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ORIGINAL RESEARCH

Shoulder pain in adolescent athletes: prevalence, associated factors and its influence on upper limb function

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Abstract
Background: Sports that require the constant use of an upper limb demand the maximum kinetic chain efficiency in this segment. Immaturity of the musculoskeletal system, followed by failure in motor skills can expose adolescents to major reports of pain complaints, particularly for the shoulder.
Objective: To evaluate the prevalence of shoulder pain in adolescent athletes and identify possible factors associated with the complaint.
Method: A total of 310 athletes, of both sexes and aged between 10 and 19 years old participated on this study. The subjects filled out a questionnaire with personal, sports and upper limb function (Quick-DASH) questions. We evaluated the height, body mass, shoulder rotation range and stability of the upper limb using the CKCUES-test. The association between pain and the variables was analyzed using multilevel modeling logistic regression. We used the Mann–Whitney test for comparing between pain and function.
Results: The prevalence of shoulder pain was 43.5%. Athletes between 15 and 19 years, handball and judo practitioners, are 1.86, 2.14 and 3.07 more likely to report shoulder pain, respectively, when compared with other sports and ages. Shoulder pain reduced function scores ($p < 0.001$) and increased changes in the range of motion ($p < 0.04$).
Conclusion: Shoulder pain is highly prevalent and is associated especially with older adolescent athletes of handball and judo, and affects the levels of function and the range of the shoulder.

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Introduction

Shoulder pain is a reality not only of professional athletes and/or adults. The immaturity of the musculoskeletal system, when followed by motor sports disability, can expose young athletes to pain and musculoskeletal injuries.[1–5] Most studies in the literature have been concerned with analyzing the prevalence or incidence of already diagnosed shoulder injuries.[6–8] However, it is known that pain is one of the first signs of damage. In this sense, few studies have addressed the prevalence of shoulder pain in adolescent athletes and those that evaluated such occurrence were limited to the analysis of only one sport. Data showed that 18.6% to 39.6% of adolescent swimmers complained of shoulder pain,[9–11] while 5.5–12.5% of adolescents who practiced volleyball reported pain.[12] Personal and sports characteristics and upper limb performance measures have been mentioned as factors that might be associated with the presence of pain in athletes.[9,12–15]

However, it is possible to observe that the studies involving adolescents and shoulder pain were limited to evaluating individual sports. Based on the above considerations, the present study aimed to evaluate the prevalence of shoulder pain in adolescent athletes involved in different sports and to identify possible associated factors. In addition, we sought to assess whether adolescents with and without complaints of shoulder pain differed in certain measurements related to shoulder function.

Methods

This study was an observational, correlational cross-sectional study, composed of adolescents, amateur athletes, aged between 10 and 19 years old, and participants in sports that required the use of the upper limb (i.e. volleyball, handball, basketball, swimming and judo). The sample size calculation was performed using the WinPepi program, using the following criteria: a population of 521 athletes, a confidence interval of 95%, a sampling error of 5%, prevalence estimated at 21.4%,[14] a sample loss of 10% and a sample design effect established at 1.5 times the size of the sample. The sampling method was a probability sample in order to maintain a representative sample of athletes involved in each of the five sports. Thus, a minimum sample of 290 athletes proportionally distributed in the five sports was required.

The study was approved by the Ethics Committee of the University of Pernambuco under the CAAE 38321114.0.0.0000.5207 Protocol. All subjects under the age of 18 years received the Consent Statement and their legal representatives received Informed Consent which they were asked to sign and return to the researchers before the athletes were included in the study.

The study included adolescent athletes of both sexes who practiced for at least a year in one of the following sports: volleyball, handball, basketball, swimming, or judo. Exclusion criteria were inappropriate filling out of the questionnaires, or a refusal to perform any assessment activity of the study.

A structured questionnaire with personal information, sports and data about shoulder pain was given to each subject to complete. To verify the presence or absence of shoulder pain, the subjects answered the Corlett Body Diagram[16] questions. To assess the upper limb as a functional unit, the Quick Disability Arm Shoulder Hand questionnaire (Quick-DASH) and its optional sports module (optional Quick-DASH) were applied. This questionnaire has been translated into Portuguese[17–19] and validated for children and adolescents.[20] The total score ranges from zero (no dysfunction) to 100 points (severe dysfunction).

Body mass and height were measured according to the standardization of the International Society for the Advancement of Kinanthropometry (ISAK), and body mass index (BMI) was calculated using the equation BMI = body mass/(Height)^2. For the classification of the nutritional status of the adolescents, the criteria suggested by the International Obesity Task Force (IOTF) were used. The passive range of internal and external rotation of the shoulder was measured with a goniometer.[21] For this, the subjects were positioned in a supine position with knees and hips flexed and the arm abducted to 90° and elbow flexed at 90° while the evaluator aligned the goniometer axis on the olecranon process with the goniometer arms perpendicular to the ground and parallel to the ulnar styloid process of the subject. The maximum external rotation was established by the stopping sensation at the end of motion (end feel). For internal rotation, a combination of the final stopping sensation, and the scapular compensation view (anterior tilt) was used to determine the end of the range of motion. For both rotations, in the case of subjects with shoulder pain, the range of motion limitation was established by the initial pain sensation reported by the participant. Three measurements were taken in each arm, and the final value was obtained by the average of the three values. The calculation of the glenohumeral internal rotation deficit (GIRD) was made by subtracting the internal rotation average of the three values of the dominant and non-dominant arm respectively.

Finally, the subjects performed the Closed Kinetic Chain Upper Extremity Stability Test (CKCUES Test), which assesses shoulder stability. In this test, the boys had to assume the traditional push-up position, while the girls assumed a modified push-up position (i.e. using the knees for support instead of the feet), both with hands supported on two pieces of tape fixed on the ground at a distance of 91.4 cm apart. Each subject was asked to perform, alternately for 15 s, the movement of touching the opposite hand. The number of touches or crossovers in 15 s was counted. The test was repeated 3 times and the 3 scores were averaged to give a mean test score which was multiplied by 68% of body mass divided by 15.[22] Before the execution, a submaximal test was performed for familiarization.

Previously, a pilot study ($n = 25$) was conducted to evaluate the intraclass correlation coefficient ($ICC_{3,3}$), the inter-day (seven days) and intra-rater measures with a confidence interval at 95% (CI95%) and the standard error of measurement (SEM), obtaining the following values: Quick-DASH (ICC = 0.81; 95% CI = 0.56–0.92; SEM = 4.2), Optional Quick-DASH (ICC = 0.73; 95% CI = 0.38–0.88; SEM = 7.0), CKCUES-test (ICC = 0.87; 95% CI = 0.64–0.95; SEM = 6.5) and shoulder range of motion (ICC = 0.82–0.91; 95% CI = 0.59–0.96; SEM = 4.2–7.1).

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