Universidade de Aveiro

Ano 2022

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Impact of action observation therapy on pain in patients with nonspecific chronic neck pain

Impacto da terapia de ação observação na dor em utentes com dor cervical crónica idiopática

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Fisioterapia – Ramo Fisioterapia Musculosquelética, realizada sob a orientação científica da Doutora Anabela G. Silva, Professora Adjunta da Escola Superior de Saúde da Universidade de Aveiro e coorientação da Doutora Rosa Andias, Bolseira de Pós-Doutoramento do Instituto de Engenharia Eletrónica e Informática de Aveiro - IEETA, da Universidade de Aveiro.

I dedicate this work to every person who helped me reach this point.
I dedicate it for my home, Lebanon; and my chosen home, Portugal.

o júri

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keywords Chronic nonspecific neck pain; Action observation; Pressure pain threshold; Randomized clinical trial

abstract

Background: Chronic neck pain (CNP) is one of the most common musculoskeletal disorders. It is associated with psychosocial factors such as stress, anxiety and depression, but also impairments of the nervous system such as the endogenous pain modulation. Action observation (AO) is a recent neurorehabilitation approach that involves the mirror neuron system, in which there seem to be an overlap between the observation and the execution of a movement. Currently, this approach has been more investigated in the literature but seems to have conflicting results as to its effect on CNP. **Objective**: This study aims to assess the immediate effects of action observation of specific neck exercises on neck pain intensity and pressure pain threshold in individuals with CNP when compared to observing a video with a natural scenery. **Methods**: This is a pilot randomized controlled trial. Participants with CNP were randomly allocated to the action observation (AO) group and to the control group. Both groups received a single session, in which the intervention was observing an 11-minute video. The AO group watched a video of a person performing specific therapeutic neck exercises while the control group watched a video of nature. Neck pain intensity, fear of movement, fear-avoidance beliefs and pressure pain threshold were assessed both at baseline and immediately post-intervention. **Results**: A total of 30 participants entered the study (AO group=15; control group=15). There was a statistically significant effect of time (baseline vs. post-intervention), but no significant interaction for group (control vs. experimental) for: pain intensity ($p<0.001$), with a mean decrease of 1.89 (35%) in the control group and 1.43 (30%) in the AO group; fear of movement ($p=0.023$) with a mean decrease of 1.8 (8.7%) in the control group and 1.4 (9.1%) in the AO group and fear-avoidance beliefs-work subscale ($p=0.014$) with a mean decrease of 0.47 (3.2%) in the control group and 2.27 (12.1%) in the AO group. No significant interaction between time and group ($p\geq0.069$) nor a significant main effect of time ($p\geq0.547$) was found for pressure pain thresholds. **Conclusion**: This study suggests that both AO technique and the observation of natural scenes reduced pain intensity, fear of movement and fear-avoidance beliefs related to work but had no effect over the pressure pain threshold in patients with CNP. Further studies with larger sample sizes are needed.

Palavras-chave

Dor cervical crónica idiopática; Ação observação; Limiar de dor a pressão; Ensaio clínico randomizado.

Resumo

Enquadramento: A dor cervical crónica (CNP) é uma das condições musculoesqueléticas mais comuns. Está associada a fatores psicossociais, como stress, ansiedade e depressão, mas também a comprometimentos do sistema nervoso central, como alterações na modulação endógena da dor. A ação-observação (AO) é uma abordagem recente de neurorreabilitação que envolve o sistema de neurónios-espelho, na qual parece existir uma sobreposição entre a observação e a execução de um movimento. Atualmente, esta abordagem tem sido mais investigada na literatura, mas parece apresentar resultados contraditórios quanto ao seu efeito na CNP. **Objetivo**: Este estudo tem como objetivo avaliar os efeitos imediatos de observar a execução de exercícios cervicais específicos através da AO na intensidade da dor cervical e no limiar de dor à pressão em indivíduos com CNP, quando comparado à observação de uma paisagem natural. **Métodos**: Trata-se de um estudo piloto randomizado controlado. Os participantes com CNP foram alocados aleatoriamente para o grupo AO e para o grupo de controlo. Ambos os grupos receberam uma única sessão, na qual a intervenção consistiu na observação de um vídeo de 11 minutos. O grupo AO assistiu a um vídeo de uma pessoa a realizar exercícios específicos para a cervical e o grupo controlo assistiu a um vídeo com paisagens naturais. A intensidade da dor cervical, o medo de movimento, as crenças de medo-evitamento e o limiar da dor a pressão foram avaliados no pré e pós tratamento. **Resultados**: Um total de 30 participantes foram incluídos no estudo (grupo de AO=15; grupo de controlo=15). Encontrou-se um efeito estatisticamente significativo no tempo de avaliação (pré vs. pós intervenção), mas não para o grupo (controlo vs. experimental) para: intensidade da dor ($p<0.001$), com uma diminuição média de 1.89 (35%) no grupo controlo e 1.43 (30%) no grupo AO; medo do movimento ($p=0.023$) com uma diminuição média de 1.8 (8.7%) no grupo controlo e 1.4 (9.1%) no grupo AO e crenças de medo-evitamento em atividades relacionados com trabalho ($p=0.014$) com uma diminuição média de 0.47 (3.2%) no grupo controlo e 2.27 (12.1%) no grupo AO. Não foi encontrada interação significativa entre o tempo e grupo ($p\geq0.069$) nem um efeito significativo para o tempo ($p\geq0.547$) para os limiares de dor à pressão. **Conclusão**: Este estudo sugere que ambas as intervenções (AO e observação de paisagens naturais), reduziram similarmente a intensidade da dor, o medo do movimento e as crenças de medo-evitamento relacionadas ao trabalho, mas não tiveram impacto no limiar da dor à pressão em indivíduos com CNP. São necessários mais estudos com amostras superiores.

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List of abbreviations

AO – Action Observation

BMI – Body Mass Index

CNP – Chronic Neck Pain

FABQ – Fear-Avoidance Beliefs Questionnaire

FABQ-PA – Fear Avoidance Beliefs Questionnaire – Physical Activity Subscale

FABQ-W – Fear Avoidance Beliefs Questionnaire – Work Subscale

ICC – Intraclass Correlation Coefficients

MCIC – Minimal Clinically Important Changes

MDC – Minimal Detectable Change

N – Newtons

NDI – Neck Disability Index

PCS – Pain Catastrophizing Scale

PPT – Pressure Pain Threshold

S1 – Primary Somatosensory Cortex

SD – Standard Deviation

SEM – Standard Error of Measurement

SPSS – Statistical Package for The Social Sciences

TSK – Tampa Scale for Kinesiophobia

VAS – Visual Analogue Scale

1. Background

1.1. Chronic neck pain

Neck pain is one of the most common musculoskeletal disorders having an age-standardized prevalence rate of 27.0 per 1000 population in 2019 (Kazeminasab *et al.*, 2022). To add to this, it is estimated that the age-standardized rate for years lived with disability from neck pain was 352.0 per 100,000 population in 2017 (Safiri *et al.*, 2020). Most episodes of acute neck pain will resolve with or without treatment, however, nearly half of the individuals with neck pain will continue to experience some degree of pain or frequent recurrences (Cohen, 2015). It was estimated that mean point, annual, and lifetime prevalence rates of CNP are of 7.6%, 37.2%, and 48.5%, respectively (Cohen and Hooten, 2017).

Neck pain is generally defined as pain felt dorsally in the cervical region and arises anywhere between the superior nuchal line and an imaginary transversal line through the first thoracic spinous process and lateral borders of the neck (Hobbes, 1995; Nugraha *et al.*, 2019). Chronic neck pain (CNP) is defined as pain in the previously described area, lasting beyond normal tissue healing time, generally taken to be 12 weeks or 3 months (Geneen *et al.*, 2017). Regarding its cause, the most common neck pain is called idiopathic or nonspecific as the onset of the painful episode is without trauma, tumor, or any other apparent cause (Xie *et al.*, 2020).

Psychosocial factors seem to play a relevant role in idiopathic neck pain. A cohort study found that depressed mood is a predisposing factor for the development of new-onset idiopathic CNP in office workers (Shahidi, Curran-Everett and Maluf, 2015). Another study stated that workplace bullying and work-related emotional exhaustion contributed to the chronification of idiopathic CNP (Kääriä *et al.*, 2012). In addition, strong associations have been detected between neck pain and psychosocial factors such as catastrophizing, stress, anxiety, and depression that influence the perception of pain (Ortego *et al.*, 2016). For example, neck pain intensity is significantly and positively correlated with anxiety (Dimitriadis *et al.*, 2015). Similarly, disability in people with CNP is significantly associated with anxiety, depression, and catastrophizing ($p < 0.05$) (Dimitriadis *et al.*, 2015).

In addition to psychosocial factors, other, more biological factors, are also relevant in the appearance and maintenance of CNP. According to the Global Burden of Diseases study, age is also a major risk factor for the appearance and maintenance of CNP: the point prevalence of neck pain peaks during the middle ages and declines thereafter, with the highest burdens being in the 45 - 49 and 50 – 54 age groups for men and women, respectively (Safiri *et al.*, 2020). Impaired endogenous pain inhibition is considered part of these factors (Shahidi, Curran-Everett and Maluf, 2015). For instance, diffuse noxious inhibitory control (DNIC), which provides one of the main supraspinal pain inhibitory pathways, is thought to be impaired in people with chronic pain compared to healthy individuals (Lewis *et al.*, 2012). DNIC is thought to involve descending spino-bulbo-spinal circuits that cause a decrease in sensitivity to a painful stimulus in the presence of another painful stimulus(Yarnitsky, 2010).

Neuroplasticity is the ability of the central nervous system to adapt to input from the environment, thus, persistent pain may also be associated with learning leading to neuroplastic changes within the peripheral and central nervous systems (Hodges and Tucker, 2011). In other words, patients with persistent pain might undergo a process of maladaptive neuroplasticity in major sensitive areas such as the primary somatosensory area (Kim, Kim and Nabekura, 2017). Cortical changes in the primary somatosensory area, also called S1, have been reported in people suffering from chronic idiopathic low back pain, including an increase in volume in the top third of S1 bilaterally when compared to healthy control subjects (Kong *et al.*, 2013). It was also shown in this same study that people suffering from chronic pain had altered functional brain connectivity. S1 showed signs of activation during a presentation of painful stimuli although, physiologically, it modulates the location and the intensity of that stimuli. The study authors interpreted the results as suggesting that chronic pain is interconnected to, and has an impact on, the central nervous system (Kong *et al.*, 2013).

Another study investigated the central sensitization in CNP (Rampazo *et al.*, 2021). It recruited 2 groups of 30 participants each, one with CNP and another as an asymptomatic control group. They assessed the central sensitization component by measuring pressure pain thresholds, temporal summation and conditioned pain modulation. Authors found

that people with CNP reported lower local pressure pain threshold, a decrease in conditioned pain modulation, greater pain catastrophizing and more depressive symptoms compared with the asymptomatic group. This study is suggesting that central sensitization and psychosocial factors should be considered during the assessment and the treatment of individuals with CNP (Rampazo *et al.*, 2021). Also, a systematic review and meta-analysis found moderate-quality evidence of mechanical hyperalgesia at remote nonpainful sites in patients with nonspecific neck pain compared with controls, indicating altered central pain processing (Xie *et al.*, 2020).

