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Original Research Article

Selected lower extremity flexibility tests as an element of functional assessment for ballet school students – Preliminary observation

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ABSTRACT

Introduction: Muscles are a part of the human neuromusculoskeletal system, stabilizing the skeleton and allowing joint movements. Muscle characteristics include flexibility and contractility. Assessment of muscle flexibility includes flexibility tests. Dance teachers put special emphasis on their students' flexibility enhancement, applying muscle stretching techniques. Soft tissue injuries are very common in dancers. One of the elements of functional assessment of the musculoskeletal system are muscle flexibility tests.

Aim: The aims of this study are: (1) flexibility assessment of rectus femoris and hamstring muscles of both lower extremities; (2) evaluation of pain in the lumbar spine. The following research hypotheses are verified: (1) in ballet school students (elementary school) rectus femoris and hamstring flexibility tests results are within normal range; (2) there are no complaints of low back pain.

Material and methods: The study included 52 ballet school students, aged 11.64 ± 0.53 (mean \pm standard deviation). Flexibility tests of rectus femoris muscle and hamstrings of both lower extremities were conducted and a numeric pain rating scale was used to assess low back pain.

Results and discussion: Shortening of rectus femoris muscle in both lower extremities, together with increased lumbar lordosis, were found in all subjects. It was observed that hamstrings of both lower extremities were stretched.

Conclusions: (1) Flexibility tests proved to be a simple tool for the assessment of flexibility of thigh muscles of both lower extremities. The results of these tests confirm muscle imbalance and relative flexibility in the lumbar spine. (2) Numeric scale is a simple tool for the assessment of low back pain. Among 52 students, 31 declared moderate pain sensations.

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1. Introduction

Muscles, as soft tissues, are components of the human neuromusculoskeletal system. They stabilize the skeletal system and enable joint movements. In physiological conditions muscles are characterized by flexibility and contractility. Flexibility is a passive property of muscles defined by the amount of force needed for the muscles to stretch.¹ To assess muscle flexibility, flexibility tests are applied.^{2,3} Contractility of a muscle is a specific characteristics which allows muscle attachments to move closer and, in turn, enables movement in joint above which the very muscle is located. Dance teachers concentrate strongly on the enhancement of body flexibility of their students, using various muscle stretching techniques. Soft tissue injuries are common in dancers.^{4,5} Therefore, functional assessment of the neuromusculoskeletal system in ballet school students, as an element of injury prophylaxis, seems to be rational. One of the elements of functional assessment of the neuromusculoskeletal system are muscle flexibility tests. For practical reasons, an attempt at assessment of the thigh muscles flexibility and detection of low back pain in the group of children attending ballet schools was made.

2. Aim

Given the significance of the issue, the following aims were formulated: (1) flexibility assessment of rectus femoris and hamstring of both lower extremities; (2) evaluation of pain in the lumbar spine. The following research hypotheses were verified: (1) in ballet school students (elementary school) rectus femoris and hamstrings flexibility tests results are within normal range; (2) there are no complaints of pain in the lumbar spine.

3. Material and methods

In total, 52 students of the Secondary Ballet School in Poznan, Poland, participated in the study. The average age of the subjects was 11.64 ± 0.53 years, the average body height was 151.10 ± 7.54 cm, the average body weight was 35.92 ± 5.41 kg and the average duration of education in ballet school was 2.17 ± 0.65 years. As an evaluation tool for the assessment of muscle flexibility rectus femoris and hamstrings flexibility tests were used.³

Flexibility test for rectus femoris muscle were conducted with the subject positioned prone and the investigator passively flexing their knee joint. The heel touching the buttock during passive flexion was considered to be a norm (Fig. 1).³

Flexibility test for the hamstring muscles were conducted with the subject positioned supine and the investigator passively flexing the hip joint with the knee extended.

Normal results included 90° of hip flexion (Fig. 2).³

Before the tests, all procedures were explained by the investigator, and results were documented in a customized form. A test for the rectus femoris and the hamstrings of both lower extremities was performed once. To define pain sensations of the lumbar spine, a numeric pain rating scale

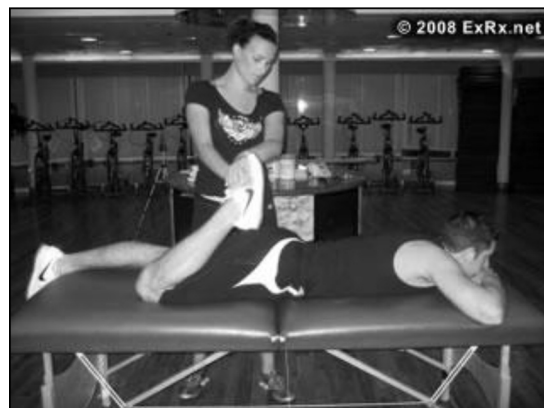


Fig. 1 – The rectus femoris muscle flexibility test.¹⁸



Fig. 2 – The hamstring muscles flexibility test.¹⁹

was used.⁶ Students determined intensity of low back pain on a scale, where 0 indicated no pain, 1–3 small pain, 4–6 moderate pain, 7–10 most severe pain. The students declared no injuries of the musculoskeletal system. The study was conducted with the approval of the Local Bioethics Committee of Poznan University of Medical Sciences and with the consent of the subjects' parents or guardians. The results were presented graphically.

4. Results

Conducted flexibility tests showed abnormal flexibility of the rectus femoris muscle of both lower extremities together with increased lumbar lordosis (relative flexibility), in all subjects (Fig. 3). The failure to reach the norm is defined as muscle shortening. Assessment of hamstrings flexibility showed that the norm was exceeded in all members of the study group, which indicates muscle stretching (Fig. 3).

Among 52 subjects, 31 students (60%) declared low back pain. On a numeric scale, the pain was ranging from 4 to 6 and was classified as moderate (Fig. 4).

5. Discussion

The study has partially proved the research hypotheses. Abnormal flexibility test results for the rectus femoris muscle,

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