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The effects of training and detraining after an 8 month resistance and stretching training program on forward head and protracted shoulder postures in adolescents: Randomised controlled study

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ABSTRACT

Purpose: This study aimed to evaluate the effects of a 32-week resistance and stretching training program applied in Physical Education classes on forward head posture and protracted shoulder posture of Portuguese adolescents (15–17 years old). The detraining effects after a 16-week period were also measured.

Methods: This prospective, randomized and controlled study was conducted in two secondary schools in Portugal. One hundred and thirty adolescents with forward head and protracted shoulder posture were randomly assigned to a control or experimental group. The sagittal head, cervical and shoulder angle were measured before and after a 32-week time intervention period. The control group (n = 46) did only the Physical Education classes whereas the exercise group (n = 42) received a posture corrective exercise programme in addition to Physical Education classes. A 16 week detraining period followed the 32-week. **Results:** Significant increase were observed in the cervical and shoulder angle in the experimental group following the 32 week-intervention period. After the 16-week detraining period no significant differences were observed in the three postural angles in the intervention group.

Conclusions: The exercise intervention was successful at decreasing forward head and protracted shoulder in adolescents. Detraining period was not sufficient to reduce the overall training effects. This study supports the postural training and rehabilitation performed during Physical Education classes, with the aim of preventing and managing upper quadrant musculoskeletal pain.

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1. Introduction

Posture can be defined as the relative position of different body parts in space (Hu, 1997) and it is an essential element of normal balance (Pausić et al., 2010) and an important health indicator (McEvoy et al., 2005 Jan).

Epidemiological studies have shown that bad posture is commonplace in adolescence (Cho, 2008 Mar), with the forward

head posture (FHP) and protracted shoulder (PS) being cited as two of the most common postural deviations in adolescents in school age (Detsch et al., 2007 Apr; Van Niekerk et al., 2008 Jan; Ruivo et al., 2014). Concurrently high prevalence of neck and shoulder pain is also common in adolescents (Straker et al., 2011 Jun).

FHP is a forward head with cervical spine hyperextension and it is associated with shortening of the upper trapezius, the posterior cervical extensor muscles (suboccipital, semispinalis and splenni), sternocleidomastoideus and the levator scapulae muscles (Lynch et al., 2010 Apr).

A PS is a forward displacement of the acromion with reference to the 7th cervical spinous process and can be measured by the shoulder angle. It is frequently associated with a protracted, anterior tilted and internally rotated scapula and with a tightness of the pectoralis minor muscle (Wang et al., 1999).

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To correct FHP, stretching of the shortened upper trapezius, sternocleidomastoideo and levator scapulae and strengthening of the deep cervical flexor muscles has shown to be the right method (Lynch et al., 2010 Apr), whereas PS treatment most often centers on strengthening of the scapular stabilizers and rotator cuff muscles and stretching of the anterior musculature, namely the pectoralis minor (Ludewig et al., 2003 Nov; McDonnell et al., 2005 Jan; Lynch et al., 2010 Apr). Interventions following these premises have already shown good results (Falla et al., 2007; Lynch et al., 2010 Apr).

Despite the studies mentioned above, as far as we know, there is no study that have evaluated the effects of a long-time period training protocol involving flexibility and strength exercises in adolescents in a school context, and the effects of detraining after 4 months of absence of the program.

Thus, the purposes of this study are:

- 1 To evaluate the effects of a 32-weeks resistance and stretching training program applied in Physical Education classes on FHP and PS Portuguese adolescents (15–17 years old).
- 2 To evaluate on adolescents submitted to strength and stretching exercises the effects of a 16-week detraining period after the end of the intervention protocol.

We hypothesized that measures of FHP, PS and shoulder pain and function would improve in response to the intervention and these beneficial effects would be sustained during the detraining period.

2. Methods

2.1. Subjects

A prospective, randomized and controlled study was conducted over a 12 month period, starting in October 2012, with adolescents of two public secondary schools, located in the city of Lisbon, Portugal.

