10,11]. Both, physical function and spinal mobility, are main domains in the recently updated ASAS–OMERACT Core Outcome Set for axSpA patients [12]. However, self-reported physical function or mobility measures do not necessarily indicate the 'real' physical performance level of a patient. Generic performance tests used to assess physical performance can objectively quantify the physical function of patients and can be assessed as a single task such as grip strength or as compound measure, such as the short performance battery test (SPPB) [13]. These tests are all associated with negative health outcomes. A disease-specific performance test is also available which has been shown to be feasible, reliable and sensitive to change [14-16]. This Ankylosing Spondylitis Performance-based Index (ASPI) is based on three BASFI items and measures the time, pain and exertion to perform ADL.

The aim of this study was to assess the association between self-reported and performance-based physical function and to investigate which performance tests are most frequently impaired in axSpA patients.

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Methods

Patients: Adult patients with a clinical diagnosis of axSpA who also fulfilled the ASAS classification criteria for axSpA [17] were consecutively recruited. Patients with significant impairment in physical function affecting their ability to perform ADL independent of axSpA were excluded. Patients were seen once when visiting to our tertiary care hospital. The study was approved by the ethics committee of the Ärztekammer Westfalen-Lippe (2017-665-f-S) and all patients gave written informed consent.

Data collection: All patients underwent a standardized assessment including collection of patient and disease characteristics, patient-reported outcomes and performance tests. The following demographic and clinical information were collected: age, gender, body mass index (BMI), disease duration, joint counts, presence of extra-spinal (sum of arthritis, enthesitis and/or dactylitis) and extra-articular manifestations (uveitis, psoriasis and/or inflammatory bowel disease), laboratory values (C-reactive protein (CRP), HLA-B 27 status) and current treatment. Conventional radiographs of the cervical and lumbar spine from routine care (timeframe previous 2 years) were used to calculate the modified stoke ankylosing spondylitis spinal score (mSASSS) to quantify structural damage of the spine [18]. Information about PA during the last three months were collected by a questionnaire.

Assessment tools: Disease activity by Bath Ankylosing Spondylitis (AS) Disease Activity Index (BASDAI) and the AS Disease Activity Score (ASDAS) [19,20], pain by a numerical rating scale 0-10 (10, severe pain), self-reported physical function by Bath AS Function Index (BASFI) [10], spinal mobility by Bath AS Metrology Index (BASMI) [11], health-related quality of life (HR-QoL) by EuroQol five dimensions questionnaire (EQ-5D-5L index and thermometer), country specific value set for Germany [21], health status with Short Form Survey Instrument 36-Item (SF-36) [22], and ASAS Health Index (ASAS HI) , screening for depressive symptoms by Patient Health Questionnaire (PHQ-9) [23], work productivity by Work Productivity and Activity Impairment questionnaire (WPAI) [24], PA by International PA questionnaire (IPAQ) [25], and the short questionnaire to assess health-enhancing PA (SQUASH) [26]. Validated thresholds for disease status were applied for ASDAS and ASAS HI [20,27].

Performance tests: Patients were asked to perform a single stance and as part of the SPPB a tandem stance, repeated chair stand test and gait speed [13]. We tested grip strength with a dynamometer in all patients. Validated cut-off thresholds were applied to define impairment as follows: SPPB Total Score ≤ 8, repeated chair stand test >15 sec, gait speed ≤ 0.8 m/s, grip strength male < 27kg, female < 16kg, single stance ≤ 10 sec [28,29]. In addition, all patients were

asked to perform the three ASPI tests (bending to pick up 6 pencils from the floor (ASPI 1), putting on socks (ASPI 2) and getting up from the floor (ASPI 3) [15]. To standardize a non-impaired performance situation, patients were not allowed to use a chair or bench to sit or lean on. For the ASPI tests putting on socks and getting up from floor the time documented in seconds was based on the mean of three repetitions. Patients were defined as being impaired if they were not able to perform at least one of the performance tests.

Statistics:

Descriptive data is presented as mean ± standard deviation (SD) when referring to quantitative variables and as absolute frequencies and percentages (%) when referring to the qualitative ones. Comparisons of continuous variables between groups were made by students t-test and categorical variables by chi-square test. A value of $p<0.05$ was considered as significant. Spearman-rho correlation was used. Correlation was considered low if ≤0.30, moderate if >0.30 and ≤0.50, high if >0.50 and <0.80 and very high if ≥0.8. Logistic regression models were used to calculate the association between impairment in ≥ 1 performance test (dependent variable) and various patient characteristics (independent variables) adjusted for potential confounders (age, sex). Statistical analyses were performed using SPSS (Chicago, Illinois, USA) version 25.

