Neck Flexor and Extensor Muscle Endurance in Subclinical Neck Pain: Intrarater Reliability, Standard Error of Measurement, Minimal Detectable Change, and Comparison With Asymptomatic Participants in a University Student Population

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Abstract

Objective: The aims of this study were to assess intrarater reliability and to calculate the standard error of measurement (SEM) and minimal detectable change (MDC) for deep neck flexor and neck extensor muscle endurance tests, and compare the results between individuals with and without subclinical neck pain.

Methods: Participants were students of the University of Aveiro reporting subclinical neck pain and asymptomatic participants matched for sex and age to the neck pain group. Data on endurance capacity of the deep neck flexors and neck extensors were collected by a blinded assessor using the deep neck flexor endurance test and the extensor endurance test, respectively. Intraclass correlation coefficients (ICCs), SEM, and MDC were calculated for measurements taken within a session by the same assessor. Differences between groups for endurance capacity were investigated using a Mann-Whitney *U* test.

Results: The deep neck flexor endurance test (ICC = 0.71; SEM = 6.91 seconds; MDC = 19.15 seconds) and neck extensor endurance test (ICC = 0.73; SEM = 9.84 minutes; MDC = 2.34 minutes) are reliable. No significant differences were found between participants with and without neck pain for both tests of muscle endurance ($P > .05$).

Conclusion: The endurance capacity of the deep neck flexors and neck extensors can be reliably measured in participants with subclinical neck pain. However, the wide SEM and MDC might limit the sensitivity of these tests. (J Manipulative Physiol Ther 2016;xx:1-7)

Key Indexing Terms: *Neck Pain; Physical Endurance; Reproducibility of Results*

Introduction

Neck pain is highly prevalent in the general population, with a mean lifetime prevalence of 48.5%.[1] Furthermore, it is responsible for high health care consumption. Goode et al[2] investigated the use of health care services in 135 patients with chronic neck pain and found that 79.3% of them had consulted with at least 1 care provider in the prior year. Furthermore, those that sought care for their neck pain consulted with a mean of 5 different professionals and had a mean of 21 visits.

When considering young adults and in particular university students, 1-year neck pain prevalence estimates are 46.0%, with approximately one-third of students reporting persistent and disabling neck pain.[3] Furthermore, neck pain has surpassed back pain as the leading musculoskeletal disorder in this population group.[3] Despite the high prevalence of neck pain in university students, this is a relatively understudied group. In addition, the high prevalence of neck pain and the evidence that neck pain at young ages is a significant risk factor for experiencing such symptoms in adulthood[4] suggest that it is of major relevance to study neck pain at early ages as a means to inform strategies aiming at preventing chronicity and disability associated with neck pain.[5]

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Patients with neck pain have been shown to present a variety of sensorial and motor impairments, such as proprioceptive deficits,[5] increased forward head posture,[6] postural control deficits,[7] and dysfunction of the muscles of the neck.[8] For the latter, in particular, there is irrefutable evidence and a variety of changes have been reported, including decreased strength and endurance of the deep cervical flexor and extensor muscles.[8–11] However, these studies mainly use individuals that actively sought treatment of their neck pain, that is, patients with neck pain. Some authors have suggested an additional category of neck pain, denominated "subclinical neck pain," that comprises individuals that have not received any treatment[5,12] and therefore are likely to have lower levels of neck pain and associated disability compared with participants who have actively sought treatment. Individuals with subclinical neck pain have been shown to have proprioceptive deficits, decreased range of motion, and alterations in cortical and cerebellar motor processing.[5,12,13] Therefore, the aims of this study were to assess intrarater reliability, standard error of measurement (SEM), and minimal detectable change (MDC) for measurement of deep flexor and extensor neck muscle endurance and compare these measurements between individuals with and without subclinical neck pain.

Methods

Data were collected at the School of Health Sciences, University of Aveiro. Measurements were taken in 1 session only, between February and June 2014. The study was approved by the Council of Ethics and Deontology of the University of Aveiro (Aveiro, Portugal). Before data collection, all participants provided their written informed consent.

Participants

Students from the University of Aveiro were invited to participate in this study and were included in either the neck pain group or the control group. To be included in the neck pain group, participants had to (1) have idiopathic neck pain and report feeling neck pain at least once a week in the prior 3 months and (2) have never received any treatment of their neck pain (except occasional analgesics). *Neck pain* was defined as pain felt dorsally between the inferior margin of the occiput and the first dorsal spinous process.[14] To be included in the control group, participants had to report no neck pain ever and no pain in any other body region in the prior 6 months. Participants in both groups were matched for sex and age (± 1 year) and had to be at least 18 years old and report no neurologic, rheumatic, or orthopedic pathology. Asymptomatic participants were required to never have felt neck pain. In both groups, participants were excluded if reporting any major musculoskeletal, neurologic, or rheumatic disease.

Procedures

Demographic and anthropometric data and extensor and flexor neck muscle endurance data were collected for both groups. In addition, neck pain characteristics were assessed for participants with neck pain. Anthropometric, demographic, and pain data were collected by 1 investigator and muscle endurance tests were performed by another investigator, who was blinded to participants' status (ie, asymptomatic or reporting neck pain). Participants were advised not to inform the investigator performing the tests as to whether they had neck pain.

Neck Pain

Neck pain location, intensity, frequency, and duration were assessed. Neck pain location was assessed using a body chart. Neck pain intensity at the moment of data collection was assessed using a 10-cm visual analog scale anchored with "no pain" and "worst possible pain." Neck pain frequency was assessed using a 4-option forced question (Question: In the last week, how often did you feel your neck pain?; Response options: [1] rarely—once a week; [2] occasionally—2 or 3 times a week; [3] several times—more than 3 times a week; [4] always). Neck pain duration was assessed using an open question.

Deep Neck Flexor Endurance Test

The deep neck flexor endurance test was performed as described by Cleland et al.[15] Participants were lying in supine position and were instructed to flex the upper cervical spine and then raise the head off the table about 2.5 cm and keep this position for as long as possible. The hand of the investigator performing the test was lying under the head of the participant. The test ended when there was loss of cervical flexion, observed through the loss of folds produced after the jaw in the test position, or when the individual supported the head on the hand of the investigator. The test was performed twice with 3 minutes of rest between repetitions.[16,17]

Neck Extensor Muscle Endurance Test

The neck extensor muscle endurance test was performed as described by Lee et al.[18] Participants were asked to lie prone on a plinth, with their head supported and their arms along their trunk. A strap was placed across T2 level to support the upper thoracic spine and a cervical range-of-motion device was placed on the head to maintain the head's alignment with the horizontal plane. A 2-kg weight was attached to a tape, placed around the participants' head, and initially supported. Endurance was measured by