More on the relationship between chronic pain and the CNS, some patients with chronic pain seem to show signs of nervous system dysregulation and altered pain modulation: positive and negative sensory phenomena are observed, such as allodynia, hypoesthesia, or increased pain sensitivity (Marcuzzi, Dean and Hush, 2013). Most forms of chronic pain are dependent on impulse input from C-nociceptive fibers. However, the excitability of these fibers would fire up a response resulting in the release of neuropeptides that make dorsal horn neurons hyperexcitable to painful (hyperalgesia) and non-painful stimuli (allodynia), this specifically happens in conjunction with the impaired CNS inhibitory response (Staud, 2011).

1.2. Action observation

Action observation (AO) is the act of observing other peoples' movements and activities (Bassolino *et al.*, 2014). It can include the observation of simple analytic gestures, but also more complex combined movements, as seen in athletes and high-performance sports practitioners (Suso-Martí *et al.*, 2020a). In the last years, this topic is gaining scientific interest and more research is being led to understand it more, probably because of the limitations that conventional approaches had. AO has been used as an intervention strategy in neurorehabilitation (Buccino, 2014), mostly investigated in patients with stroke (Lee, Kim and Lee, 2017) and Parkinson's disease (Caligiore *et al.*, 2017). A systematic review and meta-analysis found AO technique to have moderate to large effect size on arm and hand motor outcomes, on walking outcomes, on gate velocity and on activities of daily

function, in both cases of acute/subacute stroke patients and on chronic stroke patients (Peng *et al.*, 2019).

Studies on CNP have also been conducted. In a previous study, 30 patients with CNP were recruited to explore the pain modulation effects of motor imagery and AO of specific neck therapeutic exercises both locally, in the cervical region, and remotely (Suso-Martí *et al.*, 2019a). The 30 participants were randomly assigned to an AO group, motor imagery group, or placebo observation group. Pain pressure thresholds (PPTs) at C2/C3, trapezius muscle, and the non-dominant lateral epicondyle were the main outcome variables. Significant improvements in PPT scores were found in the AO group at the epicondyle between the pre-intervention and post-intervention assessments. Statistically significant improvements were also observed in PPTs of the cervical region in the AO and motor imagery groups between the pre-intervention and post-intervention assessments. AO and motor imagery induced immediate pain modulation in the cervical region and AO also induced remote hypoalgesia (Suso-Martí *et al.*, 2019b). Also, another study investigated exclusively AO and its effect on the cervical range of motion (de-la-Puente-Ranea *et al.*, 2016). For this, 28 participants were divided into two equal groups, one executed the observation of effective neck rotation exercises while the other assisted to ineffective rotation exercises. The cervical range of motion and the PPT were also measured 3 times: before the intervention, once it is done and 10 minutes later. The study found that the group with effective AO showed a significant improvement in the cervical range of motion compared to the ineffective observation group, and the PPT also increased specially at the upper cervical spine suggesting a hypoalgesic effect (de-la-Puente-Ranea *et al.*, 2016).

However, not all studies are consistent when discussing the effect of AO on chronic pain. In the randomized controlled trial of Beinert *et al.*, (2015), 45 participants with idiopathic CNP were recruited and randomly distributed into 3 groups: action observation group, motor imagery group and neck muscle vibration group. The three groups received a single intervention session of 5 minutes, and all participants were assessed before and after the intervention, measuring as primary outcomes the cervical joint position sense acuity and the pressure pain threshold. When repositioning acuity displayed significant time effects shared by all three groups without any significant difference in between groups, the

pressure pain threshold had significantly increased only in the neck muscles vibration group; showing no difference in the two groups of action observation and motor imagery (K Beinert *et al.*, 2015).

An umbrella and mapping review with meta-meta-analysis on movement representation techniques (action observation, motor imagery and mirror therapy) included 10 systematic reviews investigating pain relief after an intervention with movement representation techniques (Cuenca-Martínez *et al.*, 2022). Three of these reviews investigated chronic musculoskeletal pain, the 7 others were related to other types of pain (postsurgical and phantom limb as examples). The ones related to musculoskeletal pain found a significant reduction in chronic pain as a result of applying the movement representation techniques alongside usual treatment. The results showed that movement representation techniques could be effective for chronic musculoskeletal pain with low to moderate-quality evidence. The umbrella review concluded that the results provide relevant information about the potential clinical use of movement representation techniques in different types of patients with painful conditions (Cuenca-Martínez *et al.*, 2022).

One potential mechanism of action associated with AO is related to the mirror neuron system (MNS), which is believed to be the reason behind how action observation works (Rizzolatti *et al.*, 2021). This system is activated not only when the person is executing a function or a task, but also when they are observing another individual doing the same function or task (Rizzolatti *et al.*, 2021). The areas of the brain believed to hold that network are the superior parietal lobe, the inferior parietal lobe/intraparietal sulcus (IPL), the superior temporal sulcus (STS), the posterior middle temporal gyrus, the dorsal premotor, and ventral premotor/inferior frontal gyrus (IFG) (Mattingley, 2012). Observations using fMRI, suggest that the areas in the brain responsible for action observation and action execution seem to overlap, with the attention that the occipital area is more activated in AO than in action execution, most probably due to the implication of the visual system (Morales et al., 2019). The overlapping of these areas suggests that some kind of learning might be happening by the AO mechanism.

Another mechanism could relate AO to a rather cognitive and psychological aspect. Musculoskeletal pain-related fear is considered a behavioral acquisition, arising from different factors like a personal previous pain experience, visualization or observation of others' reaction to painful stimuli, or even verbal instructions and maladaptive instructions (Vlaeyen and Linton, 2012). Therefore, action observation of others successfully executing a strenuous task may break the pre-existing cognitive association between movement and pain among patients with high pain-related fear (Raghava Neelapala and Shankaranarayana, 2020a).

In syntheses, evidence suggests the existence of important functional brain alterations in people suffering from chronic pain in general and CNP in particular. The most studied intervention for people in pain is exercise therapy for its actual ability to restore healthy functional brain connectivity (Eller-Smith, Nicol and Christianson, 2018) and its analgesic effect (Skelly *et al.*, 2020). Also, studies have associated CNP with limiting behaviors such as catastrophizing and fear-avoidance (Dimitriadis *et al.*, 2015; Ortego *et al.*, 2016; Miller *et al.*, 2020), making exercise therapy potentially challenging. More research is conducted nowadays on the effect of mental techniques, AO, for instance, to try and bypass the fear and avoidance mechanisms usually associated with CNP. However, most of these studies are discussing the enhancement of functional activity, range of motion and cervical positioning, as well as the effect of AO on all sorts of pain (osteoarthritis, post-stroke, postsurgical, phantom limb and others). The literature around AO technique and musculoskeletal CNP present conflicting evidence, at times it is shown that AO has a positive effect on the pressure pain threshold for instance, however other studies found that there was no effect at all. This current study aims to investigate whether AO impacts pain intensity, fear of movement, fear- avoidance beliefs and the pressure pain threshold in people with CNP.

2. Methodology

This chapter will describe in detail the design, and methodology of this study (ethical considerations, study sample, data collection procedure and measurement instruments).

2.1. Ethical considerations

This study was approved by the Ethics Committee of the University of Aveiro (21-CED/2020; Appendix I). A summary information sheet that explains the objectives and the procedure of the study (Appendix II) was given to all participants that were eligible for the study and had an interest in being included. Those meeting the inclusion criteria signed an informed consent (Appendix III). Participants were informed of their privilege of leaving the study whenever they want, without penalization.

2.2. Study design

This study was a randomized controlled trial. There were two groups, the AO group, and the control group. The AO group observed a video of a person performing specific therapeutic neck exercises, and the control group watched a video with landscapes of nature. Both groups watched the videos in an isolated, neutral, and empty room, with minimal to no sounds throughout the treatment.

2.3. Sample size

A priori sample size calculation was performed considering a medium effect size (0.25), an alpha of 5%, and 95% power when using a multivariate analysis of variance. It was estimated that 15 participants were required in each group.

2.4. Recruitment of Participants

Participants were recruited from the general community by advertising through social media and from direct invitation by the principal researcher of this study and other colleagues. They entered the study if: i) reporting CNP, defined as a recurrent or persistent pain that lasts more than 3 months, with no trauma or etiology/diagnosis associated, which arises anywhere between the superior nuchal line and an imaginary transversal line

through the first thoracic spinous process and lateral borders of the neck (Hobbes, 1995; Nugraha *et al.*, 2019); ii) aged between 18 years to 65 years old; and were iii) literate in the Portuguese language. Participants were excluded if they presented any of the following conditions: cervical fracture or/and subluxation; pathology of malignant or visceral origin that causes neck pain; infectious diseases; cervical myelopathy; cervical surgery; osteoporosis; vestibular pathology; neurological disorder/deficits; rheumatic autoimmune diseases; history of cancer; severe cervical trauma (i.e automobile accident that had affected the cervical area; whiplash); severe injury; visual and hearing dysfunction not corrected by eyeglasses/contact lenses or a hearing aid. Exclusion criteria were ascertained by self-report.

2.5. Assessment Procedure

2.5.1. Participants' assessment

The evaluation of every participant took place in an appropriate site that had little to no noise and was convenient to them. Participants were asked to fill a questionnaire (created for this aim) on socio-demographic data (age, gender, profession, and schooling level) and anthropometric data (weight, height, and body mass index (BMI)) at baseline. In addition, participants were given self-rated questionnaires that were filled both at pre-treatment (Visual Analogue Scale, Neck Disability Index, Pain Catastrophizing Scale, Tampa Scale for Kinesiophobia, and Fear-Avoidance Beliefs Questionnaire) and post-treatment (Visual Analogue Scale, Tampa Scale for Kinesiophobia and Fear-Avoidance Beliefs Questionnaire). These are presented below (please see Appendix IV for more information). Moreover, participants were assessed for pressure pain threshold at pre-treatment and post-treatment. Participants were asked to wear clothes that revealed the neck region and the upper thoracic region. They were also asked to remove any accessories around their neck to have a clear area for the physical assessment

2.5.1.1. Pain

Pain intensity was assessed with a self-reported measure, the Visual Analogue Scale (VAS), which is a unidimensional scale originally introduced by Freyd in 1923 in the Psychology

area to measure well-being (Freyd, 1923; Hawker *et al.*, 2011). It is an easy and fast to administer instrument that consists of a 10-centimeters line (horizontal or vertical) with no pain at all and maximal pain at each end. Patients are asked to draw a perpendicular line that corresponds best to the actual pain intensity they are experiencing (Hawker *et al.*, 2011) and then the distance from the starting point to the drawn line will be measured in centimeters. The VAS presents good predictive validity and good test-retest reliability (r=0.71, p=0.001) (Batalha, 2012) and score changes of 2 points represent meaningful clinical changes (Dworkin *et al.*, 2008).

In addition, pain localization was also assessed using a body chart and asking participants to shade out where the pain was felt. Neck pain duration and frequency were determined with multiple-choice questions purposefully developed for this study. The closed question for pain duration ("how long have you had pain in the neck region?") had the following answers: i) between 3 to 6 months; ii) between 6 months to 1 year; iii) between 1 to 2 years; iv) between 2 to 4 years; and v) more than five years. The question for pain frequency in the past week ("how many times, in the past week, did you feel this pain?") had the following answers: i) never; ii) rarely (once per week); iii) occasionally (2 to 3 times per week); iv) many times (more than 3 times per week); v) always; vi) other.

