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Original research article

Evaluation of weak links of musculoskeletal system and experiencing pain in children and adolescents attending ballet school

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ABSTRACT

Introduction: During an education at ballet school the musculoskeletal system is exposed to high levels of physical stress. The bodies of children and adolescents throughout the period of dance education are exposed to frequent stretching and an increasing range of motion in the joints beyond their physical norm. Pain constitutes an integral part of dance education and dancer's profession.

Aim: The aim of the study was to verify whether the type of the school profile, region of the spine and the direction of the movement influence the incidence of weak link.

Material and methods: 346 subjects took part in the study, all of them students of three types of ballet schools – among them 293 females and 53 males. Prior to the study the following research hypothesis was formed: among the children and adolescents enrolled into the study there are no weak links in musculoskeletal system in the cervical, thoracic and lumbar region of the spine.

Results and discussion: Among 346 subjects on the day of the study 39 (11.27%) reported pain in cervical region, 55 (15.90%) in thoracic region, and 184 (53.18%) in lumbar region.

Conclusions: (1) Among the children and adolescents were weak links in their cervical, thoracic and lumbar region of the spine. (2) School type does not have a significant impact on the occurrence of weak links in musculoskeletal system while region of the spine and the direction of movement have a substantive influence on weak links occurrence.

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1. Introduction

Ballet is a form of art in which meaning and emotions are communicated through human movement. Ballet students study the art of dance at ballet schools in order to acquire the best dance and acting technical skills over many years. Classical ballet uses the same positions that were codified in 1760 and passed from generation to generation of dancers through observational learning.¹ The musculoskeletal system of these students is exposed to high level of physical stress during ballet training, which predisposes them to back pain. Among children and adolescents there might occur musculoskeletal dysfunctions and as a result injuries. Among the motor organ injuries most frequently encountered in dancers there are: foot and ankle problems at the first metatarsophalangeal joint, second metatarsal stress fractures, flexor hallucis longus tendinitis and anterior and posterior ankle impingement syndromes, knee joints, hip joints, lumbar and sacral spine, injuries of upper limbs and soft tissue injuries.²⁻¹¹ The bodies of children and adolescents during dance education are exposed to frequent stretching and an increasing of range of motion in the joints beyond their physiological norm, which aims to assist students in adopting proper positions and movement figures; this is very desirable in classical dance, which constitutes the basis of dance education at ballet schools in Poland and all over the world. Pain is an integral part of dance education, as well as the dancer's professional life.^{5,12,13} Pain complaints evoke changes of tonus in individual muscle groups, which contributes to changes in posture, the weakening of motor control and in movement pattern disorders.^{14,15} Due to a very high risk of future injuries among students of ballet, their motor organ functional analysis should have been already performed during their school education, as means of preventing future injuries. Many studies exist on the physiological and biomechanics characteristics of classical dancers but it requires use special measuring equipment.¹⁶ This study using physical tests the people recruited for the study were evaluated for the weak links in their musculoskeletal system, the factors conditioning their occurrence and the presence of complaints of pain in individual regions of the spine.¹⁷ By determining weak links one should understand deficits in the biomechanical chain that: disrupt neuromuscular control or stabilization, lower muscle strength, which might also predispose to pain complaints.

2. Aim

The aim of the study was to verify whether the type of the school profile (primary school, grammar school and secondary school), region of the spine (cervical, thoracic and lumbar) and the direction of the movement (flexion, side flexion, rotation, extension) influence the incidence of weak link. Moreover, during the study it was checked how many subjects reported pain in their cervical, thoracic and lumbar region of the spine following dance lessons on the day of the test. Prior to the study the following research hypothesis was formed: among the children and adolescents enrolled into the study there are

no weak links in musculoskeletal system in the cervical, thoracic and lumbar region of the spine.

3. Material and methods

In total, 346 students of ballet schools participated in the study among them 293 females and 53 males. Those enrolled for the study were the students of Polish public ballet schools in Poznań, Łódź and Gdańsk which educational programme embraced elementary stage, grammar school and secondary school. The level of elementary school was represented by 117 subjects, 106 females and 11 males. Their average age is equal to 11.65 ± 0.48 , the average number of years spent at ballet school is 2.28 ± 0.57 . The lower secondary school level was represented by 144 subjects: 121 females and 23 males. Their average age is 13.88 ± 0.79 , the average length of ballet education is equal to 4.8 ± 0.95 years. The high school level was represented by 85 subjects: 66 females and 19 males. Their average age is 17.04 ± 0.81 , the average period of ballet education is 7.95 ± 1.03 years.

To determine weak links in the musculoskeletal system of the study subjects, specially designed tests were used.¹⁷ Prior to the application of each test the students were carefully explained the nature of the test. The subjects were tested in their underwear by the same examiner. The tests results were subsequently recorded in the evaluation sheet. The analysis of the following types of activity was carried out: (1) standing small knee bend control; (2) standing arm control; (3) hands and knees limb control; (4) modified push-up; (5) lunge loading.¹⁷ Additionally the subjects self-recorded in a specially prepared study sheet whether on the day following dance lessons they felt pain in their cervical, thoracic or lumbar regions.

In order to verify the research hypothesis, the results were analyzed using three-factor variance analysis ANOVA as well as Tukey multiple test. The results obtained were statistically analyzed by means of the statistical package R.¹⁸ This research was carried out with the permission of the Local Bioethics Committee of Poznan University of Medical Sciences, and after receiving the consent of the subjects' parents or guardians.

4. Results

Among 346 subjects on the day of the study 39 reported pain in cervical region, 55 in thoracic region, and 184 in lumbar region. Among the 117 elementary school participants in the test, 9 reported pain in the cervical spine, 19 reported pain in the thoracic spine and the pain in lumbar spine was reported by 58 children. At the lower secondary school level, among 144 children 24 felt pain in cervical spine, 18 felt pain in thoracic spine – the same number of students felt that pain at high school level. Pain in lumbar region was reported by 73 children at the lower secondary school. At high school level, among the 85 participants, 6 reported pain in cervical spine and 53 felt pain in lumbar spine. In order to determine the impact of school level (elementary, lower secondary and high school), spine region (cervical, thoracic and lumbar) and the direction of the movement performed (flexion, extension, rotation and

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