Results:

1. Patient demographics

A total of 200 patients was included and analyzed. Of these, 69.0% were male with a mean age of 44.3 (12.5) years (9 patients were >65 years of age) and a mean symptom duration of 17.9 (12.6) years (136 patients with a longstanding disease ≥10 years) (table 1). Only 101 out of 191 patients of working age had a fulltime job (52.9%). The remaining patients had a part-time job (31 (16.2%)), received disability pension (33 (17.3%)), were unemployed (15 (7.9%)), students (4 (2.1%)) or housekeepers (7 (3.7%)). 9 patients were retired (4.5%). The majority of patients (66.5%) were classified as radiographic axSpA (r-axSpA). Extraspinal manifestations were seen in 13% (n=26) of patients for arthritis, 6.5% (n=13) for enthesitis and 2% (n=4) for dactylitis. Tender and swollen joint counts were low and did not differ between patients with and without impairments. Six patients underwent hip joint replacement and one patient had a spinal vertebroplasty in the past. A total of 133 patients (65.5%) was treated with bDMARDs. Patients had a moderate disease activity and self-reported physical function was moderately impaired. ASDAS inactive disease was seen in 30 patients (15%). The PHQ-9

score indicated a high prevalence of patients with major depression (n=79, 39.5%). Concordantly, HR-QoL was reduced (EQ-5D 0.7 (0.2)) or SF-36 (PCS 36.5 (10.9); MSC (45.8 (12.8)). Structural damage was rated as low in 157 patients for whom radiographs were available. 69 patients (34.5%) were in a good state of global functioning (ASAS HI). A considerable number of patients (n=71, 35.5%) reported no regular PA in the last three months. The median IPAQ total score was 2.346 MET-minutes/week (interquartile range 685.5 to 4.320) and median SQUASH total activity score was 6.000 (interquartile range 1740 to 9765).

2. Physical performance in axSpA patients

An impairment in ≥ 1 performance test including SPPB and ASPI tests was found in 91 patients (45.5%). The SPPB mean value was 10.3 (1.8) and 22 (11%) patients were ≤ 8 which indicated severely impaired performance. No impaired performance in SPPB tasks was found in 68 patients (34%) who reached the highest possible value of 12. No patient had a score of 0 or 1 in the SPPB. As many as 156 patients (78%) were capable of performing the entire ASPI test, while 21 (10.5%), 44 (22%) and 13 (6,5%) patients were not able to perform “picking up 6 pencils” (bending), “putting on socks”, and “getting up from ground”, respectively. The most frequently impaired performance test was the repeated chair stand test which 75 patients could not do (37.5%), followed by 44 patients who had problems with putting on socks (22%), and 25 who failed to do the single stance test (14.8%), see table 2 and figure 1.

Patients with impairments were significantly older (48.9 vs. 40.8 years), had a slightly higher BMI (28.7 vs. 26.1 kg/m^2), higher depression scores (PHQ-9 12.1 vs. 6.3), reduced physical function (BASFI 5.7 vs. 2.8), impaired global functioning (ASAS HI 9.6 vs. 5.0), higher disease activity (ASDAS 3.0 vs. 2.1, BASDAI 5.6 vs. 3.3) and pain scores (6.2 vs. 3.8), and were less likely to reach ASDAS inactive disease (0.3% vs 24.8%) than patients with normal performance (all p <0.01), see table 1. Furthermore, patients with impairments reported a lower level of PA in the past although an equal number of patients in both groups reported to perform regular PA in the last 3 months. The degree of structural damage in the spine was not significantly different between the two groups.

Patients with a BASFI score <4 (n=99) did not show an impaired performance – only one patient had a SPPB sum score ≤ 8 and only 6 patients were not able to perform one or more of the ASPI tests. The majority of patients with BASFI ≥4 (79.2%, 80/101 patients) did have an impaired performance as assessed by SPPB. Patients with BASFI ≥4 and <4 showed comparable differences for age, BMI and PRO, as also shown for the analysis patients with and without impairments (supplement 1). An even larger difference was seen when analyzing the discriminant effect of ASPI. Six out of 101 patients (59.14%) in the BASFI ≥4 group showed impairments in at least one ASPI tests whereas only one patient did so in the BASFI <4 group.

