



# The impact of faulty posture on rotator cuff tears with and without symptoms



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**Hypothesis:** We hypothesized that the prevalence of rotator cuff tears would be higher among individuals with poor posture, regardless of the presence of symptoms.

**Methods:** The study initially comprised 525 residents of a mountain village who participated in an annual health check. Participants completed a background questionnaire, and physical examinations were performed to evaluate shoulder function. Ultrasonographic examinations were also performed to identify rotator cuff tears, and participants were grouped according to the presence or absence of tears. Posture was classified by 2 observers into 4 types according to the classification of Kendall, as follows: ideal alignment, kyphotic-lordotic posture, flat-back posture, and sway-back posture. Univariate analyses were performed to compare differences in background characteristics between groups, then multivariate analysis was performed to identify those factors associated with rotator cuff tears.

**Results:** Final analysis was performed for 379 participants (135 men, 244 women; mean age, 62.0 years; range, 31-94 years) showing the same posture classification from both observers. Of these, 93 (24.5%) showed rotator cuff tear in one shoulder and 45 (11.9%) showed tears in both. Prevalence of rotator cuff tears was 2.9% with ideal alignment, 65.8% with kyphotic-lordotic posture, 54.3% with flat-back posture, and 48.9% with sway-back posture. Logistic regression analysis identified increased age, abnormal posture, and past pain as factors associated with rotator cuff tears.

**Conclusions:** Postural abnormality represented an independent predictor of both symptomatic and asymptomatic rotator cuff tears. These results may help define preventive measures for rotator cuff tears and in designing rehabilitation therapies for shoulder disease.

**Level of evidence:** Level III, Cross-Sectional Study.

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**Keywords:** Rotator cuff tear; asymptomatic rotator cuff tear; faulty posture; etiology; epidemiology; population-based study

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Posture is defined as a composite of the positions of all the joints of the body at any given moment, and ideal posture is also defined as an alignment of maximum physiologic and biomechanical efficiency, entailing minimal stress and strain.<sup>11</sup> Faulty posture often associated with musculoskeletal pathologic processes such as lumbar pain,<sup>25</sup> particularly the so-called forward head posture, has been considered to be related to the etiology of cervical and shoulder disorders.<sup>1,8</sup> Regarding the relationship between faulty posture and shoulder disorder, some investigations have demonstrated an influence of thoracic posture on the functions of the scapula and shoulder.<sup>18</sup> In healthy young subjects, decreased scapular upward rotation, reduced muscle force, and reduced range of shoulder abduction were identified in the scapular slouched position.<sup>10</sup> Large kyphosis in the thoracic spine has also been associated with reduced arm elevation in older subjects.<sup>4</sup>

Rotator cuff tear is one of the most common disorders affecting the shoulder, with a frequency of approximately 20% in the general population.<sup>31</sup> Many causes have been reported for these tears, including anatomic reductions in the coracoacromial arch,<sup>32</sup> intrinsic tendon degeneration plus extrinsic compression,<sup>24,26</sup> and scapular or humeral movement alterations.<sup>20</sup> As mentioned before, faulty posture including alterations in thoracic sagittal alignment contribute to scapular dyskinesis and lead to impingement of the shoulder, ending in rotator cuff tear.<sup>12</sup> However, few studies have shown direct relationships between rotator cuff tears and postural abnormalities of the entire body. Furthermore, recent studies have revealed a number of cases of asymptomatic rotator cuff tear in which the patient reported no symptoms involving the shoulder.<sup>30</sup> Exactly how posture influences asymptomatic tears, even though the tear itself does not induce pain, would be very interesting to know.

Our hypothesis was that the prevalence of rotator cuff tears would be higher among individuals with poor posture, regardless of current symptoms. The purpose of this study was thus to identify the relationship between faulty posture and rotator cuff tears in the general population with and without symptoms involving the shoulders.

## Materials and methods

### Participants

The study was performed as part of an annual preventive health medical checkup being conducted for residents of a mountain village, where agroforestry and tourism are the main industries. Residents were provided with written information explaining the purposes of the study. We surveyed all residents who met the following inclusion criteria: (1) age >20 years and provision of written informed consent before participation; (2) ability to stand without assistance, including a walking stick or walker; (3) no history of surgical treatment involving the shoulder, spine, or lower limb; and (4) no pregnancy. A priori power analysis

indicated that 220 participants would provide a statistical power of 95% at an  $\alpha$  level of .05 with a medium effect size ( $w = 0.3$ ) in performing a  $\chi^2$  test.<sup>3,6</sup> On the basis of these criteria, this study included 525 individuals (193 men, 332 women), representing approximately 10% of the total village population. Mean age of participants was 61.9 years (range, 28-94 years).

### Examination procedure

All participants completed a questionnaire regarding age, sex, dominant arm, and whether they were experiencing or had experienced any pain involving the shoulders. They then completed the Simple Shoulder Test as proposed by Lippitt et al to evaluate shoulder function in activities of daily living<sup>16</sup> and the EuroQOL questionnaire to measure health-related quality of life. EuroQOL consists of two parts: a health status descriptive system (EQ-5D) and a visual analog scale (EQ-VAS).<sup>29</sup> Participants subsequently underwent physical examinations that evaluated active forward elevation, the impingement sign, and loss of muscle strength during external rotation. Active forward elevation was measured with a goniometer as the angle between the thorax and humerus in the scapular plane with the participant standing upright. Investigation of impingement sign was performed according to the technique described by Neer.<sup>22</sup> Loss of muscle strength in external rotation was identified with the participant sitting with the arm in neutral rotation at the side and the elbow flexed to 90° and interpreted as any score lower than 5 by manual muscle testing, based on the technique described by Daniels and Worthingham.<sup>9</sup> All physical examinations were performed by the same examiner to avoid any interobserver error.

### Ultrasonographic diagnosis for rotator cuff tears

Ultrasonographic examinations were performed with the technique described by Middleton et al<sup>21</sup> using a LOGIQe system (GE Healthcare, Little Chalfont, UK) with linear array probes at 12 MHz. A finding of full-thickness rotator cuff tear was recorded when discontinuity or thinning of the rotator cuff was evident,<sup>27</sup> and a finding of a partial-thickness tear was recorded when there was minimal flattening on the bursal side of the rotator cuff or a distinct hypoechoic or mixed hyperechoic and hypoechoic defect visualized in both longitudinal and transverse planes on the deep articular side of the rotator cuff.<sup>28</sup> To avoid interobserver variation, all ultrasonographic examinations were performed by the same experienced shoulder joint surgeon, who was blinded to all other items in the evaluation. According to the findings on ultrasonographic examinations performed by this shoulder joint surgeon for 105 shoulders, in cases that subsequently underwent arthroscopic rotator cuff repair in our institute, these diagnostic criteria offer 93.7% sensitivity and 100% specificity for the diagnosis of full-thickness rotator cuff tears and 80.0% sensitivity and 90.9% specificity for the diagnosis of partial-thickness rotator cuff tears (unpublished data).

### Evaluation of posture

We adopted the classification of Kendall<sup>11</sup> to evaluate participant posture. This classification used 4 types of posture: ideal alignment, characterized by normal curves of the spine with neutral position of the head, pelvis, and hip joints; kyphotic-lordotic

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