2.5.1.2. Neck Disability Index

Participants' neck disability and pain-related limitations in activities of daily living due to CNP were assessed with the Neck Disability Index (NDI). This instrument was originally developed by Vernon and colleagues in 1991 (Vernon and Mior, 1991) and is the most widely used health measurement tool in patients with neck pain (Cleland, Childs and Whitman, 2008). The NDI is a valid and reliable self-rated questionnaire (Vernon, 2008). It was developed for several acute and chronic clinical conditions of the cervical spine (Macdelilld *et al.*, 2009), cervical spine surgery, whiplash injury (Vernon and Mior, 1991), cervical radiculopathy (Cleland *et al.*, 2006), acute neck pain (Vos, Verhagen and Koes, 2006) and chronic neck pain (Vernon, 2008; Macdelilld *et al.*, 2009).

The NDI consists of 10 items: seven for functional activities (personal care, lifting, reading, work, driving, sleeping, and recreation), two for symptoms (pain intensity and headaches), and one on concentration (concentration) (McCarberg, Stanos and D'Arcy, 2009). Each item has a 6-point Likert scale, which defines the progressive levels of pain and limitation in activity, ranging from 0 (no pain or disability) to 5 (very painful or maximal limitation). Participants are asked to choose the most appropriate option according to their current state of pain and disability. The total score is of 50 with scoring distribution interpretation as follows: 0 to 14 = no disability; 5 to 14 = mild disability; 15 to 24 = moderate disability; 25-34 – severe disability; over 34 = complete disability (Vernon, 2008). If participants fail to answer one question, the total score is then changed to 45 and converted to percentage (Vernon, 2008). However, if 3 or more answers are missing, the final score is considered invalid (Vernon, 2008). The NDI European Portuguese version and has good internal consistency (α Cronbach's of 0.95) and high test-retest reliability (intraclass correlation coefficients (ICC) [2,1] = 0.91) (Cruz *et al.*, 2015). The value of the minimal detectable change is 13 points, and the minimal clinically important change is 6 points (Pereira, 2012).

2.5.1.3. Pain Catastrophizing Scale

Pain catastrophizing was assessed with the Portuguese version of the Pain Catastrophizing Scale (PCS) (Sullivan, Bishop and Pivik, 1995a; Osman *et al.*, 2000). It was mainly developed to underline the impact of catastrophizing on the perception of and response to nagging pain (Sullivan, Bishop and Pivik, 1995a; Osman *et al.*, 2000). The original PCS is a self-report scale that is made up of three subscales with 13-item scale: rumination (4 items; 9,8,10,11); magnification (3 items; 6,7,13); helplessness (6 items; 1,2,3,4,5,12) (Sullivan, Bishop and Pivik, 1995a; Osman *et al.*, 2000). Participants are instructed to recall past painful experiences and to indicate to what level they have experienced each item on a 5-point Likert scale: 0 (not at all) to 4 (all the time) (Sullivan, Bishop and Pivik, 1995a). The total score is the sum of the responses to all 13 items, and ranges from 0 to 52, and higher scores are indicative of higher catastrophic thinking. The subscales' scores are computed by summing the identified items (Sullivan, 1995; Sullivan, Bishop and Pivik, 1995b). The PCS is a reliable and valid measure with a high internal consistency (α=0,87) (Sullivan, 1995).

Moreover, the Portuguese version reports the instrument to be valid and reliable with a high internal consistency (α Cronbach's of 0.90) in a study that consisted of 30 participants with acute and subacute low back pain (Jácome and Cruz, 2005).

2.5.1.4. Tampa Scale for Kinesiophobia

Fear of movement was assessed with the Portuguese version of the Tampa Scale for Kinesiophobia (TSK), a self-reporting scale. Kinesiophobia was first introduced by Miller, Kori, and Todd in 1990 at the Ninth Annual Scientific Meeting of the American Pain Society (Hudes, 2011) and has been used for over a decade for evaluating pain-related fear for several spinal and musculoskeletal regions (Shashidhar H., Robert P. and Dennis D., 1990; Lundberg, Styf and Jansson, 2009). The original form of TSK is unidimensional and has 17 items (Shashidhar H., Robert P. and Dennis D., 1990). Further, 4 items were removed from the original scale to be TSK-13, as it improved the psychometric properties (Neblett *et al.*, 2016a). The Portuguese version of TKS (Cordeiro *et al.*, 2013) is comprised of a 13-item scale with a scoring of 4-point Likert as follows: (1) (strongly disagree); (2) (somewhat disagree); (3) (somewhat agree); and (4) (strongly agree). The final score may range between 13-52, and the higher the score the higher the level of fear perceived when executing movements (Neblett *et al.*, 2016a). Levels of severity are distinguished as: 'subclinical' (13–22), 'mild' (23–32), 'moderate' (33–42), and 'severe' (43–52). A method to interpret whether the results of the TSK results are clinically meaningful is by recognizing a shift in the severity level (Neblett *et al.*, 2016a). The Portuguese version of the TSK showed good internal consistency (α Cronbach's of 0.82) and test-retest reliability (CCI from 0.94 to 0.98), and good construct validity in a study of 166 participants with nonspecific chronic low back pain (Cordeiro *et al.*, 2013). A Danish study estimated the standard error of measurement and smallest detectable change of TSK-13, in chronic patients, 2.42 and 6.71, respectively (Eiger *et al.*, 2022).

2.5.1.5. Fear-Avoidance Beliefs Questionnaire

Fear-avoidance beliefs were assessed with the Portuguese version of the Fear-Avoidance Beliefs Questionnaire (FABQ), originally developed by Waddell et al. (Waddell *et al.*, 1993).

It was specifically developed for the chronic low back pain population. However, it has been utilized to assess the relation between pain-related fear and disability among various chronic pain conditions (Zale *et al.*, 2013).

The FABQ is a self-reported questionnaire that is composed of 16 items with two subscales: fear-avoidance and physical activity (FABQ-PA) (5 items); fear-avoidance and work (FABQ-W) (11 items). It is made of 7 Likert scoring points: 0 (completely disagree) to 6 (completely agree) (Waddell *et al.*, 1993) and the higher the score the higher the level of beliefs. The work subscale has a maximum score of 42 (items 6, 7, 9-12, 15) and the physical activity subscale has a maximum score of 24 (items 2, 3, 4, 5). A score higher than 34 in the work subscale indicates a risk for prolonged work restrictions/not returning to work soon (Fritz and George, 2002), and a score higher than 15 in the physical activity subscale indicates a high level of fear-avoidance beliefs (Burton *et al.*, 1999).

The Portuguese version of FABQ was translated and adapted to the Portuguese population with a sample of 102 participants with chronic low back pain (Gonçalves and Cruz, 2007). It showed high reliability (K of Cohen =0.795) and internal consistency (α Cronbach's of 0.88 for FABQ-W and 0.77 for FABQ-PA). Lastly, item number 8 was removed for better internal consistency and easier interpretation (Gonçalves and Cruz, 2007). An Italian study established, through their study with patients with chronic low back pain, that the minimally clinical important difference for FABQ-W is 7 points and for FABQ-PA is 4 points (Monticone *et al.*, 2020).

2.5.1.6. Pain Pressure Threshold

Pain pressure threshold was measured with an electronic pressure algometer (JTECH Medical Industries, Salt Lake City, US). Algometer is a semi-objective method to assess the pain pressure threshold of different tissues (Frank, McLaughlin and Vaughan, 2013). The idea was first brought by Libman in 1934 (Keele, 1954), in which he evaluated individual sensitivity to pain by pressure on the styloid process (Keele, 1954). It is required to have a controlled rate of application of pressure and the direction of the pressure (Frank, McLaughlin and Vaughan, 2013). Pain pressure threshold is the minimum amount of

pressure required to produce pain or tenderness (Fischer, 1987; Nussbaum and Downes, 1998)

Training

Prior to testing, the examiner had to undergo four hours of training with the hand-held pressure algometer, to be familiarized with the procedure and with the device. Training consisted of a minimum of twenty trials on rigid surfaces to practice applying constant pressure. Furthermore, three participants were recruited for the examiner to conduct practice trials on their cervical region. These participants did not present any symptomatology of the spinal spine and did not participate in the data collection phase of the study (Frank, McLaughlin and Vaughan, 2013).

Procedure

Pain pressure threshold was measured both at the right and left upper trapezius muscles (at the middle distance between the posterior angle of the acromion and C7), the right and left articular pillar between C1 and C2 (1 cm later and above the spinous process of C2), the right and left articular pillar of C5/C6 (1 cm lateral to the middle distance between C5 and C6's spinous processes) (Sá and Silva, 2017). The mentioned points were measured appropriately with a Tape Measure and marked with a pen.

A test trial run was conducted on a distal segment of the participants to demonstrate the procedure and become familiarized. The algometer was applied vertically (90º) on the marked points on the skin surface, to allow the force to be applied perpendicularly. The applied pressure was at a rate of 3N/s up to a maximum of 60N. Each point was measured three times consecutively with 30-40 seconds time intervals. Participants were instructed to say the word "stop" as soon as the pressure sensation changed to pain stimuli. The reading of each run on the hand-held algometer was recorded. The procedure was established according to several studies (Goulet, Clark and Flack, 1993; Chesterton *et al.*, 2007; Lacourt, Houtveen and van Doornen, 2012; Frank, McLaughlin and Vaughan, 2013; Sá and Silva, 2017). Participants were positioned in prone and with their head aligned and relaxed (Sá and Silva, 2017). Pain pressure threshold algometry has demonstrated a very

high intratester reliability with intraclass-correlation (ICC=0.94-0.97) and great interrater reliability (ICC=0.79-0.90) and high test-retest reliability (ICC=0.76-0.79) (Walton, Macdermid, *et al.*, 2011). It has also shown to be clinically valid and effective for CNP (Kinser, Sands and Stone, 2009). A variation of 4.41 N is considered a minimal detectable change for PPT tested for acute neck pain population (Walton, MacDermid, *et al.*, 2011).

2.5.2. Randomization and distribution of participants per group

The participants were randomly assigned to the AO group and the control group through a computerized random list generator (https://www.randomizer.org/). A research team member who was not involved in the assessment or the intervention was held accountable for randomizing and maintaining the list. Treatment allocation was concealed until after the baseline intervention, when an opaque envelope with the information of group allocation was open.

2.5.2.1. Action observation and control

The participants were divided into two groups, each having to attend an individual session with approximately 120 minutes duration. The session started with pre-treatment assessment, in the following order: first, the participants had to fill the self-rated questionnaires, including pain intensity, followed by assessing the pressure pain threshold. Then participants were instructed to sit on a comfortable chair in a silent room with no outside interruptions, in front of a computer screen and a white wall, to observe the video designated for every group (see figure 1 for illustration). After watching the video, the participants were asked to refill two questionnaires (TSK and FABQ) and pain intensity and finalizing with reassessing the pressure pain threshold.

Figure 1: Intervention settings demonstration

2.5.2.2. Action observation group

Participants were asked to observe video clips of a person performing two different exercises of cranio-cervical flexion with full attention and concentration and to not perform any motion or execute any movement during the observation time (O'Leary *et al.*, 2007). Different versions of the video were produced for males and females and for three age groups (18-33, 34-48, 49-65 years old) so that each participant was shown a video of a person from the same sex and age group (Geifman, Cohen and Rubin, 2013). Exercises involved cranio-cervical flexion-extension movements with resistance and cranio-cervical flexion against a wall (Suso-Martí *et al.*, 2019b) as illustrated in Figure 2.

