Effects of a Resistance and Stretching Training Program on Forward Head and Protracted Shoulder Posture in Adolescents

Rodrigo Miguel Ruivo, PhD,[a] Pedro Pezarat-Correia, PhD,[a] and Ana Isabel Carita, PhD[b]

Abstract

Objective: The purpose of this study was to evaluate the effects of a 16-week resistance and stretching training program applied in physical education (PE) classes on forward head posture and protracted shoulder posture in Portuguese adolescents.

Methods: This prospective, randomized, controlled study was conducted in 2 secondary schools. One hundred and thirty adolescents (aged 15-17 years) with forward head and protracted shoulder posture were randomly assigned to a control or experimental group. Sagittal head, cervical, and shoulder angles were measured with photogrammetry and Postural Assessment Software. The American Shoulder and Elbow Surgeons Shoulder Assessment was used to assess shoulder pain, and neck pain during the last month was self-reported with a single question. These variables were assessed before and after a 16-week intervention period. The control group (n = 46) attended the PE classes, whereas the exercise group (n = 84) received a posture corrective exercise program in addition to PE classes.

Results: A significant increase in cervical and shoulder angles was observed in the intervention group from pretest to posttest ($P < .05$). For the shoulder pain scores in both groups, there were no significant changes after the 16 weeks.

Conclusions: A 16-week resistance and stretching training program decreased forward head and protracted shoulder postures in adolescents. (J Manipulative Physiol Ther 2016;xx:0-10)

Key Indexing Terms: *Neck; Exercise; Posture; Rehabilitation*

Introduction

Epidemiological studies have reported a high prevalence of spinal postural deviations in children and adolescents,[1,2] with a high prevalence of self-reported upper quadrant musculoskeletal pain among adolescents.[3] Forward head posture (FHP) and protracted shoulders (PSs) are 2 of the most common postural deviations in people of all ages, including children and adolescents of school age,[4] with the shoulder and neck regions being cited in many references as the areas of greatest discomfort in adults[5,6] and adolescents.[3,7]

Forward head posture is characterized by hyperextension of the upper cervical spine (C1–C3) and flexion of the lower cervical spine (C4–C7),[8] and it is associated with shortening of the upper trapezius, posterior cervical extensor muscles (suboccipital, semispinalis, and splenii), sternocleidomastoideus, and levator scapulae muscles.[9] It is suggested that FHP leads to an increase in the compressive forces on the cervical apophyseal joints and posterior part of the vertebra and to changes in connective tissue length and strength resulting in pain.[10]

A PS is a forward displacement of the acromion with reference to the seventh cervical spinous process and can be measured by the shoulder angle. It is frequently associated with a protracted, anteriorly tilted, and internally rotated scapula and with a tightness of the pectoralis minor muscle,[11] shoulder modifications that can be associated with pain.[12]

To correct FHP, stretching of the shortened upper trapezius, sternocleidomastoid, and levator scapulae and strengthening of the deep cervical flexor muscles have been found to be effective,[9] whereas PS treatment most often is

[a] Laboratory of Motor Behavior, Faculdade de Motricidade Humana, Universidade de Lisboa, CIPER, Lisbon, Portugal.

[b] Secção Autónoma de Métodos Matemáticos, Faculdade de Motricidade Humana, Universidade de Lisboa, CIPER, Lisbon, Portugal.

Corresponding author: Rodrigo Miguel Arsénio dos Santos Ruivo, PhD, Avenida Fernando Pessoa, lote 3.20.01, Bloco B, 4 A, 1990-102 Lisbon, Portugal. Tel.: +351 919996559; fax: +351 217507001. (e-mail: *rodrigo.ruivo@netcabo.pt*).

Paper submitted May 14, 2014; in revised form September 18, 2016; accepted September 27, 2016.

0161-4754/$36.00

http://dx.doi.org/10.1016/j.jmpt.2016.10.005

based on strengthening of the scapular stabilizers and rotator cuff muscles and stretching of the anterior musculature, namely, the pectoralis minor.[9,13,14] Interventions based on these premises have already produced good results.[9,15] To our knowledge, no study has attempted to correct posture through a training protocol involving flexibility and strength exercises with adolescents in a school context.