At the beginning, a total of 275 adolescent students aged 15–17 years old were evaluated with photogrammetry. We chose those ages to avoid the effects of pubertal jump. The students were screened by measuring the cervical (CV) and shoulder (SH) angle with photogrammetry. If the CV and SH angle were less than 50° and 52° respectively, the adolescent was considered to have FHP and PS and was selected to the study.

Participants were excluded if their CV and SH angle was equal or higher than 50° and 52° respectively, if they had visual deficits, diagnosed balance disorders, musculoskeletal pathologies, such as a history of shoulder surgery, cervical or thoracic fracture, were non-ambulatory, displayed functional or structural scoliosis, or had excessive thoracic kyphosis.

Given these criteria, a total of 130 adolescents from 17 different classes filled the inclusion criteria and were recruited.

After a blind randomization we only considered for this study 46 students in the control group and 42 adolescent in the experimental group. The remaining 42 students were recruited for another longitudinal study.

The randomisation was generated using a random numbers table and allocation to one of the three 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 as to which intervention was considered therapeutic.

After randomization the intervention group, constituted by 42 participants (15.5 ± 1.0 years), 27 females and 15 males, began a 32-week stretching and strengthening program that was performed in the last part of the Physical Education (PE) classes. The control group, constituted by 46 adolescents (15.9 ± 1.1 years), 32 females and 14 males, only participated in the PE classes. Since the 32nd

week until the 48th week the experimental group did not follow the interventional training program and both groups only participated in PE classes.

A diagram of patients' retention and randomization throughout the study is shown in Fig. 1.

The study was approved by the Research Ethics Committee of the Faculty of Human Kinetics of the Technical University of Lisbon. The participation of all students was voluntary, and written informed consent was obtained from all participants and their parents or legal guardians prior to the commencement of the study.

2.2. Intervention protocol

Adolescents in the intervention group began a 32-week stretching and strengthening program. Exercises in the program were completed twice a week, in the last 15 min of each PE class, with the supervision and help of the PE teacher and the aid of an illustrated handout. The PE classes of the control group didn't include this specific protocol.

The training protocol was constituted by four strengthening exercises and three stretching exercises (Table 1) and was designed based on the assumption that the use of therapeutic exercise is effective in the correction of specific neck and shoulder postures (Chiu et al., 2002 Jun; Benedetti et al., 2008 Jan; Lynch et al., 2010 Apr; Diab et al., 2012 Apr). Strengthening exercises are targeted to the activation of rotator cuff, namely the teres minor and infraspinatus, the scapula stabilizers such as trapezius (mainly the medium and lower trapezius), the rhomboids and the deep cervical flexor muscles. The stretching exercises are directed to the pectoralis minor and the neck muscles, sternocleidomastoid and levator scapulae.

Based on the training principles and considering the school calendar we developed a long-term plan with an appropriate selection of training intensity, volume, rest interval between sets, velocity and frequency. As the plan was to be performed in PE classes the prescribed exercises were to be strictly followed in two non-consecutive training days a week. For resistance training we started with light loads and 2 sets of 15 repetitions for a general adaptation and then we applied changes throughout the year, with periods with gradual and smooth increase of intensity and sets and/or repetitions, and others, mainly after the holidays, with a lower intensity or volume. The rest interval between sets was of 30 s. Summarily, students started with two sets of 15 repetitions in October, increased one set in November, and then decreased to 3 sets of 12 repetitions in December. After Christmas holidays they performed 3 sets of 10 repetitions in January, 3 sets of 12 in February and again 3 sets of 10 repetitions in March, April and May with an increasing intensity.

In the three stretching exercises we used the static stretching with a 30 s hold for two sets (Page, 2012). The all interventional program takes an average of 15 min to perform and the order of the exercises was random.

Following 16 weeks of detraining, the subjects were reassessed with identical procedures at similar times of the day as the training phase.

2.3. Testing procedure

2.3.1. Posture alignment assessment

Posture alignment assessment in both groups was performed in the beginning, after 32 and 48 weeks. Standing cervical and shoulder posture was measured with a highly reliable photogrammetric method (Lau et al., 2010 Oct) and PAS software, that also proved to be valid and reliable (FerreiraDuarte et al., 2010 Jul; Ruivo et al., 2013 Oct; Ruivo et al., 2015).

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