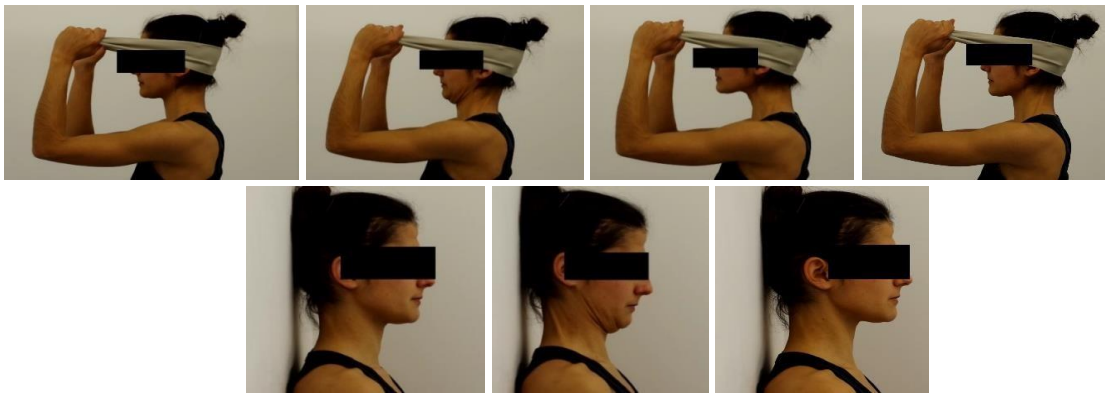

Figure 2: Specific neck exercises. First row: Cranio-cervical flexion-extension exercise against resistance. Second row: Cranio-cervical flexion exercise

The video was composed of 11 minutes total, divided as follows: four minutes of observing clips of the exercises performed by another individual, illustrated in Figure 1 (Suso-Martí *et*

al., 2019b), followed by three minutes of rest (Wright *et al.*, 2018), which consisted of a completely black screen so the participants would not be interrupted in this period, and the last four minutes the exercises were displayed once again. In the video clips that included the demonstration of the exercises, each one of the exercises illustrated in Figure 2 was displayed for two minutes. This protocol was adapted from a previous study (Suso-Martí *et al.*, 2019b).

2.5.2.3. Control group:

Participants in this group observed a video that displayed natural scenes with no human movement stimuli, similar to other previous studies (Buccino *et al.*, 2012; Bang *et al.*, 2013; Suso-Martí *et al.*, 2019c). The protocol of the video for this group was designed similarly to the other group. The first two minutes were of natural landscape with a lake, followed by two minutes of another natural landscape with a lake (see figure 3 for the natural scenes used in the control group's video), then three-minute interval of rest with a completely black screen, and finally the four minutes of the natural landscape with lakes repeated. The nature video clips were not static, but rather moving from right to left with the presence of a light breeze onto the trees and moving water. All the set up and instructions were similar to the AO group.

Figure 3: Natural scenes

2.6. Statistical Analysis

All data analyses were performed using Statistical Package for Social Science (SPSS) 25.0 for Windows (SPSS Inc, Chicago, IL). Mean and standard deviation (SD) and count and proportion were used to describe continuous and categorical variables, respectively. Data were assessed for outliers, normality using Kolmogorov-Smirnov test, and homogeneity of variance. Between-group differences for baseline characteristics were explored using a Student's t-test (continuous variables) or a non-parametric equivalent, Mann-Whitney test, and using Chi-square for nominal variables. A general linear model of repeated measures (ANOVA of two factors) was used to identify between-group differences, using time (T1: pre-treatment and T2: post-treatment), and intervention (AO vs. control) as the factors, and were used to assess the effect of action-observation. Partial eta squared was used as an indicator of effect size and interpreted as small (0.01), medium (0.06), and large (0.14) effect size (Richardson, 2011). Significance for all statistics was set at $p<0.05$.

3. Results

This chapter presents the results of this study.

3.1. Baseline Assessment

3.1.1. Sample characteristics

A total of 42 individuals were screened for eligibility. Of these, 3 did not meet the inclusion criteria, 8 refused to participate and 30 entered the study (15 in the control group and 15 in the experimental group) as described below.

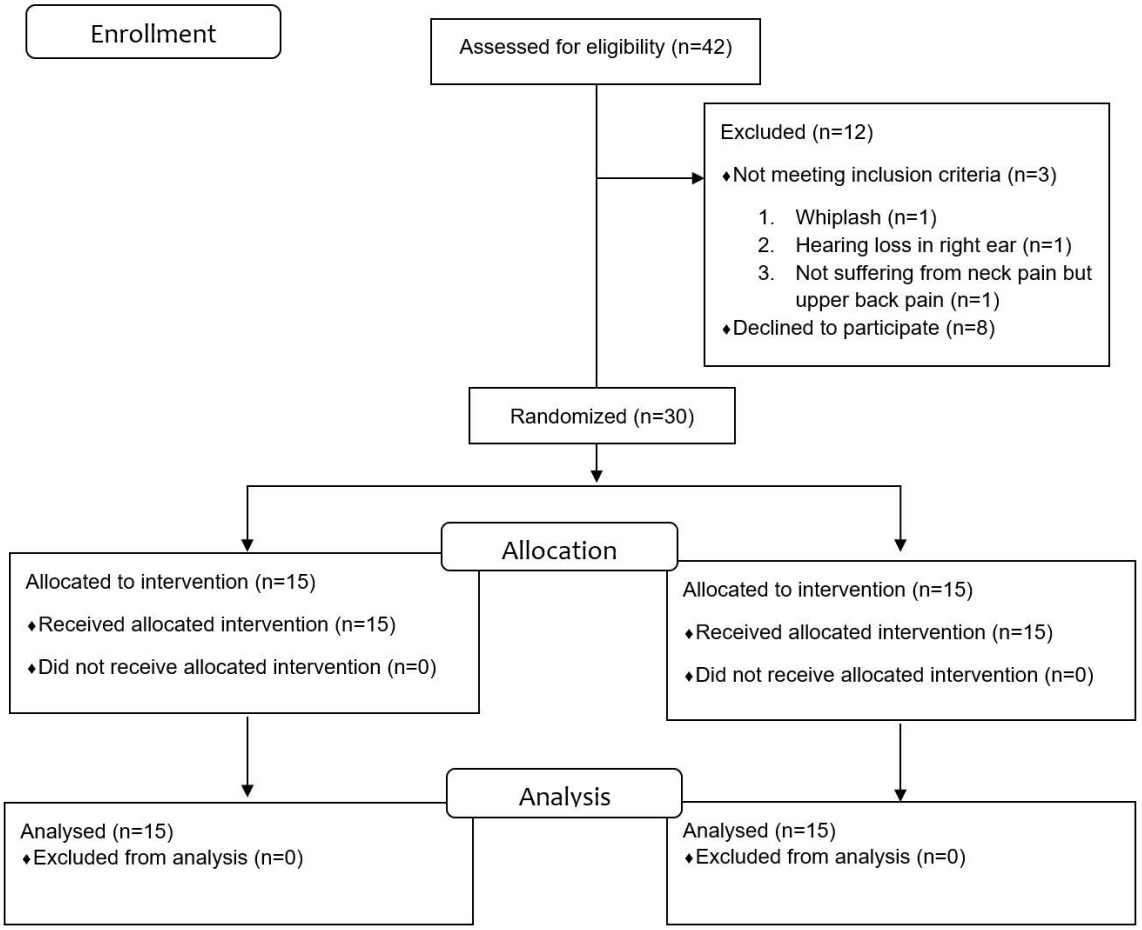

Figure 4: Study's CONSORT flow diagram.

Table 1 presents the sociodemographic characteristics of participants in both groups. The control group was composed of 5 males (33.3%) and 10 (66.7%) females, while the AO group had 6 males (40%) and 9 (60%) females. The mean age (±SD) in the control group was 43.6 (±8.1) years old, and in the AO group was 40.33 (±9.7) years old. There were no between-group differences (p>0.05) for sociodemographic data (Table 1).

Table 1: Sociodemographic characterization of the sample.

Variables		**Control Group (n=15)**	**AO Group (n=15)**	**p- value**
Gender	Female n (%)	10 (66.7%)	9 (60%)	0.705
	Male (%)	5 (33.3%)	6 (40%)	
Age (years)	Mean ±SD	43.6 (±8.1)	40.33 (±9.7)	0.325
Weight (Kg)	Mean ±SD	68.1 (±12.7)	70.3 (±14.6)	0.658
Height (cm)	Mean ±SD	165.5 (±9.2)	169.5 (±8.2)	0.211
BMI	Mean ±SD	24.8 (±3.7)	24.4 (±4.2)	0.775
Education Level, n (%)	Secondary Education n (%)	2 (13.4%)	1 (6.7%)	0.485
	Undergraduate Education n (%)	8 (53.3%)	8 (53.3%)	
	Master's degree n (%)	5 (33.3%)	4 (26.7%)	
	Doctor Degree n (%)	0 (0%)	2 (13.3%)	

3.1.2. Neck pain characteristic

Table 2 presents neck pain characteristics for each group at baseline. No statistically significant between-group differences were found (p>0.05).

Table 2: Neck pain characteristics.

Variables		Control Group (n=15)	AO Group (n=15)	p- value
VAS	Mean ±SD	5.4 (±1.7)	4.7 (±1.8)	0.216
Pain Frequency	Rarely (1xweek), n (%)	0 (0%)	0 (0%)	0.454
	Occasionally (2/3xWeek), n (%)	1 (6.7%)	1 (6.7%)	
	Many times (>3xWeek), n (%)	6 (39.9%)	6 (39.9%)	
	Always (%), n	7 (46.7%)	4 (26.7%)	
	Other, n (%)	1 (6.7%)	4 (26.7%)	
Pain Duration	Between 3 to 6 Months	2 (13.3%)	1 (6.7%)	0.845
	Between 6 months to 1 year, n (%)	2 (13.3%)	1 (6.7 %)	
	Between 1 year to 2 years, n (%)	1 (6.7%)	1 (6.7%)	
	Between 2 years and 5 years, n (%)	3 (20%)	2 (13.3%)	
	More than 5 years, n (%)	7 (46.7%)	10 (66.6%)	

Abbreviations: VAS – Visual Analogue Scale; SD – Standard Deviation; AO – Action Observation

3.1.3. Neck disability, catastrophizing, fear-avoidance beliefs, and fear of movement

Table 3 presents baseline mean ± SD values for disability, catastrophizing, fear of movement, and fear-avoidance beliefs for both the control and the AO groups. No between- group statistically significant differences were found at baseline ($p>0.05$).

Table 3: Mean ±SD for disability, catastrophizing, fear of movement, and fear-avoidance beliefs for both the control and the experimental groups at baseline (mean±SD).

Variables	Control Group (n=15)	AO Group (n=15)	p-value
NDI (0 – 50)	11.67 (±4.58)	10.53 (±4.88)	0.517
PCS (0 – 52)	20.67 (±13.54)	15.27 (±12.92)	0.273
TSK (13-52)	29.67 (±6.08)	29.33 (± 6.97)	0.890*
FABQ-PA (0 – 24)	10.93 (±6.11)	7.13 (±4.85)	0.07
FABQ-W (0 – 42)	14.47 (±6.45)	18.73 (±6.58)	0.084

*Non-parametric distribution.