However, 30.3% (54/178) patients with BASMI <4 had a SPPB sum score ≤ 8 and 77.3% (17 of 22) patients with BASMI ≥4 did demonstrate an impaired performance. Almost none of patients in remission did have an impaired performance. Impairments were seen in 4 patients who were either not able to perform the chair rise test or the ASPI test 2 (putting on socks). Performance tests in axSpA patients stratified by fulfilment of remission criteria based on ASDAS are shown in Supplement 2.

Prevalence of impairments tend to increase with age. In the age group ≥65, 5 out of 9 patients (55.6%) presented with impairments in at least one performance test and SPPB ≤ 8 was found in 2 out of 9 patients (22.2%) whereas in age group <65, 82 out of 191 patients (42.9%) presented with impairments in at least one performance test and SPPB ≤ 8 was found in 20 out of 191 patients (10.5%). None of the patients <30 years of age had impairments in performance but prevalence increase with each decade (SPPB ≤ 8: age group >30 in 3 patients (7.3%), >40 in 6 patients (9.1%), >50 in 7 patients (18.9%), >60 in 5 patients (23.8%), and >70 in 1 patient (50%).

Impairments were more prevalent in patients with longstanding disease. Although mean SPPB scores were comparable in both groups (10.6 (1.5) for symptom duration <10 years versus 10.1 (1.9) in longstanding disease) SPPB ≤ 8 was more frequently present in patients with longstanding disease (5/64 (7.8%) for patients with symptom duration <10 years versus 17/136 (12.5%) in longstanding disease). Impairments in at least one performance test were seen in 24/64 (37.5%) patients with symptom duration <10 years versus 63/136 (46.3%) in longstanding disease. In contrast, patients with long-standing disease reported being physically active (self-report by IPAQ and SQUASH) more often than patients with symptom duration <10 years.

3. Association between self-reported physical functioning and actual physical performance

The correlation between self-reported physical functioning and performance tests was moderate to high for all tests except grip strength where it was low (table 3). The best association was found between BASFI and SPPB and single stance (table 3 and figure 2). Mobility and self-reported global functioning showed a similar correlation with the performance tests as with the BASFI. Although the correlation between self-reported PA and performance tests was low, significant associations were noted for gait speed and total SPPB scores. No significant correlation was found between structural damage and performance tests (table 3).

The logistic regression analysis revealed that impairment was associated with increased age (OR 1.05 (95%CI 1.01-1.11) and compromised mobility (BASMI 1.97 (95%CI 1.25-3.25).

Furthermore, impairment was associated with less structural damage (mSASSS; OR 0.96 (95%CI 0.92-1.00).

Discussion

In this cohort of axSpA patients impaired physical performance was common . Our study is among the first to study performance tests in axSpA patients by using and comparing the performance live with different tools. For the first time we show that a relevant proportion of patients (43.5%) does not even reach targets originally validated in geriatric patients and frequently used in such populations. Patients with impairments were significantly older, had a higher BMI, higher depression scores, higher disease activity and lower self-report physical and global function compared to patients with no impairments in performance. The proportion of patients with impairments in performance increased with age, but in the group of patients <65 years of age, as many as 10.5% of patients showed severe impairments in performance according to the established SPPB threshold ≤ 8. This impairment was particularly seen in tests requiring muscle power, coordination and balance such as in the repeated chair test, putting on socks (ASPI 2) or single stance. Of note, impairments in performance could be seen in generic measures for which thresholds exists. The values of the disease-specific ASPI tests in our study are comparable to those published recently indicating that axSpA populations might be comparable at least in terms of performance and physical function [15,30-32]. However, a significant proportion of patients did not show any impairments in physical performance. Of note, in our study peripheral involvement of joints and entheses was low - this could result in less limitations in performance.

However, we could also demonstrate that more than one third of patients in our cohort reached the highest possible value in the SPPB test. Considerable variability in SPPB scores with the notion of a ceiling effect has been reported in geriatric cohorts [33]. A ceiling effect was especially observed in individuals living an independent life who report to be physically active.

Neither patients with structural damage nor patients with high disease activity had consistently impaired performance scores. In both domains, patients with no and those with severe limitation of performance were found. We actually found a negative association between impaired performance and structural damage with a quite low extend of structural damage in our cohort. However, each additional increase of one unit in structural damage was associated with a 4% decrease in the odds of patients with an impaired performance. This association should be interpreted with caution because the relatively low sample size and the absence of major structural damage might have limited the generalizability of this result. Moreover, recent studies did show that a substantial increase in mSASSS scores is needed to cause a functional impairment [34,35].. Self-reported PA and other patient-reported outcomes could well discriminate

patients with and without impairments. Impairment was also present in patients on bDMARDS which is likely not to be a result of the medication but rather the underlying disease status.

