# Increased Body Mass Index in Ankylosing Spondylitis Is Associated with Greater Burden of Symptoms and Poor Perceptions of the Benefits of Exercise

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***ABSTRACT.*** ***Objective.*** Increased body mass index (BMI) in patients with ankylosing spondylitis (AS) is associated with a greater burden of symptoms and poor perceptions of the benefits of exercise. In AS, the effect of obesity on disease characteristics and exercise perceptions is unknown. We evaluated the prevalence of obesity in AS, to assess the attitudes of patients toward exercise and to evaluate the effect of obesity on symptoms and disease activity.

***Methods.*** Demographic data and disease characteristics were collected from 46 patients with AS. Disease activity, symptomatology, and functional disability were examined using standard AS questionnaires. BMI was calculated. Comorbidity was analyzed using the Charlson Comorbidity Index. Patients' attitudes toward exercise were assessed using the Exercise Benefits and Barriers Scale (EBBS). We compared the disease characteristics, perceptions regarding exercise, and functional limitations in those who were overweight to those who had a normal BMI.

***Results.*** The mean BMI in the group was 27.4; 67.5% of subjects were overweight or obese. There was a statistically significant difference between those who were overweight and those with a normal BMI regarding their perceptions of exercise (EBBS 124.7 vs 136.6, respectively), functional limitation (Bath AS Functional Index 4.7 vs 2.5, Health Assessment Questionnaire 0.88 vs 0.26), and disease activity (Bath AS Disease Activity Index 4.8 vs 2.9). There was no difference between the groups in terms of their comorbid conditions or other demographic variables.

***Conclusion.*** The majority of patients in this AS cohort were overweight. They had a greater burden of symptoms, worse perceptions regarding the benefits of exercise, and enhanced awareness of their barriers to exercising. This is of particular concern in a disease where exercise plays a crucial role.
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*Key Indexing Terms:*
ANKYLOSING SPONDYLITIS · OBESITY · EXERCISE
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Ankylosing spondylitis (AS) is a chronic inflammatory arthritis that primarily affects the axial skeleton and is characterized by pain, stiffness, and reduced spinal mobility. These lead to limitations in physical functioning and impaired quality of life[1]. Physical activity is a central component in the management of AS[2] and has been shown to increase mobility, decrease disability, and improve quality of life[3,4,5]. The Assessment of Spondylo-Arthritis International Society and the European League Against Rheumatism (ASAS/EULAR) recommendations for the management of AS state that management requires a combination of nonpharmacological and pharmacological treatments[2]. Nonpharmacological treatment of AS should include regular self-directed exercise. There is a growing body of evidence to support the importance of exercise in the management of AS. Despite this, rates of regular participation in exercise remain low, ranging from 18% to 47.5% depending on the study[6,7,8].

Obesity in the general population is associated with an increase in all-cause mortality[9,10,11], accelerated cardiovascular risk[11], impaired functional capacity[12], and an increased rate of malignancy, diabetes[13] and depression[14]. In rheumatoid arthritis (RA), increased adiposity is protective against radiological progression[15,16] and in some studies has been shown to promote longevity[17]; however, it is also associated with impaired quality of life[18]. In AS the prevalence of obesity and its relationship to disease-specific features are not known. Our aim was to identify the prevalence of a raised body mass index (BMI) in our patients with AS, to look at their degree of comorbidity and examine the disease-specific features in those who are normal and overweight or obese.

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## MATERIALS AND METHODS

Forty-six patients with AS according to the modified New York criteria[19] attending the rheumatology outpatient clinics in a large teaching hospital were recruited for study. In Ireland AS is not managed in the community; these patients would have been initially referred for investigation of back pain rather than for management of severe disease.

Demographic data collected included age, sex, and smoking status (current, ex-smoker, nonsmoker). A full review of all available patient records was performed by a single investigator. Comorbid conditions, bone mineral density measured by dual-energy x-ray absorptiometry (femoral neck rather than spinal T score), and occupational status (employed, unemployed, retired) were recorded.