Abbreviations: NDI – Neck Disability Index; PCS – Pain Catastrophizing Scale; TSK - Tampa Scale of Kinesiophobia; FABQ-PA – Fear Avoidance Belief Questionnaire – Physical Activity Subscale; FABQ-W – Fear Avoidance Belief Questionnaire – Work Subscale; AO – Action Observation

3.1.4. Pressure pain threshold

Table 4 presents baseline mean ± SD values for pressure pain threshold for both groups. There was a between group statistically significant difference for pressure pain threshold at two levels, in which mean values for PPT at levels of right C5-C6 and left trapezius muscle were significantly higher in the AO group compared to the control group ($p<0.05$).

Table 4: Baseline values for pressure pain threshold (mean±SD).

Variables	Control Group (n=15)	AO Group (n=15)	p-value
PPT – R – C1,C2 (N)	10.52 (±5.44)	13.38 (±6.43)	0.198
PPT – L – C1,C2 (N)	10.04 (±5.03)	12.14 (±4.93)	0.257
PPT – R – C5,C6 (N)	9.95 (±5.17)	13.88 (±7.46)	0.104*
PPT – L – C5,C6 (N)	8.84 (±4.00)	13.48 (±6.85)	0.032*
PPT – R – TRAP (N)	10.70 (±4.65)	13.33 (±5.99)	0.190*
PPT – L – TRAP (N)	8.29 (±3.27)	11.55 (±4.63)	0.034

*Non-Parametric test used for comparison; Abbreviations: SD – standar deviation; PPT –pressure pain threshold; R – right side; L – left side; TRAP – trapezius muscle; N – Newtons; AO – Action Observation

3.2. Post-intervention assessment

3.2.1. Neck pain intensity

There was a significant effect of time for pain intensity (F (1,28) =14.39; p=0.001; η2p=0.34), but no interaction between time of assessment and group (F (1,28) =0.28; p=0.604; η2p=0.01) (Table 5). Pain intensity mean decrease from baseline to post-intervention was 1.89 (95% CI: -3.20, -0.60) in the control group and 1.43 (95% CI: -2.79, -0.08) in the AO group.

3.2.2. Fear of movement and fear-avoidance beliefs

There was a significant main effect of time for fear of movement (F (1,28) =5.75; p<0.023; η2p=0.17), but no interaction between time of assessment and group (F (1, 28) =0.09; p= 0.767; η2p=0.003). Fear of movement mean decrease from baseline to post-intervention was 1.80 (95% CI: -3.79, 0.19) in the control group and 1.40 (95% CI: -3.46, 0.66) in the AO group.

As for the FABQ-PA subscale, there was neither a significant interaction between time and group (F (1,28) =2.12; p=0.156; η2p=0.071) nor a significant main effect of time (F (1,28) =0.63; p=0.435; η2p=0.022). There was a significant effect of time for the FABQ-W subscale (F (1,28) =6.80; p=0.014; η2p=0.195), but no interaction between time of assessment and group (F (1,28) =2.95; p=0.097; η2p=0.095) for that subscale. Mean decrease from baseline to post-intervention was 0.47 (95% CI: -2.33, 1.39) in the control group and 2.27 (95% CI: -3.53, -1.00) in the AO group.

Table 5: Pain intensity, fear of movement, and fear avoidance beliefs (mean±SD) at pre- and post-intervention and within-group mean difference and respective 95% confidence interval.

	Control Group (n=15)			AO group (n=15)		
Outcome Measures	Pre-Treatment	Post-Treatment	Mean Difference & 95% CI*	Pre-Treatment	Post-Treatment	Mean Difference & 95% CI*
VAS (cm)	5.4 (±1.7)	3.56 (±2.67)	-1.89 [-3.20, -0.60]	4.7 (±1.8)	3.22 (±2.18)	-1.43 [-2.79, -0.08]
TSK (13-52)	29.67 (±6.08)	27.87 (±7.76)	-1.8 [-3.79, 0.19]	29.33 (± 6.97)	27.93 (±5.51)	-1.4 [-3.46, 0.66]
FABQ-PA (0 – 24)	10.93 (±6.11)	11.47 (±4.84)	0.53 [-1.20, 2.27]	7.13 (±4.85)	8.93 (±6.81)	1.8 [-1.16, 4.76]
FABQ-W (0 – 42)	14.47 (±6.45)	14 (±6.51)	-0.47 [-2.33, 1.39]	18.73 (±6.58)	16.47 (±7.64)	-2.27 [-3.53, -1.00]

*Confidence Interval at 95%; Abbreviations TSK - Tampa Scale of Kinesiophobia; FABQ-PA – Fear Avoidance Belief Questionnaire – Physical Activity Subscale; FABQ-W – Fear Avoidance Belief Questionnaire – Work Subscale; AO – Action Observation

3.2.3. Pressure pain threshold

No significant interaction between time and group ($F(1,28) \geq 0.13$; $p \geq 0.069$; $\eta 2p \leq 0.113$) nor a significant main effect of time $F(1,28) \geq 0.547$; $p \geq 0.112$; $\eta 2p \leq 0.088$) was found for pressure pain thresholds at any of the 6 sites. Mean and standard deviation for each group at baseline and post-intervention as well as within group mean differences and respective 95% confidence intervals are shown in Table 6.

Table 6: Pressure pain threshold for both groups at pre– and post-intervention (mean±SD) and within group mean differences and respective 95% confidence interval.

Variables Outcome	Control Group (n=15)			AO group (n=15)		
	Pre-treatment	Post-Treatment	Mean Difference & 95% CI	Pre-treatment	Post-Treatment	Mean Difference & 95% CI
PPT – R – C1,C2 (N)	10.52 (±5.44)	10.22 (±5.60)	-0.29 [-1.16, 0.57]	13.38 (±6.43)	11.86 (±6.73)	-1.52 [-3.71, 0.68]
PPT – L – C1,C2 (N)	10.04 (±5.03)	10.08 (±5.39)	+0.05 [-0.56, 0.66]	12.14 (±4.93)	11.87 (±6.91)	-0.27 [-2.06, 1.52]
PPT – R – C5,C6 (N)	9.95 (±5.17)	10.69 (±5.02)	+0.74 [-0.39, 1.88]	13.88 (±7.46)	14.01 (±8.00)	+0.13 [-1.12, 1.38]
PPT – L – C5,C6 (N)	8.84 (±4.00)	9.67 (±3.53)	+0.82 [-0.35, 2.00]	13.48 (±6.85)	13.26 (±7.41)	-0.22 [-1.41, 0.97]
PPT – R – TRAP (N)	10.70 (±4.65)	10.85 (±4.03)	+0.15 [-1.11, 1.42]	13.33 (±5.99)	12.80 (±7.35)	-0.52 [-3.14, 2.10]
PPT – L – TRAP (N)	8.29 (±3.27)	9.27 (±3.73)	+0.98 [-0.20, 2.15]	11.55 (±4.63)	11.12 (±5.17)	-0.43 [-1.50, 0.65]

Abbreviations: PPT –Pressure Pain Threshold; N – Newtons; AO – Action Observation

3.3. Relevant clinical change

Table 7 represents the number of participants and their corresponding percentages that demonstrated significant clinical important changes for pain intensity, fear of movement, and fear-avoidance beliefs, at post-intervention.

8 (53.3%) participants had a minimally clinical important decrease in pain intensity in the control group, while 6 (40%) of AO group participants showed an important reduction in pain intensity and one case increase pain intensity. As for fear of movement, clinical important changes are considered through a shift of severity. The control group had 3 participants that improved and shifted to a lower severity and one case who showed increase in the severity, while the AO group had 1 participant that improved and 1 that got worse. Concerning the FABQ-PA subscale, 2 participants showed a clinical decrease and one case of increase in the scores, while the AO group showed 3 cases of decrease in that subscale´s values, but 6 participants showed a clinically important increase. Concerning the FABQ-W subscale, no clinical minimal changes were observed in any of the groups.

Table 7: Number and percentage of participants that showed potentially clinical changes for pain intensity, fear of movement, and fear-avoidance beliefs

Outcome measures	MCIC	Stages of Severity Changes	Control Group	AO Group
VAS (cm)	2		↓8 (53.3%)	↓6 (40%) ↑ 1 (6.7%)
TSK (13-52)		Subclinical: 13-22 Mild: 23-32 Moderate: 33-42 Severe: 43-52	↓2 Mild to Subclinical ↓ 1 Moderate to Mild ↑ 1 Mild to Moderate	↓1 severe to Moderate ↑1 Mild to Moderate
FABQ-PA (0 – 24)	4		↓2 (13.3%) ↑1 (6.7%)	↓3 (20%) ↑6 (40%)
FABQ-W (0 – 42)	7		0%	0%

Abbreviations: VAS – Visual Analogue Scale; TSK – Tampa Scale for Kinesiophobia; FABQ-PA – Fear of Avoidance Questionnaire Physical Activity; FABQ-W: Fear of Movement Questionnaire – Work; MCIC – Minimal Clinically Important Changes

Table 8 represents the number of participants and their corresponding percentages that demonstrated a difference more than the minimal detectable change for neck pressure pain threshold, at post-intervention.

The minimal detectable change (MDC) considered for pressure pain threshold (PPT) is 4.41 N (Walton, Macdermid, *et al.*, 2011). Both groups showed variations, whether increases or decreases, at different tested sites as shown in table 8. However, overall, 3 participants of the control group showed an increase in PPT variation at post-intervention and 1 participant showed a decrease, while 4 participants of the AO group showed an increase in PPT score and 5 participants showed a decrease in PPT score.

Table 8: Number and percentage of participants that showed potentially clinical changes for tactile acuity and muscle strength

Outcome measures	MDC	Control Group	AO Group
PPT – R – C1,C2 (N)	4.41	0%	↓2 (13.3%)
PPT – L – C1,C2 (N)		0%	↑2 (13.3%)
PPT – R – C5,C6 (N)		0%	↑1 (6.7%)
PPT – L – C5,C6 (N)		↑1 (6.7%)	0%
PPT – R – TRAP (N)		↓1 (6.7%)	↓3 (20%) ↑1 (6.7%)
PPT – L – TRAP (N)		↑2 (13.3%)	0%

Abbreviations: TPD – Two-Point Discrimination; N – Newtons; SEM – Standard Error of Measurement; MDC – Minimal Detectable Change

4. Discussion

The aim of this study was to investigate the impact of action observation therapy on pain in patients with nonspecific chronic neck pain. Results suggest that both approaches had relatively equal impact on pain intensity, fear of movement, and fear-avoidance beliefs related to work. No apparent impact over the physical activity fear-avoidance beliefs nor over PPT were found.

Regarding pain intensity tested through the VAS, both groups showed a decrease in the mean value from baseline to post-intervention. The control group decreased by a mean of 1.89 values or 35% while the AO group decreased by a mean of 1.43 values or 30%. According to Dworkin et al (2008) both percentages, 35% and 30% respectively for the control group and AO group, fall under the interval of «minimally important change» situated between 30% and 41% (Dworkin *et al.*, 2008). There is a different way to interpret the outcome mean variations when looking at the individual differences between baseline and post-intervention in both groups: a decrease of 2 points in VAS is considered a meaningful clinical change (Dworkin *et al.*, 2008). The results showed that 8 (53.3%) participants in the control group and 6 (40%) in the AO group had a decrease of a minimum of 2 points from baseline to post-intervention, while 1 participant in the AO group had an increase in pain intensity of 2 points or more. AO might provoke cortical activations similar to the actual movement execution due to the overlapping of cortical areas between real execution and AO technique (Hardwick *et al.*, 2018). It is possible that this overlapping and the well-documented phenomenon of exercise-induced hypoalgesia acted as a potential explanation as why AO group manifested a decrease in pain intensity from baseline to post-intervention (Martin-Gomez *et al.*, 2019). There is probably a top-down central mechanism responsible for this hypoalgesia (Hardwick *et al.*, 2018; Beinert, Sofsky and Trojan, 2019). From another perspective, AO could induce an increase in cortical excitability, which was associated with a decrease in pain perception (Larsen, Graven-Nielsen and Boudreau, 2019). AO might also impact the maladaptive neuroplastic changes found in individuals with chronic pain (Suso-Martí *et al.*, 2020b). In addition, action observation technique could

contribute to the gradual extinction of the patterns of associative learning between pain and movement due to the activation of the neural mechanisms of movement, but without leading to the appearance of pain (Simons, Elman and Borsook, 2014).

