Abstract

Objective. Spinal mobility is assessed frequently in patients with AS/axial SpA using the BASMI to provide baseline measurement and monitor change over time. The interpretation of BASMI scores has been hindered by the absence of normative values. We aimed to obtain normative values for the BASMI in healthy men and women in a UK population.

Methods. A cross-sectional study of 168 volunteers stratified by gender and age was completed. Exclusion criteria comprised factors potentially influencing spinal mobility. Each component of the BASMI was assessed, with the total score computed using the 10-point scoring system. Measurements were taken by physiotherapists following an agreed protocol. Data were summarized and analysed with age-specific centiles and CIs calculated.

Results. Total BASMI scores ranged from 0 to 4.4, with only 1.2% of the sample having a score of 0. The estimated median score for an individual age 25 years was 0.9, increasing with age to 2.1 for an individual age 65 years. There was a corresponding increase in component BASMI scores, which was more pronounced for some components than others.

Conclusion. Our data indicate that it is unusual for healthy individuals to score zero on the BASMI, which has implications for the interpretation of scores, especially at baseline. The generation of normative values has the potential to inform clinical assessment of spinal mobility and assist patients in understanding how their spinal mobility compares with that of a healthy age-matched population.

Key words: ankylosing spondylitis, axial spondyloarthritis, BASMI, spinal mobility, normative, age.
highlighted the need for further work to explore if this was a coincidental finding or if in fact this should be expected. When receiving a diagnosis and being informed about the meaning of clinical measures, patients are keen to understand the implications and relevance of their measurements. Assuming that the normative score for the BASMI is near zero has the potential to misguide patients. As well as helping patients to interpret their BASMI scores, clinicians may find age- and gender-related reference values helpful to inform their understanding and interpretation of spinal mobility in the patients they treat. Therefore the aim of this study was to obtain normative values for the total BASMI score in healthy men and women in a UK population.

Materials and methods

Ethical approval was obtained from the Faculty of Health and Medicine Ethics Committee at Lancaster University and written informed consent was obtained from all participants according to the Declaration of Helsinki.

Volunteers and physiotherapists

A sample of 150–180 participants was deemed sufficient to obtain 95% CIs with a width <0.30 for centiles. This was based on simulations from a uniform distribution consistent with pilot data [12]. In total, 168 participants were recruited from a UK population, stratified by gender and age, between September and December 2012. Volunteers were excluded from the study if they were pregnant, had a diagnosis of AS/axial SpA, had acute back problems or were affected by a chronic back condition or any other impairment that was limiting their perceived normal movement at the time of measurement.

Fourteen physiotherapists from the Ankylosing Spondylitis Special Interest Group North West (ASSIGNnw) volunteered to recruit participants and undertake BASMI measurements for this study, with each therapist identifying and measuring 12 adults (2 males and 2 females from each of the following age groups: <30 years, 30–50 years, ≥50 years). The therapists’ mean (s.d.) qualification experience was 21.5 (11.4) years (range 3–34 years) and the mean (s.d.) years of experience working in AS/axial SpA was 14 (11.6) years (range 0.5–34 years).

Procedure

To address possible inconsistencies in measurement, the ASSIGNnw consensus of measurement for each domain was followed [12]. The BASMI comprises four spinal measurements (cervical rotation, tragus-to-wall distance, modified Schober’s test and lumbar lateral flexion) and one hip mobility measurement (intermalleolar distance). For cervical rotation, tragus-to-wall and lumbar side flexion, the average of the right and left measurements was taken [4]. Each component of the BASMI was assessed, with the total score computed using the BASMI-10 scoring system [13]. Additional data collected included gender, ethnicity, date of birth and history of back problems.

Statistical analysis

Data were summarized and analysed in Intercooled Stata 11 (StataCorp, College Station, TX, USA). Age-specific centiles and CIs were obtained from maximum likelihood estimation using log (score +0.5) and exponential-normal density using the methods of Royston and Wright [14]. Current evidence suggests that the diagnosis of AS most commonly occurs between the ages of 25 and 34 years [15, 16]. Therefore we present centiles starting at age 25 years and increasing in 10-year intervals, as this will have particular clinical relevance for comparison purposes with BASMI scores of AS/axial SpA patients.

Results

A total of 168 participants with a mean age of 41.4 (16.2) years (range 18–85 years) participated in this study between September and December 2012. The majority of participants were white Caucasian (97.6%). As per the sampling frame, there were equal numbers of males (n = 84) and females (n = 84) and equal numbers of participants in each age group.

The total BASMI scores ranged from 0 to 4.4, with only two individuals (1.2%) in the entire cohort having a total BASMI score of zero. The median total BASMI score for an individual of 25 years was 0.9, which increased with age (Table 1). Centiles were calculated and examples relevant to the BASMI-10 scoring system [13] are presented in Table 1. For ages <55 years, the widths for the 5th and 50th centiles were typically 0.22–0.25; for age 65 years they were up to 0.45, and for the 95th centile were wider, ranging from 0.54 to 0.92.

There was a corresponding increase in all component scores for spinal mobility, which was most pronounced for lumbar lateral flexion, increasing from a BASMI component score of 0 in the <30 years age group to 3 in the ≥50 years age group. In contrast, tragus-to-wall distance did not deteriorate, consistently scoring 1 on the component BASMI score across all three age groups (Table 2). Given their clinical relevance, summary statistics are presented for the total BASMI score, component scores and raw measurements (Table 2). No clear differences were identified between sexes (Table 2).