Assessment of performance is of great importance in patients with limitations in spinal mobility and a variable involvement of peripheral joints. Qualitative work on the importance of difficulties in everyday activities in patients with r-axSpA showed that domains such as “turn head when driving" or "carry groceries" are problems most frequently reported by AS patients [36]. Well-maintained performance is important because patients with r-axSpA may have an increased prevalence of falls and fractures [37,38]. The importance of the restriction of everyday activities is also reflected in the BASFI questions, which explicitly address ADL and which are operationalized in the ASPI performance test [10,31,39]. However, no judgement about impairments in ASPI tests can be made because no normative values exist to describe no impairments at all.

Associations between self-reported functioning and performance-based tests as well as between self-reported PA and performance-based tests exist although the extend was mainly low to moderate in our study. This indicates that the methods used were able to assess physical functioning but also that they, at least partly, can assess different aspects of physical function. Of note, PA questionnaires do not accurately estimate fitness and performance when compared to maximal oxygen uptake[40]. Physical function is a domain that describes the capability of an organism to independently perform specific tasks. In a clinical context, recognition of limitations in performing basic tasks is important because impairments in these domains can predict the future development of disability[41]. . Because impairments in physical function are often reversible when assessed at an early stage of disease, we propose that objective measures of physical function should be used to assess the association between self-reported and performance-based physical functioning [1,6].

Our study does not allow a conclusion on how to reliably identify patients with impaired performance. However, we assume that from the patient's point of view it is relevant to address possible limitations in performance at an early stage in order to effectively counteract onset of limitations in the future. We were able to demonstrate the time-dependent influence with the analysis on the dependence between symptom duration and impaired performance in our cohort. Impairments in performance are in its nature multifactorial and we show in our analysis that, at least to some extend, age, disease activity, structural damage and mobility are drivers of the limited performance. However, in a disease which is characterized by a rather slow deterioration in mobility over time in the vast majority of patients other factors may also play a role. Female sex, older age, active smoking, lower educational level, and high disease activity at onset were independently associated with bad functional outcomes at 24 months in a prospective cohort with axSpA patients with a short disease duration [42]. Ward et al. found that functional impairment over time in r-axSpA patients was increased with age, active smoking

status and absence of social support. Moreover, patients with impairments in specific performance tasks requiring mobility of the spine might be able compensate for their deficits. Conditional abilities, such as strength, coordination and endurance, as opposed to mobility, do not necessarily have to be affected in axSpA patients. Indeed, regular physical exercising and good social support, were shown to be associated with improvement in disability over time in axSpA patients [5].However, factors outside the physical function domain such as adaptive processes including coping strategies might have taken place and might explain variability in performance. However, such processes were not investigated in our cohort. Further research is needed to better understand such processes and effects in detail.

Since functional impairments can be potentially influenced by PA, studies should be performed to identify the cause of these deficits [43]. This is especially important when not only muscle function but also muscle mass of the patients is affected such as in sarcopenia [44].For axSpA, a prevalence of sarcopenia between 20- 34% has been reported [45,46]. [46]. Future studies need to prospectively examine performance and sarcopenia in axSpA patients and whether physical function tests predict negative health outcomes.

To prevent limitations in performance and physical functioning, ASAS management recommendations, ASAS quality standards and ASAS-OMERACT core domain set for axSpA include guidance for monitoring and promoting physical functioning, PA and performance [2,3,47]. Moreover, EULAR recommendations for PA explicitly address the need for axSpA patients to focus on cardiorespiratory fitness, muscle strength, flexibility and neuromotor performance [7]. Based on our findings promotion of PA should address these domains but should emphasize coordination, balance and muscle power of the lower extremity as well. However, studies showed that the cardiorespiratory fitness is low in AS patients compared to controls but that no group differences exist in balance or muscular capacity between patients and controls [48]. Moreover, a standardized workflow does not exist for supervised physical exercises which might address specific needs in patients with axSpA. Promotion of PA is in line with educational needs of patients with SpA who rated information on the domain “movement” and “prognosis of disease” as important [49].