Distraction seems to be a factor that might have had an impact on pain intensity in both groups, each following different potential mechanisms detailed below. Starting by the AO group, several studies have reported that at the neurophysiological level, distraction caused by mental practices might be associated with the generation of hypoalgesic effects (Peerdeman *et al.*, 2017; Hayashi *et al.*, 2019). It has been theorized also that pain perception can be reduced due to the limited recruitment capacity to process information (Johnson *et al.*, 1998). Distraction had also been demonstrated to trigger the endogenous pain modulation system resulting in lowering pain intensity (Valet *et al.*, 2004). As for the control group, no visuals of the painful area were included and this might have created a distraction from the participants´ pain, especially after a series of questionnaires and clinical testing before the intervention all assessing their pain and calling attention to the cervical area. This was the subject of a study, Rischer *et al.*, (2020), where participants were asked to complete a working memory task. It was concluded that there was a significant pain intensity reduction when completing the task compared to control group, most probably due to the distraction from pain factor. From another perspective, a previous systematic review analyzed the criteria related to the theory of evolution, and developed the «stress reduction theory», a healing power of nature that lies in an unconscious, autonomic response to natural elements that can occur without recognition and most noticeably in individuals who have been stressed before the experience. Certain natural places (especially those along watersides and with visible horizons, just like the ones shown to the control group of this study) may be seen as safe havens, areas in which our species tended to have greater rates of survival (Bratman, Hamilton and Daily, 2012). Potentially, the natural landscapes shown in the control group might have contributed to relaxation and decreased pain intensity.

Concerning the fear of movement, the TSK variable in both groups also showed a decrease in the mean value. The control group showed a decrease of 1.8 values or 8.7% while the AO group noted a decrease in 1.4 value or 9.1% from baseline to post-intervention. The

decrease percentages seem to be close to each other. One way to interpret whether the results of the TSK changes are clinically meaningful is by recognizing a shift in the severity levels (Neblett *et al.*, 2016b). The mean differences in both groups did not shift in severity (29.67 to 27.87 in the control group and 29.33 to 27.93 in the AO group) and both falling under the «mild kinesiophobia» subdivision. However, looking at the individual level, 2 participants in the control group shifted from mild to subclinical and 1 participant from moderate to mild but 1 participant shifted up a category switching from mild to moderate kinesiophobia. As for the AO group, 1 participant improved and shifted from severe to moderate and another participant worsened on the TSK shifting from mild to moderate. It is important to remember that there are interconnections between the endogenous inhibitory system and the brain centers for fear such as the amygdala (Schenk, Krimmel and Colloca, 2017). This interconnectedness suggests that trying to address one factor will have an impact on the other. Previously, we explained few of the potential mechanisms of action in both groups to theorize the positive impact on pain intensity. Similarly, this might explain the positive impact in both groups on the fear of movement factor. Furthermore, a potential explanation exclusive for the AO group goes back to the presence of mirror neuron systems that modulates the processing of nociceptive information through observing other's facial expressions. Observing others executing a strenuous task successfully may alter the higher order cognitive appraisals about pain such as patient expectancies about movement, reducing by this the fear of actually executing that same movement (Wiech, 2016; Schenk, Krimmel and Colloca, 2017). As for the control group, a study investigated the effect of viewing slides of natural scenes on fear from the final exam in a population of students (Ulrich, 1979). Participants reported higher levels of positive affect and lower levels of fear after seeing slides of natural scenes than those who viewed urban ones (Ulrich, 1979). As per our current knowledge, there are only one study investigating kinesiophobia in CNP population and it reached a different conclusion: La Touche *et al.*, (2018) stated that AO had activated autonomic changes thought to be associated with fear while observing neck movements in patients with CNP. Another study but this time related to knee osteoarthritis, Öztürk *et al.*, (2021), stated that AO did not have any significant effect on kinesiophobia when added to physical therapy in people with

osteoarthritis knee pain. Since results seem contradictory, more studies with larger sample sizes are needed to better understand the effect of AO technique on kinesiophobia.

In terms of fear-avoidance beliefs, there was no significant variation concerning the FABQ-PA subscale ($p>0.05$). However, both groups attained a lower score in the FABQ-W subscale, with a mean decrease from baseline to post-intervention of 0.47 and 2.27 points for the control and AO groups, respectively. The minimally clinical important difference for this subscale is 7 points while the standard error of measure is 2.15 according to (Monticone *et al.*, 2020). A decrease of 2.27 in the AO group might be considered above the measurement error, but it is not a large change to determine it as a clinically relevant important change. Moreover, there was none of the participants in both groups that had a score variation of 7 or more points between baseline and post-intervention. A potential explanation for FABQ-W improvement from baseline to post-intervention in the AO group might be due to the nature of the task shown and the ease with which the individuals performed the task in the videos (Raghava Neelapala and Shankaranarayana, 2020b). These individuals had a neutral facial expression, not depicting any difficulty nor pain whilst moving, and the mirror neuron system picks up emotional cues and replicates them, possibly making fear-avoidance beliefs less impactful (Avenanti *et al.*, 2006). As for the control group, the calming effect of observing nature, well described by (Bratman, Hamilton and Daily, 2012), sending evolutionary reassuring messages to the insula and amygdala, and acting on the fear factor, may be a potential explanation for improvement in the FABQ-W scale.

As for pressure pain threshold (PPT), there were no statistically significant changes from baseline to post-intervention in both groups. Although some studies reported an increase in PPT from baseline to post-intervention using AO technique, the different methodologies used between studies may help to explain the different results found. For example, de-la-Puente-Ranea *et al.*, (2016) found an increase in AO group PPT values directly after the intervention in a non-specific CNP population at C2 level, but it went back to baseline values 10 min after the intervention. However, the intervention was very different from the current study in two major points, this might potentially explain the difference in results: both groups in de-la-Puente-Ranea *et al.*, (2016) observed neck rotation exercices, one

group observed a full range of rotation and the other observed half way to the full range of motion, whereas this current study had a total different approach for the control group. The second major difference was the time of the intervention where the afore mentioned study showed the neck rotation videos for only one minute compared to this present one that involved an 11 min intervention. The time of the intervention seems to be a common factor, as in Suso-Martí *et al.*, (2019), the protocol was very similar to this present study, but it was investigating 3 groups: other than the AO group and the control group there was a third one where the intervention was based on motor imagery technique; the intervention was 4 min long. Their results suggested better PPT scores after the AO intervention, both locally (at C2 level and upper trapezius muscle) and distally at the non-dominant epicondyle. The only difference between the two protocols was the time of the intervention: Martí et al effected their intervention during an uninterrupted 4 min video, while this current study had participants sitting for 11 min in front of the laptop, observing two 4 min videos of specific neck exercises with a 3 min interval in between them of black screen. This difference in the intervention time could be a potential reason behind these distinct results. Some participants reported that the intervention time was too long, especially during the 3 min of black screen where they felt the urge to move but could not, creating by this some degree of frustration.

From another point of view, Beinert *et al.*, (2015) found similar results to this current study: mental representation techniques (AO and motor imagery) had no significant effect on PPT. The author theorized that it might be due to the short intervention done during a single session. He speculated that the effective intervention duration was too short in order to translate improved sensorimotor function into reduced pain perception (K. Beinert *et al.*, 2015). This might potentially give a reason why this current study reached the same results. Additionally, there was no further follow-up to investigate any eventual changes in PPT. Similar results were discussed In another study (Beinert, Sofsky and Trojan, 2019), a potential mechanism was discussed that could be the reason why PPT changes were statistically irrelevant. The authors reported that it is possible that if the observed movement is able to trigger pain or fear responses in patients during real execution, the pain modulation response might be lower. On that matter, some participants assigned to

the AO group reported some discomfort after the intervention, either because they were bothered by the movements executed by the person showing on the video or by the fact that they were restricted from moving and they felt the urge to imitate the exercises. This result has also been demonstrated in this single case control using functional magnetic resonance, that show the activation of cortical areas related to pain processing after the mental practice of painful movements (Beinert *et al.*, 2017).

It appears that results are a bit contradictory, as there was a significant positive impact on pain intensity in both groups while none of the groups showed a statistically significant improvement in pressure pain threshold. We might try to justify this by remembering that VAS is a self-reported measurement, subject to more subjectivity and suggestibility than the PPT, and probably is more influenced by the participant´s expectancy levels. Expectations related to the treatment might have an analgesic effect (Buhle *et al.*, 2012). A study of 2 fMRIs concluded that expectations and placebo analgesia were related to decreased brain activity in pain-sensitive regions (Wager *et al.*, 2004). It was suggested as well that superior clinical outcomes and pain reduction were observed in individuals who expect high positive outcomes and less pain as a result of an intervention (Cormier *et al.*, 2016). The announcement to participate in this current study informed that we were investigating a new technique for the treatment of chronic pain, which might have influenced participants´ expectations.

4.1. Clinical implications and future investigations

This study suggests that videos of nature as well as AO videos of specific neck exercises lowered pain intensity in people with idiopathic CNP. Similarly, the individuals experienced lower kinesiophobia levels and an improvement in fear-avoidance beliefs related to work when observing natural videos or observing neck exercises. Thus, it seems that these low-cost interventions strategies can be useful in the treatment of people with CNP, with the possibility of being performed at home without supervision. Clinically, limited are the ways with which therapists can manage the fear factor associated to CNP. This study offers a potential tool to help deal with that fear, specially related to movement or fear-avoidance behaviors related to work. In addition to larger sample sizes, future studies should consider

having a 3rd group with no intervention. This study suggests that both AO and observation of natural landscapes similarly influenced pain intensity and fear related mechanisms, thus, creating a third group where no intervention is done would be an interesting suggestion to better analyze the potential effect of AO technique. More research is needed with larger samples and post-intervention follow-up, or also a treatment plan with more AO interventions to better investigate the role of this technique in the treatment of CNP.

4.2. Limitations of the study

The present study had several limitations. The sample size was relatively small with consequent limitations on the generalizability of the results and increases in the probability of a type II error. Variables were only assessed at baseline and post-treatment, and this does not provide any details as to whether the results were maintained for a longer period. A long-term follow up would have given an insight of further benefits. The lack of a previously established and validated protocol of AO therapy in the treatment of CNP places a critical question to whether the protocol followed in this study was too short or too limited to what could have been achieved. There is no validated tool that can assess the participants' attention level throughout the observational period, this could have indirectly influenced the results of this study. Because of logistic reasons and being far from the university labs, the study was conducted in two different clinics, taking into consideration that the same equipment was used by the same practitioner and the location´s criteria were respected.