Disease characteristics were investigated, and included year of diagnosis, age at diagnosis, and medication. Disease activity was examined using the Bath AS Disease Activity Index (BASDAI), Bath AS Functional Index (BASFI), patient global score, Health Assessment Questionnaire (HAQ), and total back and nocturnal back scores. The presence and type of extraarticular disease were noted.

BMI was recorded in the usual manner and classified according to the World Health Organization classification as either below weight, normal weight, overweight, or obese class I, II, or III[20].

*Comorbidity.* Comorbid conditions were scored using a modified Charlson Comorbidity Index (CCI)[21,22,23]. This was included to account for the role additional illnesses may play in changing attitudes toward exercise. The CCI was initially developed for predicting mortality in a cohort of patients with breast cancer and assigns a weight to each comorbid condition according to the risk of mortality. It has since been used to assess the degree of comorbidity in a wide variety of conditions such as hypertension, RA[24,25], and diabetes[22,23]. In the development phase of the index, mortality for each disease considered was converted to a relative risk of death within 12 months. A weight was then assigned to each condition based on the relative risk. The CCI can then be further adapted to account for increasing age. Relative risk was calculated to increase by 2.4 for each additional decade of life. To allow for this, 1 point can be added to the CCI score for each decade of life over the age of 50 years.

From a practical perspective, the following are assigned a score of 1: myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatological disease, peptic ulcer disease, mild liver disease, and diabetes without complication. Given a score of 2 are diabetes with chronic complications, hemiplegia, renal disease, nonmetastatic solid tumor, leukemia, and lymphoma. Given a score of 3 is moderate to severe liver disease. Metastatic solid tumor and AIDS are given a score of 6. For our analyses we also used the age-adjusted Charlson Index (CCIa). For the CCIa the cumulative score is calculated to include the sum total of all comorbid conditions and number of decades over 5.

*Attitudes toward exercise.* To assess the patient's perception of exercise we used the Exercise Benefits and Barriers Scale (EBBS)[26]. This is a well-validated questionnaire originally developed in healthy individuals. It has been used in many rheumatological conditions including AS to assess an individual's perceptions concerning the benefits of and barriers to exercise[6]. It has not, however, been formally validated in AS. The EBBS questionnaire consists of 29 benefits items in 5 categories. These are physical performance, preventive health, psychological outlook, social interaction, and life enhancement. There are 14 barriers items in 3 categories: physical exertion, time expenditure, and exercise environment. Individuals rate their agreement to each perceived benefit and barrier item on a Likert scale consisting of 4 answer options from strongly disagree to strongly agree. The possible range of scores on the questionnaire as a whole is 43–172, and higher scores indicate a more positive perception of exercise. For the barriers scale the range is 14–56, higher scores indicating a greater perception of barriers to exercise. For this analysis we used the combined benefits and barriers scale, giving their overall perception of exercise, and also noted a separate score for the barriers component. Fatigue was measured using the Fatigue Severity Scale[27,28], a self-report questionnaire used extensively in rheumatological conditions. Pain and stiffness were quantified using visual analog scales (VASP, VASS, respectively) with a total possible score of 100.

The Statistical Package for Social Sciences version 18.0 was used (SPSS Inc.). Patients were grouped according to whether they were normal weight or obese or overweight. Chi-square testing was used to compare categorical variables between the groups and Student's t test for analysis of continuous variables. Significance was set at $\rho = 0.05$.

Ethical approval for the study was granted by the St. James's Hospital ethics committee.

## RESULTS

Forty-six patients were included in our analysis. The patient demographic data and disease characteristics are shown in Table 1.