The purpose of this study was to evaluate the effects of a 16-week resistance and stretching training program applied in physical education (PE) classes on Portuguese adolescents (15-17 years old) with FHP and PSs. Effects on neck and shoulder pain were also assessed. We hypothesized that measures of FHP and PSs, neck pain (NP), and shoulder pain and function would improve after the intervention.

Methods

Ethics

The Research Ethics Committee of the Faculty of Human Kinetics of the Technical University of Lisbon approved the study, and all procedures were performed according to the Declaration of Helsinki. The clinical trial is recorded in the ClinicalTrials.gov Identifier with the following registration code: NCT02190331. The participation of all students was voluntary, and written informed consent was obtained from all participants and their parents or legal guardians prior to commencement of the study.

Participants

A prospective, randomized, and controlled study was conducted over a 4-month period, starting in October 2012, with adolescents of two public secondary schools located in Lisbon, Portugal. At the beginning, a total of 275 adolescent students aged 15 to 17 years were evaluated with photogrammetry. We chose this age group to avoid the effects of a pubertal jump. The cervical and shoulder angles were measured using photogrammetry. If the cervical and shoulder angles were <50° and <52°, respectively, the adolescent was considered to have FHP and PSs and was referred to the study.

Participants were excluded if their cervical and shoulder angles were ≥50° and ≥52°, respectively; if they had visual deficits, diagnosed balance disorders, or musculoskeletal pathologies (such as a history of shoulder surgery, or cervical or thoracic fractures); if they were nonambulatory; if they exhibited functional or structural scoliosis; or if they had excessive thoracic kyphosis.

Thoracic kyphosis was calculated by an experienced investigator who has worked in musculoskeletal therapy for more than 10 years, using the Bioprint software and a validated and optimized estimation technique.[16]

Given these criteria, 130 adolescents from 17 different classes (9 from the 10th grade, 7 from the 11th grade, and 1 from the 12th grade) met the inclusion criteria and were recruited for the study. They were randomly assigned to two groups, a control group and an exercise group. The randomization was generated using an arbitrary number table, and allocation to one of the two groups was concealed using sequentially numbered opaque envelopes held at a central location. The investigator responsible for the outcome assessments was blinded to group allocation. Participants were blinded to which intervention was considered therapeutic. After randomization, the intervention group, composed of 84 participants (50 female and 34 male; 15.5 ± 1.1 years), began a 16-week stretching and strengthening program that was performed in the last part of the PE classes. The control group, composed of 46 adolescents (32 female and 14 male; 15.9 ± 1.1 years), participated only in the PE classes. It must be emphasized that the numeric discrepancy between the control and intervention groups was justified because the intervention group would be split into two subgroups for future study purposes after the 4-month program. Figure 1 is a diagram of retention and randomization of patients throughout the study.

One hundred thirty students fulfilled the inclusion criteria and were assessed at the beginning. After the 4-month period, 15 participants who were selected (7 from the control group and 8 from the experimental group) did not return for the second assessment because they were transferred from school or class, or were excluded because they missed practice for 2 consecutive weeks because they missed classes.

Testing Procedure: Posture Alignment Assessment

Posture alignment assessment in both groups was performed at the beginning and after the 4-month training period. Standing cervical and shoulder posture was measured with a highly reliable photogrammetric method,[17-19] which allows quantitative assessment of postural alterations,[20] and Postural Assessment Software (PAS). This software had already proven to be valid and reliable.[21,22]

Three angles were measured: sagittal head, cervical, and shoulder angles. We chose these angles because they had been used in previous studies and were found to be reliable,[23] enabling the comparison of results. The intrarater reliability of the researcher with computerized photogrammetry using the PAS for the angles studied was also confirmed by a separate preparatory study.[21]

The angles in the sagittal view (Fig 2) were obtained as follows:

Sagittal head angle: The angle formed at the intersection of a horizontal line through the tragus of the ear and a line joining the tragus of the ear and the lateral canthus of the eye.
Cervical angle: The angle formed at the intersection of a horizontal line through the spinous process of C7 and a line to the tragus of the ear. If the cervical angle was less than 50°, the participant was considered to have FHP. Selection of 50° as a reference angle was guided by the studies of Diab and Moustafa[24] and Yip et al,[25] with the latter reporting 55.02° ± 2.86° as a normal range. As is well