5. Conclusion

This study investigated the immediate effect of AO of specific neck exercises versus the observation of natural scenery. The results suggest that both techniques had a similar and positive impact on idiopathic CNP intensity, kinesiophobia and fear-avoidance beliefs related to work, but no effect on pressure pain threshold. Further studies with larger sample sizes are needed.

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Appendix I – Ethics committee approval

universidade de aveiro

PARECER 21-CED/2020

CONSELHO DE ÉTICA E DEONTOLOGIA

Comissão Permanente para os Assuntos de Investigação (CPAI)

Parecer nº: 21-CED/2020
Requerente: Anabela G. Silva
Título do Projeto: "Terapia da ação-observação: impacto na força dos músculos cervicais, na intensidade da dor, na acuidade táctil e no limiar de dor à pressão em indivíduos com dor cervical crónica não específica"
Orientador e Investigador responsável: Anabela G. Silva (Prof. Adjunta, Escola Superior de Saúde da UA)
Equipa de Investigação:
- Anabela G. Silva (Prof. Adjunta, Escola Superior de Saúde da UA).
- Maura Bezerra (Fisioterapeuta e estudante do Mestrado em Fisioterapia – ramo músculo-esquelético).
- Tala Al Shrbaji (Fisioterapeuta e estudante do Mestrado em Fisioterapia – ramo músculo-esquelético).

Enquadramento Institucional: Centro de Investigação em Tecnologias e Serviços de Saúde (CINTESIS)
Relator: Domingos Moreira Cardoso
Relatores Adjuntos: Ana Isabel Andrade, António Rocha Andrade, Armando Pinho, Isabel Malaquias e Paula Cristina Moreira Silva Pereira.

I.Relatório

O principal objetivo deste projeto é avaliar a efetividade de uma sessão de terapia de observação da ação na intensidade da dor, limiar de dor à pressão mecânica, acuidade táctil, e força muscular da cervical em participantes com dor cervical crónica não específica. Os objetivos secundários são avaliar a efetividade desta intervenção na cinesiofobia (medo do movimento) e crenças de medo – evitamento.

O pedido de parecer contém a informação necessária, nomeadamente a seguinte.

• Os objetivos, metodologias experimentais e planificação que incluem:
1. Participantes e recrutamento;
2. Testes de força muscular;
3. Teste de acuidade táctil;
4. Limiar de dor à pressão mecânica;
5. Grupo experimental;
6. Grupo controlo;
7. Análise estatística;
8. Medidas Covid.

• As questões éticas sobre as quais pretende que o CED se pronuncie, nomeadamente, na fase de recrutamento, sobre a folha de informação fornecida a todos os interessados, sendo a decisão de participação da responsabilidade destes, bem como a possibilidade de desistirem em qualquer momento sem necessidade de justificação, o consentimento informado, os procedimentos de recolha de informação que serão implementados de modo a evitar constrangimentos pessoais, a não existência de quaisquer pagamentos e a informação de que os riscos não são superiores aos do dia-a-dia dos participantes. Todos os dados recolhidos serão confidenciais e anónimos e, após conclusão do estudo, os resultados serão incluídos na dissertação de Mestrado e eventualmente numa publicação científica. Adicionalmente, ter-se-ão em conta todas as normas éticas e legais e toda a informação recolhida será codificada, armazenada por um período de 3 anos, após o qual será destruída.

• A indicação da legislação que está na origem do pedido.

• A descrição sucinta de estudos semelhantes já publicados em revistas de circulação internacional.

• Os contributos do projeto para os objetivos estratégicos da entidade de acolhimento.

• A experiência da investigadora responsável na área do projeto, tendo referido 5 publicações em revistas de circulação internacional.

• O apêndice e anexos incluem o formulário de pré-participação com os critérios de exclusão, a declaração do Encarregado de Proteção de Dados, a folha de informação aos participantes, a declaração de consentimento informado, a declaração de apoio a este projeto do Diretor do CINTESIS e a tabela de questões éticas associadas ao projeto.

II.Parecer

a. Fundamentação

1. O pedido de parecer relativo ao projeto em causa apresenta-se bem elaborado e fundamentado, assinalando as questões éticas associadas ao seu desenvolvimento.
2. O projeto teve início em outubro de 2020 e tem data de conclusão prevista para julho de 2021.
3. Os participantes darão o seu consentimento informado, livre e esclarecido por escrito.
4. Os riscos associados à participação neste estudo não são superiores aos associados ao dia-a-dia dos intervenientes.

5. A confidencialidade será garantida e os participantes, se assim o entenderem, podem desistir do estudo em qualquer momento sem necessidade de justificação.

De acordo com o exposto, conclui-se que o projeto em análise respeita os princípios de ética neste tipo de estudos, na medida em que assegurará:

1. O consentimento informado dos participantes, que será anterior à recolha de dados;
2. A intervenção voluntária dos participantes e a possibilidade de desistência do estudo em qualquer altura, sem necessidade de justificação;
3. Que os riscos associados à participação no estudo não são superiores aos riscos associados ao dia-a-dia do participante;
4. Que os dados recolhidos no projeto são analisados apenas pela equipa de investigação, garantindo-se a confidencialidade, através da codificação dos dados obtidos, da responsabilidade da investigadora responsável e sua destruição após um período de 3 anos.

b. Recomendações

1. Deverá sempre ser respeitado o Regulamento Geral de Proteção de Dados (RGPD), assim como a legislação Europeia relacionada com a investigação em seres humanos.

c. Conclusão

De acordo com o anteriormente referido e com os princípios seguidos por este Conselho, é emitido o seguinte parecer:

1. A Comissão Permanente do Conselho de Ética, constituída pelos Relatores acima indicados, após apreciação da documentação recebida e atendendo a que os procedimentos descritos no projeto de investigação:

1.1 Asseguram a não utilização de métodos invasivos;

1.2 Garantem que os participantes são previamente informados e esclarecidos sobre os pressupostos em que assenta o estudo;

1.3 Incluem o consentimento informado dos participantes;

1.4 Garantem a privacidade dos dados recolhidos.

2. Considera que merece parecer favorável a realização do projeto "Terapia da ação-observação: impacto na força dos músculos cervicais, na intensidade da dor, na acuidade táctil e no limiar de dor à pressão em indivíduos com dor cervical crónica não específica".

O Presidente da CPAI

Assinatura

Assinado por : **Armando José Formoso de Pinho**
Num. de Identificação: BI06902165
Data: 2021.01.23 12:09:43 +0000

CHAVE MÓVEL

I.Plenário CED

Submetido ao CED o respetivo parecer da sua Comissão Permanente, este Conselho, em sua reunião plenária de 20 de janeiro de 2021, por entender que ficam salvaguardadas as exigências éticas e os princípios da justiça e da autonomia e bem-estar dos participantes, concorda por unanimidade com o mesmo, em razão do que o ratifica e dá **parecer favorável** à realização do projeto intitulado: "Terapia da ação-observação: impacto na força dos músculos cervicais, na intensidade da dor, na acuidade táctil e no limiar de dor à pressão em indivíduos com dor cervical crónica não específica".

O Presidente do CED

Assinado por : **António Costa Dias de Figueiredo**
Num. de Identificação: BI01589648
Data: 2021.01.25 17:32:47 +0000

Assinatura

CHAVE MÓVEL

Appendix II – Informative document

Universidade de Aveiro Escola Superior de Saúde
Ano 2021/2022

DOCUMENTO INFORMATIVO AO PARTICIPANTE

TERAPIA DA AÇÃO OBSERVAÇÃO: IMPACTO NA FORÇA DOS MUSCULOS CERVICAIS, NA INTENSIDADE DA DOR, NA ACUIDADE TÁCTIL E NO LIMIAR DE PRESSAO DA DOR EM PACIENTES COM DOR CERVICAL CRÓNICA NÃO ESPECÍFICA.

1. Apresentação do estudo

Eu sou o fisioterapeuta Mário Bou-Assaf, e estou a frequentar o 2º ano do Mestrado em Fisioterapia, da Escola Superior de Saúde da Universidade de Aveiro (ESSUA) e gostaria de o/a convidar para participar neste estudo que pretende avaliar o impacto da terapia de Ação Observação de exercícios específicos do pescoço nas(os): intensidade da dor; acuidade tátil; força dos músculos cervicais em pacientes com dor cronica cervical não específica. Este estudo será realizado por mim e sob a orientação da Professora Doutora Anabela Silva. Peço-lhe que leia atentamente as informações que se seguem e caso necessite de algum esclarecimento adicional, não hesite em contactar-me. O meu contacto e o da orientadora encontram-se no final deste documento.

2. Sou obrigado(a) a participar no estudo?

A decisão de participar ou não no estudo é sua. Se decidir participar, vamos pedir-lhe que assine a folha do consentimento informado. O consentimento informado garante que sabe o que irá ser feito no estudo e que deseja participar de livre vontade. Se decidir participar e depois quiser desistir, **poderá fazê-lo em qualquer altura e sem dar nenhuma explicação.**

3. Será que sou a pessoa indicada para participar neste estudo?

Para participar neste estudo procuramos pessoas com dor na região do pescoço, sentida nos últimos 3 meses. Se estiver alguma das seguintes patologias: fratura ou luxação cervical, patologia de origem maligna ou visceral que provoque dor cervical, doenças autoimunes reumáticas, infeção, mielopatia, cervical cirurgia cervical, trauma envolvendo a cervical, lesão severa, osteoporose, doença do sistema nervoso, doença vestibular, deficiência visual e auditiva que não sejam corrigidas, pedimos-lhe que não participe, uma vez que a intervenção proposta não é a mais indicada para este tipo de problemas.

4. O que irá acontecer se eu decidir participar?

Se decidir participar, irá se deslocar até a sala de pesquisa da Universidade de Aveiro onde estará sentado(a) a assistir um vídeo de 11 minutos e realizará exatamente o que lhe for instruído previamente de acordo com a folha de instruções que lhe será entregue pelo investigador. No decorrer do estudo você será avaliado(a) com um conjunto de questionários sobre: a sua dor; incapacidade relacionada com a sua dor; medo de movimento; crenças que modificam o seu movimento e sua intensidade da dor; e catastrofização, e testes físicos como: testes aos músculos do pescoço e sensibilidade do toque. As avaliações serão realizadas em 2 momentos diferentes: antes da intervenção e depois da intervenção. Todo o processo de pesquisa pode durar cerca de 2 horas.

5. Quais são os possíveis benefícios de participar neste estudo? E possíveis riscos?

Este estudo pode não o ajudar a si especificamente. Contudo, ajudará a compreender se as intervenções que vamos testar permitem obter melhorias na dor de pescoço e devem ser utilizadas futuramente para ajudá-lo(a) a si ou outras pessoas. O estudo envolve fisioterapeutas com experiência na área e os procedimentos aplicados não têm efeitos adversos conhecidos.

6. O que irá acontecer aos dados recolhidos?

Os dados recolhidos serão analisados pela equipa de investigação deste projeto. Toda a informação recolhida a seu respeito será codificada e mantida confidencial. Todos os envolvidos no estudo sabem que não podem divulgar a sua identidade, nem usar os dados recolhidos para outros fins que não os estritamente relacionados com os objetivos desta investigação. Os dados recolhidos farão parte da minha dissertação de mestrado e, eventualmente, de artigos ou apresentações. Contudo, apenas serão divulgados os dados totais de todos os participantes como um todo e não individualmente. O seu nome nunca será associado a quaisquer dados.

7. Terei que ter despesas relacionadas com este estudo?

Não terá nenhuma despesa relacionada com este estudo.