The mean age of the group was 45.1 years and it included 35 males (76.1%). Twelve (26.1%) were current smokers and 5 (10.9%) were ex-smokers. Twenty-four (52.2%) were employed, 26 (34.7%) were either unemployed or retired, and employment status was unknown in 6 (13%) individuals. Regarding bone density, the mean T score measured at the hip was –1.47 (SD 1.46). The mean BMI in the group was 27.4 (SD 4.0). Fifteen (32.6%) individuals had a normal BMI, 17 (37%) were in the overweight range, and 14 (30.5%) were obese (Table 1).

*Disease characteristics*. The mean disease duration was 12.8 (SD 10.87) years. Thirty-two individuals (69.6%) were being prescribed biologic therapy. The mean HAQ in the group was 0.73 (SD 0.67), the mean EBBS was 128.7 (SD 13.5), and the mean barriers score was 29.4 (SD 5.57). Nocturnal back pain score was 3.7 (SD 2.7) and the mean total back pain score was 4.2 (SD 2.5). The patient global score measured an average of 4.3 (SD 2.7). The mean BASDAI was 4.3 (SD 2.4) and the BASFI was 4.1 (SD 2.9). VAS for pain and stiffness had mean scores of 31.6 (SD 28.0) and 40.4 (SD 28.7), respectively (Table 2).

*Comorbidity*. There was a history of uveitis in 10 (21.7%) and inflammatory bowel disease (IBD) in 8 (17.4%) subjects. The mean CCI was 1.33 (SD 1.05), and adjusted for age this increased to 1.59 (SD 1.29). Forty patients

*Table 1.* Patient demographic data.

| Characteristic | N (%) | Mean (SD) |
|---|---|---|
| Male | 35 (76.1) | |
| Age, yrs | | 45.1 (range 24–69) |
| Disease duration, yrs | | 12.9 (10.9) |
| Current smoker | 12 (26.1) | |
| Ex-smoker | 5 (10.9) | |
| Body mass index, kg/m$^2$ | | 27.4 (4.0) |
| Normal weight, BMI < 25 | 15 (32.6) | |
| Overweight, BMI 25–30 | 17 (37) | |
| Obese, BMI > 30 | 14 (30.5) | |
| Bone mineral density, T score | | –1.47 (1.46) |
| In current employment | 24 (52.2) | |

BMI: body mass index.

*Table 2*. Burden of symptomatology and comorbidity in the entire ankylosing spondylitis cohort.

| Measure | N (%) | Mean (SD) |
|---|---|---|
| HAQ | | 0.73 (0.67) |
| EBBS | | 128.7 (13.5) |
| Nocturnal back pain | | 3.7 (2.7) |
| Total back pain | | 4.2 (2.5) |
| Patient global score | | 4.3 (2.7) |
| BASDAI | | 4.3 (2.4) |
| BASFI | | 4.1 (2.9) |
| VAS pain | | 31.6 (28.0) |
| VAS stiffness | | 40.4 (28.7) |
| Fatigue Severity Scale | | 44.1 (26.9) |
| Uveitis/iritis | 10 (21.7) | |
| Inflammatory bowel disease | 8 (17.4) | |
| Charlson Index | | 1.33 (1.05) |
| Age-adjusted Charlson Index | | 1.59 (1.29) |

HAQ: Health Assessment Questionnaire; EBBS: Exercise Benefits and Barriers Score; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; BASFI: Bath Ankylosing Spondylitis Functional Index; VAS: visual analog scale.

(87%) assessed had no significant comorbid illness as measured by the CCI.

*Comparison of categorical variables*. Comparison of those with a normal BMI to those who were overweight or obese revealed no significant differences between the groups in terms of sex, smoking history, the prevalence of IBD or uveitis, treatment with biologic therapy, or employment status using chi-square testing (Table 3).