<table>
<thead>
<tr>
<th>Age, years</th>
<th>5th</th>
<th>50th</th>
<th>95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>0.2</td>
<td>0.9</td>
<td>2.2</td>
</tr>
<tr>
<td>35</td>
<td>0.3</td>
<td>1.1</td>
<td>2.5</td>
</tr>
<tr>
<td>45</td>
<td>0.5</td>
<td>1.4</td>
<td>2.8</td>
</tr>
<tr>
<td>55</td>
<td>0.8</td>
<td>1.7</td>
<td>3.1</td>
</tr>
<tr>
<td>65</td>
<td>1.1</td>
<td>2.1</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male and female</td>
</tr>
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<tr>
<td><strong>Total BASMI score, median (IQR)</strong></td>
<td>0.8 (0.6-1.5)</td>
<td>0.8 (0.6-1.4)</td>
<td>0.8 (0.6-1.4)</td>
</tr>
<tr>
<td>Modified Schobers, median (IQR), cm</td>
<td>6.5 (5.75-7.35)</td>
<td>6.6 (6-7.25)</td>
<td>6.5 (6-7.35)</td>
</tr>
<tr>
<td>Modified Schobers BASMI score, median (IQR)</td>
<td>1 (0-2.5)</td>
<td>1 (0-2)</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>Intermalleolar distance, median (IQR), cm</td>
<td>110 (106-119)</td>
<td>117 (113.5-127)</td>
<td>115.35 (109-122.5)</td>
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<tr>
<td>Intermalleolar distance BASMI score, median (IQR)</td>
<td>1 (1-2)</td>
<td>1 (0-1)</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>Cervical rotation, median (IQR), degrees</td>
<td>86.0 (77-90)</td>
<td>82.5 (76.25-87.5)</td>
<td>85.0 (77-90)</td>
</tr>
<tr>
<td>Cervical rotation BASMI score, median (IQR)</td>
<td>1 (0.1-1.5)</td>
<td>1 (0-1.5)</td>
<td>1 (0-1)</td>
</tr>
<tr>
<td>Tragus-to-wall, median (IQR), cm</td>
<td>10.55 (10.0-11.65)</td>
<td>10.25 (9.5-10.8)</td>
<td>10.25 (9.8-11)</td>
</tr>
<tr>
<td>Tragus-to-wall BASMI score, median (IQR)</td>
<td>1 (0-1)</td>
<td>1 (0-1)</td>
<td>1 (0-1)</td>
</tr>
<tr>
<td>Lumbar lateral flexion, median (IQR), cm</td>
<td>21.65 (18.6-24.25)</td>
<td>21.5 (18.75-23.5)</td>
<td>21.5 (18.75-24)</td>
</tr>
<tr>
<td>Lumbar lateral flexion BASMI score, median (IQR)</td>
<td>0 (0-1)</td>
<td>0 (0-1)</td>
<td>0 (0-1)</td>
</tr>
</tbody>
</table>

**IQR**: interquartile range.
Discussion

Informed by previous work suggesting that healthy volunteers may have BASMI scores similar to or worse than people with AS [12], this study aimed to determine normative values for the BASMI score in healthy men and women in a UK population.

Our findings suggest that zero is not a normal score for an individual from a healthy population, with only 1.2% of our sample achieving this score. We observed age-related increases in the total BASMI score, which is consistent with recent research by Ramiro et al. [17], who, using a similar methodology, also found that the total BASMI score increased in individuals between the ages of 25 and 45 years in a Dutch and Portuguese population. Our results also indicate that the magnitude of increase in the BASMI score is more apparent with increasing age. This is in line with previous research undertaken on spinal mobility by Finnsback and Mannerkorpi [8] and Intolo et al. [11], who found that in a healthy population the reduction in spinal mobility occurs most markedly after the age of 40 and 50 years, respectively.

With respect to component BASMI scores, there was a corresponding increase with age that was more pronounced for some spinal mobility measures than others. With regard to lateral lumbar flexion, Finnsback and Mannerkorpi [8], using a measurement technique consistent with ours in a healthy population, found median scores of 20 cm for both males and females ages 20–49 years, and scores of 14.75 and 17.5 cm for females and males, respectively, ages 50–75 years, which concur with our findings. The only published normative data for tragus-to-wall measurements used a seated tragus-to-wall measurement in a population of healthy men and women, and found results consistent with ours, that there is no age-related deterioration [8]. Clinically this is of interest, as it appears that the tragus-to-wall measure does not deteriorate with age to the same extent as other component measures, suggesting this measure is truly disease specific. Although in our study measurements were taken by a number of different therapists, a sensitivity analysis was conducted on the summary statistics to determine if those individuals who were more experienced obtained different results, and no important differences were identified.

The data we have presented provide important initial data to aid clinicians in their interpretation of BASMI scores and subsequent clinical management of patients and add strength to our previous observation that some healthy people have the potential to obtain BASMI scores higher than patients with AS. It remains to be determined how our centiles can be applied to other populations, particularly as the participants were predominantly white Caucasian. We would therefore recommend similar studies using larger samples in both UK and other populations. Future research should also take into account the influence of factors other than age and sex. Maksymowych et al. [18] demonstrated a relationship between inter-malleolar distance and height, and more recently Assassi et al. [19] showed that spinal metrology parameters are significantly associated with BMI. Therefore measures of both height and weight and lifestyle factors such as occupation should be included in future research to develop our findings.

A better informed interpretation of BASMI scores will assist in illustrating to patients what a normal age-matched individual would typically score on the BASMI. Such information is important to someone who is newly diagnosed and being assessed clinically for the first time, potentially informing their expectations about treatment effects. Furthermore, such information has the potential to take into account the influence of age, guarding against deterioration being interpreted purely as being associated with the disease process.

Rheumatology key messages

- A BASMI score of zero is not normal in a healthy population.
- The BASMI score increases with age in healthy individuals.
- Normative values will aid interpretation of BASMI scores.

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References