How may our findings have an impact on the management of patients in clinical practice ? First, subjects with limitations in in performance tests should receive additional diagnostic workups to achieve a thorough understanding of the nature of the underlying condition[50]. As for the general population, it is relevant for axSpA patients to treat sarcopenia, frailty and/or other conditions appropriately to improve outcomes. Second, it is recognized that patients with axSpA experience a high rate of falls [37]. Consequently, a well preserved muscle function is important to prevent these often debilitating events. Third, preservation of performance might have an impact on ADL - a domain which has been reported to be most frequently impaired in patients with axSpA.[36]

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In conclusion, we have identified a high number of patients with impairments in physical performance tests. Importantly, impairment was frequently seen in complex tasks requiring coordination, balance and muscle power of the lower body. Our data strongly suggest that only collecting questionnaires is insufficient to assess function in patients with axSpA. Performance tests provide qualitatively different information than BASFI and BASMI assessments in patients with axSpA and are also needed to identify impairments in ADL.

Key messages:

- Performance-based physical function has not been assessed in a large cohort of axSpA patients
- Almost half of the patients were not able to perform at least one of the performance tests
- Impairments in physical performance tests was frequently seen in tasks requiring coordination and muscle power of the lower extremity

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Table 1: Patient characteristics, health status and outcome parameters at baseline

Variables*	**axSpA (n=200)**	**Impaired population (n=91)**	**Not-impaired population (n=109)**	**p-Value**
Male, n (%)	138 (69.0)	64 (70.3)	74 (67.9)	0.77
Age, years	44.3 (12.5)	49.1 (10.9)	40.3 (12.4)	**< 0.01**
BMI	27.3 (5.4)	28.9 (6.2)	25.8 (4.2)	**< 0.01**
HLA-B27 positive, n (%),	170 (86.7)	75 (82.4)	95 (87.2)	0.24
Symptom duration, years	17.9 (12.6)	20.7 (14.0)	15.5 (10.9)	**0.02**
Nr-axSpA, n (%)	67 (33.5)	46 (42.2)	21 (23.1	**0.02**
History of extraspinal-manifestation+, n (%)	108 (54.0)	55 (60.4)	53 (48.6)	0.09
mSASSS, 0-71 (n=157)	10,2 (18,8)	12.6 (20.2)	7.9 (17.2)	0.22
Current drug treatment, n (%)#				
- NSAID intake	122 (61.0)	63 (69.2)	59 (54.1)	**0.04**
- Prednisolone intake	15 (7.5)	9 (9.8)	6 (5.5)	0.25
- bDMARD intake	133 (66.5)	55 (60.4)	78 (71.6)	0.08
- csDMARD intake	20 (10.0)	9 (9.9)	11 (10.1)	0.89
Self-reported exercise (last 3 months), n (%)	129 (64.5)	53 (58.2)	76 (69.7)	0.07
ASDAS, 0-10	2.5 (1.1)	3.0 (0.9)	2.1 (1.0)	**< 0.01**
ASDAS inactive disease, n (%)	30 (15.0)	3 (0.3)	27 (24.8)	**< 0.01**
BASDAI, 0-10	4.3 (2.3)	5.6 (1.8)	3.3 (2.2)	**< 0.01**
Pain, NRS 0-10	4.9 (2.8)	6.2 (2.3)	3.8 (2.7)	**< 0.01**
BASFI, 0-10	4.0 (2.7)	5.8 (2.3)	2.7 (2.1)	**< 0.01**
BASMI, 0-10	3.5 (1.8)	4.4 (1.7)	2.7 (1.5)	**< 0.01**
Current joint count, tender joints	3.4 (6.5)	2.1 (2.6)	4.4 (8.3)	0.38
Current joint count, swollen joints	1.0 (1.8)	0.5 (1.0)	1.4 (2.3)	0.25
ASAS HI, 0-17	7.0 (4.1))	9.5 (3.4)	4.9 (3.4)	**< 0.01**
PHQ-9, 0-27, sum score	8.8 (6.2)	11.6 (6.5)	6.5 (4.8)	**< 0.01**
PHQ-9, major depression (≥ 10), n (%)	79 (39.5)	53 (58.2)	26 (23.9)	**< 0.01**
EQ-5D	0.7 (0.2)	0.6 (0.2)	0.8 (0.2)	**< 0.01**
SF-36, PSC	36.5 (10.9)	29.8 (8.1)	42.1 (9.8)	**< 0.01**
SF-36, MSC	45.8 (12.8)	41.9 (14.3)	49.1 (10.3)	**< 0.01**
WPAI, absenteeism (%)	15.9 (33.7)	31.6 (43.5)	7.3 (23.3)	**< 0.01**
WPAI, presenteeism %	29.2 (26.1)	47.4 (27.1)	18.8 (18.9)	**< 0.01**

