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Original article

Neck muscle endurance and head posture: A comparison between adolescents with and without neck pain

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ABSTRACT

Objective: The main aims of this study were to compare the neck flexor and extensor endurance and forward head posture between adolescents with and without neck pain. The secondary aims were to explore potential associations between muscles endurance, head posture and neck pain characteristics and to assess intra-rater reliability of the measurements used.

Methods: Adolescents with neck pain ($n = 35$) and age-matched asymptomatic adolescents ($n = 35$) had their forward head posture, neck flexor endurance and neck extensor endurance measured using clinical tests. Intra-rater reliability was also assessed.

Results: Forward head posture and neck flexor and extensor endurance tests showed moderate to almost perfect intra-rater reliability (ICC between 0.58 and 0.88). Adolescents with neck pain showed significantly less forward head posture (neck pain $= 46.62 \pm 4.92$; asymptomatic $= 44.18° \pm 3.64°$, $p > 0.05$) and less neck flexor (neck pain $= 24.50 \pm 23.03$s; asymptomatic $= 35.89 \pm 21.53$s, $p > 0.05$) and extensor endurance (neck pain $= 12.6.64 \pm 77.94$s; asymptomatic $= 168.66 \pm 74.77$s, $p > 0.05$) than asymptomatic adolescents.

Conclusions: Results suggest that changes in posture and neck muscle endurance are a feature of adolescents with neck pain.

1. Introduction

Musculoskeletal pain is highly prevalent in young people. A systematic review of studies on musculoskeletal pain prevalence showed that it can affect up to 40% of children and adolescents (King et al., 2011). Similar findings were reported by Hoftun et al. (2011), who studied 7373 adolescents aged 13–18 years old and reported a musculoskeletal pain prevalence of 44%. This high pain prevalence was associated with high disability as 60% of adolescents reported difficulties performing leisure activities, 50% reported difficulties sitting during classes and 34% reported sleep problems. Among musculoskeletal pain syndromes, neck pain (NP) was the most prevalent affecting 17.2% of adolescents (Hoftun et al., 2011). Furthermore, evidence suggests that NP prevalence has increased in the last decades in adolescents aged 16–18 years old from 22.9% in 1991 to 29.5% in 2011, while the prevalence of low back pain remained relatively constant (Ståhl et al., 2014). It has been suggested that this increase in NP prevalence is associated with a concurrent increase in the use of Information and Communication Technologies. For example, several studies have found an association between computer use and NP (Hakala et al., 2006; Auvinen et al., 2007; Briggs et al., 2009).

Studies in adults have shown that NP is associated with a variety of functional deficits such as poor postural control, decreased range of motion, neuromuscular deficits and postural deviations (Falla et al., 2004; Edmondston et al., 2007; Cagnie et al., 2007; Silva et al., 2009; Silva and Cruz, 2013). In particular, adult patients with NP show impaired performance of the neck extensor muscles and neck flexor muscles and increased forward head posture (FHP) when compared to asymptomatic controls (Falla, 2004; Silva et al., 2010; Schomacher and Falla, 2013). Despite the high and increasing prevalence of NP in adolescents, studies characterising functional changes in this age group are scarce.

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Understanding NP and associated functional changes at younger ages might help define more appropriate intervention strategies for this age group while simultaneously contributing to the understanding of NP at older ages and raising awareness for the need of early interventions. Furthermore, it is necessary to know whether clinical tests used for adults are able to reliably measure neck muscle function and head posture in adolescents. Therefore, the main aim of this study was to compare the neck flexor and extensor muscle endurance and FHP between adolescents with and without NP. The secondary aims were i) to explore potential associations between neck muscles endurance, head posture and NP characteristics and ii) to assess intra-rater reliability of the measurements used.

2. Methods

2.1. Participants

Participants were recruited from the 10th, 11th and 12th grades at the Secondary School of Estarreja, in the academic year of 2013/2014. There were 487 students distributed for 23 classes. A total of 452 (92.8%) students attended school on the days of screening and, therefore, were screened for inclusion in the study. Screening of participants was performed through a self-report questionnaire with inclusion and exclusion criteria. Equal number of students with and without chronic idiopathic NP was recruited from each class. Chronic idiopathic NP was defined as: pain felt dorsally between the inferior margin of the occiput and T1 not related to trauma or any known pathology that was present at least once a week during the last 3 months (Bogduk and McGuirk, 2006). Asymptomatic participants had no current pain and reported that they had never had NP. All participants were excluded if they reported any of the following conditions: 1) a history of cervical trauma or surgery; 2) congenital anomalies involving the spine (cervical, thoracic or lumbar); 3) bony abnormalities such as scoliosis; 4) any systemic arthritis; or 5) any disorder of the central nervous system. Inclusion and exclusion criteria were established by self-report.