*Table 3*. Categorical variables for patients with normal body mass index (BMI) compared to those overweight or obese.

| Variable | Normal BMI (< 25) N | Overweight/obese (> 25) N | Chi-square | Significance |
|---|---|---|---|---|
| Sex | | | | |
| Female | 3 | 8 | | |
| Male | 11 | 24 | 0.68 | 0.79 |
| Uveitis | | | | |
| No | 11 | 25 | | |
| Yes | 3 | 7 | 0.01 | 0.97 |
| IBD | | | | |
| No | 10 | 28 | | |
| Yes | 4 | 4 | 1.75 | 0.19 |
| Smoker | | | | |
| No | 8 | 12 | | |
| Yes | 4 | 8 | | |
| Ex-smoker | 0 | 5 | 2.48 | 0.23 |
| Biologic | | | | |
| No | 2 | 12 | | |
| Yes | 12 | 20 | 2.48 | 0.12 |
| Employed | | | | |
| No | 2 | 12 | | |
| Yes | 9 | 15 | | |
| Retired | 0 | 2 | 4.250 | 0.23 |

IBD: inflammatory bowel disease.

*Comparison of continuous variables (Table 4)*. Further analysis revealed significant differences between the groups in terms of HAQ scores; the mean HAQ in the overweight or obese group was 0.88, and it was 0.28 in the normal-weight subjects (p = 0.002). On analysis of the patients' perceptions of exercise and the perceived benefits, the overweight and obese patients had a mean score of 124.7; the mean score in those with normal BMI was 136.6 (p = 0.006), reflecting a significantly more positive perception of exercise among those with a normal BMI. In terms of the perceived barriers to exercise there was also a significant difference between the 2 groups. In those of normal weight the mean barriers score was 26.5, whereas it was 31.1 in those who were overweight or obese (p = 0.008).

*Table 4*. Comparison of disease characteristics, attitudes toward exercise, and comorbidity for patients with normal body mass index (BMI) compared to those overweight or obese.

| BMI | N | Mean | SD | Significance |
|---|---|---|---|---|
| HAQ | | | | |
| Overweight or obese | 31 | 0.88 | 0.65 | |
| Normal | 14 | 0.26 | 0.27 | 0.002* |
| EBBS | | | | |
| Overweight or obese | 29 | 124.7 | 12.3 | |
| Normal | 14 | 136.6 | 13.3 | 0.006* |
| Barriers | | | | |
| Overweight or obese | 29 | 31.1 | 5.44 | |
| Normal | 14 | 26.5 | 4.62 | 0.008* |
| Nocturnal back pain | | | | |
| Overweight or obese | 31 | 4.0 | 2.7 | |
| Normal | 14 | 2.9 | 2.5 | 0.189 |
| Total back pain | | | | |
| Overweight or obese | 31 | 4.5 | 2.5 | |
| Normal | 14 | 3.3 | 2.2 | 0.113 |
| Patient global score | | | | |
| Overweight or obese | 31 | 4.9 | 2.6 | |
| Normal | 14 | 2.7 | 2.3 | 0.008* |
| BASDAI | | | | |
| Overweight or obese | 31 | 4.8 | 2.3 | |
| Normal | 14 | 2.9 | 2.2 | 0.010* |
| BASFI | | | | |
| Overweight or obese | 30 | 4.7 | 2.9 | |
| Normal | 14 | 2.5 | 1.8 | 0.004* |
| VAS pain | | | | |
| Overweight or obese | 31 | 34.0 | 27.9 | |
| Normal | 14 | 23.0 | 25.9 | 0.209 |
| VAS stiffness | | | | |
| Overweight or obese | 31 | 43.9 | 30.5 | |
| Normal | 14 | 29.9 | 21.0 | 0.081 |
| Fatigue Severity Scale | | | | |
| Overweight or obese | 29 | 45.8 | 25.6 | |
| Normal | 14 | 41.9 | 30.9 | 0.681 |
| Age-adjusted Charlson Index | | | | |
| Overweight or obese | 31 | 0.55 | 1.15 | |
| Normal | 14 | 0.71 | 1.64 | 0.735 |

* Statistically significant. HAQ: Health Assessment Questionnaire; EBBS: Exercise Benefits and Barriers Scale; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; VAS: visual analog scale; BASFI: Bath Ankylosing Spondylitis Functional Index.