WPAI, overall work impairment	16,1 (33,6)	31.8 (43.3)	7.5 (23.0)	**< 0.01**
WPAI, activity impairment	41,75 (29,1)	58.4 1 (25.8)	28.1 (24.5)	**< 0.01**
IPAQ, MET-min/week, median (IQR)	2346 (685,5 - 4320)	2220.7 (99 – 2980,7)	3605.1 (1386 - 5226.0)	**< 0.01**
SQUASH, total activity score, median (IQR)	6518 (5251)	3240 (1386 - 5226)	7770 (4650 - 11310)	**< 0.01**

*Values are presented as mean (SD) if no further information given
$ Patients were defined as being impaired if they were not able to perform at least one of the performance tests
#numbers add up to >100 because combinations of drug treatment do occur
+ sum of arthritis, enthesitis and/or dactylitis

ASAS HI, ASAS Health Index; ASDAS, AS Disease Activity Score; BASDAI, Bath Ankylosing Spondylitis Disease Index; BASFI, Bath Ankylosing Spondylitis Functioning Index; BASMI, Bath Ankylosing Spondylitis Metrology Index; EQ-5D, EuroQol five dimensions questionnaire; IPAQ, International physical activity questionnaire; mSASSS, modified stoke ankylosing spondylitis spinal score; PHQ, Patient Health Questionnaire; SF-36, Short Form Survey Instrument 36-Item; SQUASH, short questionnaire to assess health-enhancing physical activity; WPAI, work productivity and activity impairment questionnaire

	Performance Test (n=200)	Patients with impairments		Mean (SD)	95%-CI	Min-Max	Median	p25-p75 percentile
Generic			total	10.3 (1.8)	10.0-10.5	2.0-12.0	11.0	9.0-12.0
	SPPB, 0-12	22 (11.0 %)	No impairments	11.5 (0.7)	11.3-11.6	10.0-12.0	12.0	11.0-12.0
		18 (9.0 %)	impairments	8.8 (1.7)	8.5-9.2	2.0-12.0	9.0	9.0-10.0
			total	14.3 (5.9)	13.4-15.1	6.8-42.9	12.8	10.5-17.0
	Repeated chair stand test, in seconds		No impairments	10.9 (2.0)	10.5-11.3	6.8-14.9	11.0	9.4-12.7
		75 (37.5 %)	impairments	18.9 (6.3)	17.5-20.4	10.6-42.9	17.6	15.5-20.8
			total	1.1 (0.3)	1.08-1.16	0.4-2.4	1.1	1.0-1.3
	Gait speed, in m/s		No impairments	1.2 (0.2)	1.2-1.3	0.9-2.4	1.2	1.1-13
		18 (9.0 %)	impairments	1.0 (0.3)	0.9-1.0	0.4-1.8	1.0	0.9-1.1
			total	42.2 (9.7)	40.5-43.8	15.0-66.0	43.0	36.4-48.0
	Grip strength male, in kg (n=138)		No impairments	45.4 (7.5)	43.7-47.2	27.5-66.0	45.0	40.7-50.0
		11 (8.0 %)	impairments	38.4 (10.6)	35.7-41.0	15.0-61.0	38.5	30.0-45.0
			total	24.0 (5.4)	22.6-25.3	12.0-38.0	24.0	21.8-27.0
	Grip strength female, threshold <16 kg (n=62)		No impairments	26.1 (4.9)	23.0-29.0	13.0-38.0	27.0	24.3-27.8
		6 (9.7 %)	impairments	21.2 (4.6)	18.0-26.0	12.0-27.0	22.0	19.4-23.1
	Single stance, threshold ≤10 sec (n=169)		total	66.6 (45.8)	59.5-73.6	2.2-120.0	60.2	19.9-120.0