2.2. Experimental procedures

Ethical approval to conduct the research was obtained from the Aveiro University Ethics Committee (process number 1/2014). Participants attended for assessment on one occasion where they had their NP characteristics assessed and measures of weight, height, FHP and neck flexor and extensor endurance taken as specified below. All measurements were taken in the school facilities by A.C. Oliveira, a physiotherapist with more than 10 years of clinical practice.

2.2.1. Assessment of NP

NP intensity at the moment, frequency in the previous week, duration and associated disability were assessed. Pain intensity was measured using a 10 cm visual analogue scale (VAS) anchored with “no pain” and “worst pain imaginable”. Pain frequency was assessed by asking participants to choose one of the following options: 1) seldom (once a week), 2) occasionally (2–3 times a week), 3) often (more than 3 times a week) or 4) always (all days). To characterize pain duration participants were asked to choose one of the following options: i) between 3 and 6 months, ii) more than 6 months and less than 1 year, iii) more than 1 year and less than 2 years; iv) more than 1 year and less than 5 years or v) five years or more. To assess pain associated disability participants were asked to answer Yes or No to the following question “Does your NP interfere with any of your daily activities?”.

2.2.2. Measurement of FHP

FHP was characterized through the measurement of the angle between C7, the tragus of the ear and the horizontal. This angle was measured using a universal goniometer and a bubble level (Fig. 1). It gives the position of the head relative to the trunk, when the gaze is in horizontal or in natural head posture, with decreasing values indicative of a more FHP (Silva et al., 2009). It has been shown to be valid (van Niekerk et al., 2008). Participants stood in their stocking feet in a position they felt was “natural” for them and were instructed to have a similar distribution of body weight through each foot, to place their feet slightly apart and have their arms by their sides. The spinous process of C7 was identified by palpation according to Hickey et al. (2000) and marked with a small piece of tape. To facilitate the natural head posture that was sought, participants were asked to tilt their head forwards and backwards with decreasing amplitude until they felt that a natural FHP was reached (Solow and Tallgren, 1971). Once settled, measurements were taken and the procedures repeated 3 times. The mean of the 3 measurements was used for statistical analysis.

2.2.3. Measurement of neck flexor endurance

Neck flexor endurance was measured using the deep neck flexor endurance test as described by Cleland et al. (2006). Participants were in supine position with their arms by their side. They were asked to flex the upper cervical spine, move their heads away from the couch approximately 2.5 cm and then maintain this position for as long as possible (Fig. 2). The investigator had a chronometer in one hand while the other hand was kept beneath the participant's head. The test ended when participants dropped their heads or lost the craniocervical flexion. Head drop was assessed by observing the position of the head and feeling it touching the investigator's hand, loss of cranio cervical flexion was assessed by examining the position of the mandible in relation to the neck and by observing the skin folders posterior to the mandible formed when the head is in craniocervical flexion. A change in the thickness of this skin fold or visible motion of the chin was interpreted as a loss of craniocervical flexion, resulting in termination of the endurance test. The test was repeated twice with a 5 min interval between repetitions and the mean used for statistical analysis.

2.2.4. Measurement of neck extensor endurance

The neck extensor endurance test was performed in line with Edmondston et al. (2008). Participants were in prone position, head neutral, arms by their sides and a 10 cm stabilizing velcro was placed at the 6th dorsal vertebra level. An inclinometer and a 5 cm strap were placed around the participants head with 2 Kg weight hanging from it (Fig. 3). Participants were asked to support this weight for as long as possible while maintaining the neutral head positioning. The weight and the participants' head were supported until the beginning of the test. The test ended when the head moved more than 5° from the neutral position or a maximum of 5 min was reached. The test was repeated twice with a 5 min interval between repetitions and the mean used for statistical analysis.

3. Data analysis

Statistical analysis was performed using SPSS version 22. Intrarater reliability was assessed using three measurements for FHP and two measurements for each muscle test. An intraclass correlation coefficient (ICC), model 2,1 was used. Reliability coefficients were interpreted as unacceptable if less than 0.40, moderate if between 0.41 and 0.60, substantial if between 0.61 and 0.80, and almost perfect agreement if 0.81 to 1.00 (Landis and Koch, 1977). The standard error of measurement was calculated as