The patient global scores were also significantly higher in those of normal weight (p = 0.008) as were the BASDAI (p = 0.01) and BASFI (p = 0.004). There was a nonsignificant difference between the groups in their nocturnal back pain scores, total back pain, VAS for stiffness and pain, and fatigue severity index, although each of these had a higher mean score in the overweight or obese patients. In terms of their comorbidity, there was no significant difference between the groups in terms of CCI and CCIa scores.

## DISCUSSION

The mean BMI in this group of patients with AS was 27.4, which is in the overweight or pre-obese range; 67.5% were overweight or obese and 30.5% of the population studied were obese. This is higher than the proportion of obesity in the general population. In the Irish population 14% were obese when last assessed[31]; however, it is impossible to make any assumptions regarding the entire AS population from our study. It is, however, a concern that such a large proportion of our patients are overweight. In agreement with the findings in the general population, those who are overweight or obese have a greater degree of functional limitation[9,32]. This is demonstrated by the statistically significant difference in the HAQ scores between the 2 groups and in the differences in the BASFI measurements, both of which measure functional limitation.

Our overweight and obese patients had fewer positive perceptions about the benefits of exercise and a greater awareness of the barriers to exercise. Being overweight itself is often considered a barrier to exercise[33]. This variable is not specifically examined in the EBBS, which may limit its usefulness as a tool in assessing the influence of overweight and obesity on attitudes and practices related to exercising. The overweight and obese patients had a lower sense of overall well-being as demonstrated by the patient global results with increased disease activity as measured by the BASDAI.

There was an equal incidence of comorbid conditions in the 2 groups as measured by the CCI and CCIa. The populations studied were not different in terms of the burden of other chronic diseases that might have limited their ability to exercise. It is notable, however, that no score is given to IBD in this tool: 17.4% of our patient population had IBD. This is a common comorbidity in AS and this perhaps limits the usefulness of the CCI in AS.

Fatigue is frequently found to be a barrier to exercising in rheumatic diseases. In AS in particular fatigue is commonly cited as a debilitating symptom and for this reason is included in the BASDAI. The Fatigue Severity Scale was used in this study to further assess the role of fatigue in preventing our patients from exercising, and in assessing whether fatigue played a larger role in those who were overweight or obese. We found that there was no difference between the groups in terms of their fatigue.

The current obesity epidemic is a global health concern because of the negative effects of increased adiposity on health, quality of life, and longevity. In AS the high prevalence of obesity is a particular concern, given the increased standardized mortality rate demonstrated in this group, attributed in large part to accelerated cardiovascular risk[34,35]. Increased physical activity is associated with longevity and decreased all-cause mortality in the normal population[36]. In patients with AS, exercise is central to maintenance of function and management of symptoms; it is associated with improved spinal mobility and functional capacity, and decreased pain and stiffness[5,37]. The role of exercise in AS lies both in the management of disease-specific variables and in controlling cardiovascular risk. The influence of obesity on cardiometabolic risks in these patients is unknown.

Our study is limited by the small numbers of subjects and our reliance on self-report measures. Formal quantification of physical activity would have strengthened the study.

Our study demonstrated that our patients with AS are for the most part overweight or obese. Those who are overweight or obese have fewer positive perceptions about the benefits of exercise and increased awareness of barriers to exercise, compared to patients with a normal BMI. In particular, those who were overweight had higher self-reported disease activity scores, worse patient global scores, and greater functional limitation. From a practical point of view the issue of increased BMI should be addressed, explaining to the patient that there is an increased burden of disability and functional limitation associated with adiposity. With improvements in pharmacotherapy our AS patients have a lower burden of symptomatology; however, this should not diminish the central role of regular exercise in disease management. The obesity epidemic is a global health concern; its effect on the management and prognosis of rheumatic diseases requires further investigation.

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