			No impairments	90.3 (36.9)	82.7-97.9	12.8-120.0	120.0	59.3-120.0
		25 (14.8 %)	impairments	35.9 (37.4)	27.1-44.7	2.2-120.0	20.5	9.1-50.9
Disease-specific			total	18.6 (9.5)	17.2-20.0	4.7-69.3	16.5	12.4-21.4
	ASPI 1 (bending), time in seconds		No impairments	14.8 (6.2)	13.6-16.0	4.7-55.0	13.6	10.9-16.9
		21 (10.5%)	impairments	21.9 (6.4)	19.9-23.7	11.7-45.7	21.4	17.4-27.7
			total	12.8 (6.4)	11.8-13.9	4.1-42.2	11.2	8.8-14.6
	ASPI 2 (putting), time in seconds		No impairments	11.3 (5.5)	10.2-12.3	4.1-42.2	10.0	8.0-12.7
		44 (22%)	impairments	16.5 (6.8)	14.5-18.5	5.9-36.4	14.6	11.8-20.3
			total	6.5 (5.0)	5.7-7.2	1.6 – 33.0	4.9	3.3-8.0
	ASPI 3 (getting up), time in seconds		No impairments	4.1 (1.7)	3.7-4.4	1.6-9.2	3.8	2.7-5.1
		13 (6.5%)	impairments	7.1(3.1)	6.2-8.1	2.3-19.9	6.7	5.9-11.4

Table 2: Performance tests in patients with axSpA

95%-CI, 95%-confidence interval; max, maximum; min, minimum; p, percentile; SD, standard deviation; NA=not applicable; SPPB, short physical performance battery

Table 3: Correlation between performance and self-reported functioning

Variables (n= 200)	**Total SPPB score**	**Repeated chair stands**	**Gait speed**	**Grip strength**	**Single stance**	**ASPI 1**	**ASPI 2**	**ASPI 3**
Age, years	-0.40**	0.35**	-0.41**	-0.20**	-0.44**	0,41**	0,29**	0,54**
BMI, kg/m^2	-0.23**	0.28**	-0.30**	ns	-0.33**	0,30**	0,21**	0,21**
ASDAS	-0.45**	0.41**	-0.35**	-0.17*	-0.44**	0,38**	0,19**	0,19**
mSASSS[a]	-0.09	0.08	0.09	0.12	0.16	0.15	0,38**	0,38**
BASMI, 0-10	-0.47**	0.41**	-0.49**	-0.23**	-0.52**	0,52**	0,59**	0,59**
BASFI, 0.10	-0.57**	0.49**	-0.46**	-0.18*	-0.58**	0,58**	0,38**	0,38**
ASAS HI, 0-17	-0.56**	0.53**	-0.42**	-0.22**	-0.56**	0,54**	0,22**	0,22**
PHQ-9, 0-27	-0.44**	0.42**	-0.31**	-0.16*	-0.41**	0,46**	0.08	0.08
SQUASH	0.30**	-0.18*	0.30**	0.14*	0.27**	-0,27**	-0,04**	-0.12
IPAQ	0.24**	-0.21**	0.19*	0.15*	0.10	-0.19*	0,30**	-0.04

Values are presented as the Spearman correlation coefficient (r), ns= not significant, *p<0.05, **p<0.01

[a] (n= 157)

Table 4: Logistic regression with impairment in ≥ 1 performance test as dependent variable

Characteristic	Univariable				Multivariable		
	N	OR[1]	95% CI[1]	p-value	OR[1]	95% CI[1]	p-value
Age (in years)	200	1.06	1.04, 1.09	**<0.001**	1.05	1.01, 1.11	**0.021**
Sex (male)	200						
no		—	—		—	—	
yes		1.12	0.61, 2.06	0.71	1.14	0.39, 3.38	0.8
ASDAS	200	2.51	1.82, 3.57	**<0.001**	1.10	0.58, 2.11	0.8
IPAQ	197	1.00	1.00, 1.00	**0.002**	1.00	1.00, 1.00	0.2
BASFI	200	1.76	1.51, 2.09	**<0.001**	1.34	0.98, 1.85	0.071
BASMI	200	1.79	1.49, 2.21	**<0.001**	1.97	1.25, 3.25	**0.005**
mSASSS	157	1.01	1.00, 1.03	0.12	0.96	0.92, 1.00	**0.041**
Arthritis (current)	200						
no		—	—		—	—	
yes		4.84	1.95, 13.8	**0.001**	2.60	0.69, 11.2	0.2
Major depression	200						
no		—	—		—	—	

yes		4.45	2.45, 8.27	**<0.001**	1.93	0.69, 5.54	0.2

[1] OR = Odds Ratio, CI = Confidence Interval

Figure 1: Percentage of participants with impaired performance tests

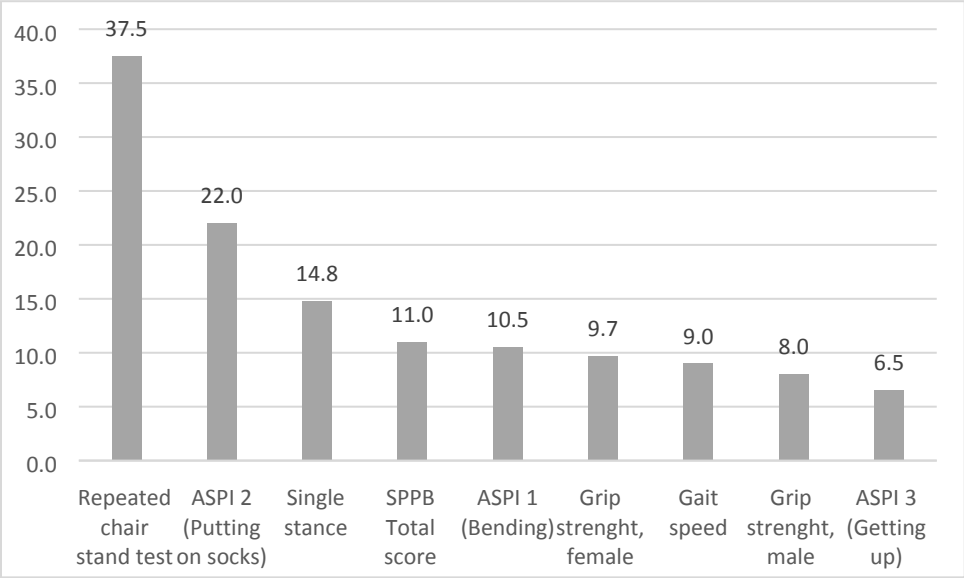
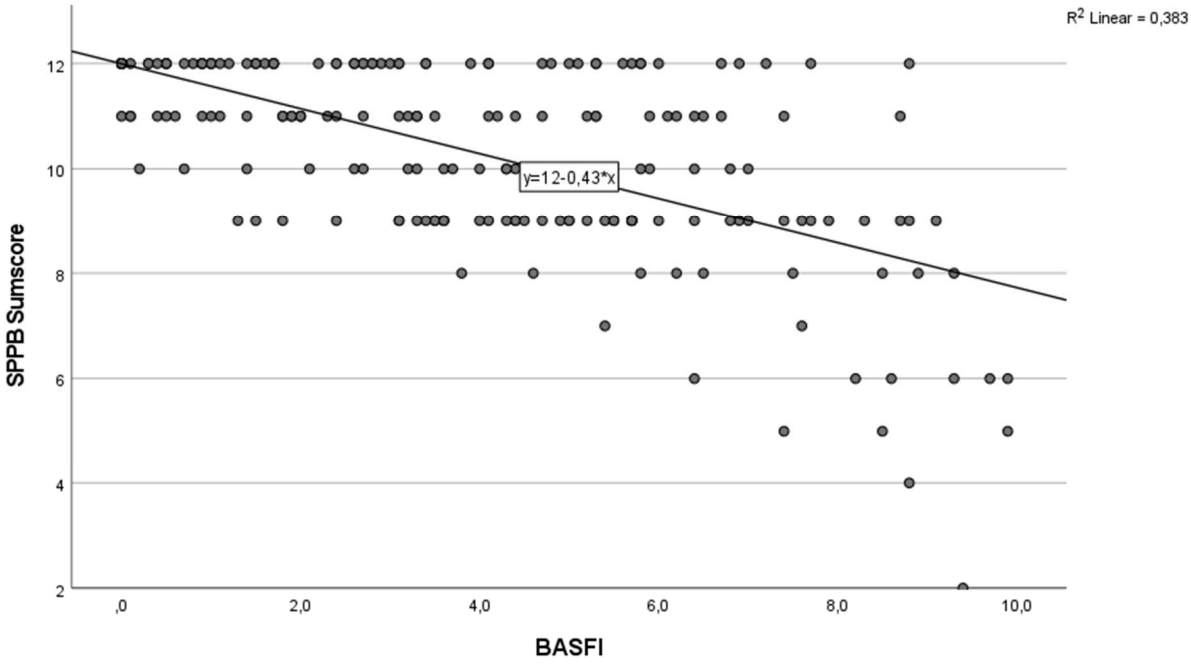


Figure 2: Relation between performance tests and self-reported physical functioning as well as mobility

Relation between (A) Bath Ankylosing Spondylitis Functioning Index (BASFI) questionnaire and (B) Bath Ankylosing Spondylitis Mobility Index (BASMI)

(A)



(B)