8. A quem devo contactar em caso de ter alguma dúvida ou algum problema?

Se tiver alguma dúvida, queixa e/ou quiser falar sobre a investigação, por favor contacte:

Investigadores responsáveis:

Fisioterapeuta Mário Bou-Assaf
Telefone: 910901136
E-mail: mariobouassaf@ua.pt

Professora Doutora Anabela Silva
Telefone: 234 370 200; Extensão: 23899
E-mail: asilva@ua.pt

Appendix III – Informed consent

Universidade de Aveiro Escola Superior de Saúde
Ano 2021-2022

TERAPIA DA AÇÃO OBSERVAÇÃO: IMPACTO NA FORÇA DOS MUSCULOS CERVICAIS, NA INTENSIDADE DA DOR, NA ACUIDADE TÁCTIL E NO LIMIAR DE PRESSAO DA DOR EM PACIENTES COM DOR CERVICAL CRÓNICA NÃO ESPECÍFICA.

B. CONSENTIMENTO INFORMADO

Por favor preencha a seguinte secção, assinalando com uma cruz (x) a opção mais adequada:

	Sim	Não
1. Li o documento informativo sobre este estudo?		
2. Recebi informação suficiente e detalhada sobre este estudo?		
3. Percebi o que o estudo implica e o que me vai ser pedido		
4. Foi-me permitido fazer as perguntas que quis e as minhas dúvidas foram todas esclarecidas?		
5. Compreendi que posso abandonar este estudo: • Em qualquer altura • Sem dar qualquer explicação • Sem que daí resulte qualquer penalização para mim		
6. Concordo em participar voluntariamente neste estudo que inclui a avaliação e participação numa sessão de terapia de ação-observação?		

Nome do Participante: _____ Assinatura do Participante: _____

Data: ____/____/_____

Nome do Investigador: _____ Assinatura do Investigador: _____

Data: ____/____/_____

Appendix IV – Assessment form

AVALIAÇÃO – MOMENTO 1

QUESTIONÁRIO DE CARACTERIZAÇÃO DEMOGRÁFICA, ANTROPOMÉTRICA E CLÍNICA

Por favor, responda a cada uma das perguntas de forma apropriada, assinalando com um X a resposta adequada ou preenchendo com a informação solicitada.

A. Informação demográfica e antropométrica

A.1. Género (Assinalar apenas uma opção)

- ☐ Feminino
- ☐ Masculino
- ☐ Prefiro não dizer
- ☐ Outro. Especificar: _____

A.2. Data de nascimento: ___/___/____ (dia/mês/ano)

A.3. Peso: _____ (kg) **A.4.** Altura: _____ (cm) **A.4.1** IMC: _____ kg/m^2

A.5. Nível escolar

- Especificar: _____

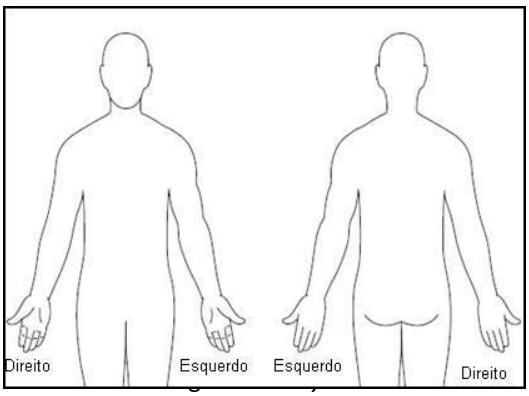
A.6. Profissão

- Especificar*:* _____

B. Informação clínica

B.1. Neste momento, tem dor ou desconforto no pescoço?

- ☐ Sim (P.f. indique na Figura 1 a localização)
- ☐ Não



B.2. Quantas vezes, **NA ÚLTIMA SEMANA**, sentiu essa dor?

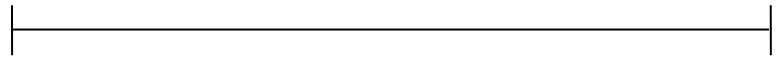
- ☐ Nunca
- ☐ Raramente (1 vez por semana)
- ☐ Ocasionalmente (2 a 3 vezes por semana)
- ☐ Muitas vezes (mais do que 3 vezes por semana)
- ☐ Sempre
- ☐ Outro: _____

B.3. Há quanto tempo sente dor na região do pescoço?

- ☐ Entre 3 a 6 meses
- ☐ Entre 6 meses a 1 ano
- ☐ Entre 1 a 2 anos
- ☐ Entre 2 a 5 anos
- ☐ Mais de 5 anos

B.4. Escala Visual Analógica

Na seguinte escala, tem assinalada numa extremidade a classificação "Sem Dor" e na outra a classificação "Dor Máxima". Por favor, faça uma cruz ou um traço perpendicular à linha no ponto que representa a intensidade da sua dor.



0 (Sem dor) 10 (Dor Máxima)

B.5. O que agrava a sua dor:

_____

_____

_____

B.6. O que alivia a sua dor:

_____

_____

_____

C. INCAPACIDADE ASSOCIADA À DOR: NECK DISABILITY INDEX – VERSÃO PORTUGUESA

QUESTIONÁRIO SOBRE OS PROBLEMAS QUOTIDIANOS RELACIONADOS COM DORES NO PESCOÇO (Versão Portuguesa do NDI)

Este questionário foi concebido para dar informações de como a sua **dor no pescoço** afecta a sua capacidade de agir no dia-a-dia. Por favor, responda a cada secção deste questionário assinalando apenas **UM** dos quadrados que melhor se aplique ao seu caso. Sabemos que pode considerar como aplicáveis a si duas afirmações em cada secção mas, por favor, assinale apenas o **quadrado que descreve melhor** o seu problema.

Secção 1 – Intensidade da dor

- ☐ Neste momento não sinto nenhuma dor.
- ☐ Neste momento a dor é muito fraca.
- ☐ Neste momento a dor é moderada.
- ☐ Neste momento a dor é bastante forte.
- ☐ Neste momento a dor é muito forte.
- ☐ Neste momento a dor é mais forte do que se possa imaginar.

Secção 2 – Cuidados pessoais (lavar-se, vestir-se etc.)

- ☐ Posso tratar de mim normalmente sem causar mais dores.
- ☐ Posso tratar de mim normalmente, mas isso causa-me mais dores.
- ☐ É doloroso tratar de mim próprio e sou lento(a) e cuidadoso(a).
- ☐ Consigo realizar a maior parte dos meus cuidados pessoais, mas preciso de algum auxílio.
- ☐ Na maior parte dos meus cuidados pessoais, preciso todos os dias auxílio.
- ☐ Não consigo vestir-me, lavo-me com dificuldade e permaneço deitado(a) na cama.

Secção 3 – Levantar coisas

- ☐ Consigo levantar coisas pesadas sem causar mais dores.
- ☐ Consigo levantar coisas pesadas mas causa-me mais dores.
- ☐ A dor impede-me de levantar coisas pesadas do chão, mas posso levantá-las se estiverem convenientemente colocadas, como por exemplo em cima de uma mesa.
- ☐ A dor impede-me de levantar coisas pesadas, mas consigo fazê-lo se forem coisas leves ou de peso médio, convenientemente colocadas.
- ☐ Posso levantar apenas coisas muito leves.
- ☐ Não consigo levantar ou transportar seja o que for.

Secção 4 – Leitura

- ☐ Posso ler o tempo que quiser sem causar dores no pescoço.
- ☐ Posso ler o tempo que quiser mas com uma ligeira dor no pescoço.
- ☐ Posso ler o tempo que quiser mas com dores moderadas no pescoço.
- ☐ Não posso ler o tempo que quiser por causa das dores relativamente fortes no pescoço.
- ☐ Quase que não posso ler por causa das dores muito fortes no pescoço.
- ☐ Não posso ler nada por causa das dores no pescoço.

Secção 5 – Dores de cabeça

- ☐ Não tenho qualquer dor de cabeça.
- ☐ Tenho ligeiras dores de cabeça que aparecem de vez em quando.
- ☐ Tenho dores de cabeça moderadas que aparecem de vez em quando.
- ☐ Tenho dores de cabeça moderadas que aparecem frequentemente.
- ☐ Tenho fortes dores de cabeça que aparecem frequentemente.
- ☐ Tenho dores de cabeça quase permanentemente.

Secção 6 – Concentração

- ☐ Consigo concentrar-me sem dificuldade.
- ☐ Consigo concentrar-me, mas com ligeira dificuldade.
- ☐ Sinto alguma dificuldade em concentrar-me.
- ☐ Sinto muita dificuldade em concentrar-me.
- ☐ Sinto imensa dificuldade em concentrar-me.
- ☐ Não sou capaz de me concentrar de todo.

Secção 7 – Trabalho / Actividades diárias

- ☐ Posso trabalhar tanto quanto eu quiser.
- ☐ Só consigo fazer o meu trabalho habitual, mas não mais.
- ☐ Consigo fazer a maior parte do meu trabalho habitual, mas não mais.
- ☐ Não consigo fazer o meu trabalho habitual.
- ☐ Dificilmente faço qualquer trabalho.
- ☐ Não consigo fazer nenhum trabalho.

Secção 8 – Guiar um carro

- ☐ Posso guiar um carro sem causar qualquer dor no pescoço.
- ☐ Posso guiar um carro durante o tempo que quiser, mas com uma ligeira dor no pescoço.
- ☐ Posso guiar um carro durante o tempo que quiser, mas com dores moderadas no pescoço.
- ☐ Não posso guiar um carro durante o tempo que quiser devido a dores relativamente fortes no pescoço.
- ☐ Mal posso guiar um carro devido às dores muitos fortes no pescoço.
- ☐ Não posso guiar um carro por causa das dores no pescoço.

Secção 9 – Dormir

- ☐ Não tenho dificuldade em dormir.
- ☐ O meu sono é ligeiramente perturbado (fico sem dormir no máximo 1 hora)
- ☐ O meu sono é um bocado perturbado (fico sem dormir entre 1 a 2 horas)
- ☐ O meu sono é moderadamente perturbado (fico sem dormir entre 2 a 3 horas)
- ☐ O meu sono é muito perturbado (fico sem dormir entre 3 a 5 horas)
- ☐ O meu sono é completamente perturbado (fico sem dormir entre 5 a 7 horas)

Secção 10 – Actividades de lazer

- ☐ Sou capaz de fazer qualquer das minhas actividades de lazer, sem sentir quaisquer dores no pescoço.
- ☐ Sou capaz de fazer qualquer das minhas actividades de lazer, mas com algumas dores no pescoço.
- ☐ Sou capaz de fazer a maior parte das minhas actividades de lazer, mas não todas, devido às dores no pescoço.
- ☐ Sou capaz de fazer apenas algumas das minhas actividades de lazer habituais devido às dores no pescoço.
- ☐ Dificilmente sou capaz de fazer quaisquer actividades de lazer devido às dores no pescoço.
- ☐ Não sou capaz de fazer nenhuma das minhas actividades de lazer.

Score:_____[50] Data:___/___/___

D. CATASTROFIZAÇÃO: PAIN CATASTROPHIZING SCALE – VERSÃO PORTUGUESA

PCS

Toda a gente passa por situações de dor em certos momentos da sua vida. Estas experiências podem incluir dores de cabeça, dores de dentes, dores articulares ou dores musculares. As pessoas estão muitas vezes expostas a situações que podem causar dor, tais como doenças, ferimentos, intervenções de dentista ou cirurgias.
Queremos conhecer os pensamentos e sentimentos que tem quando está a sentir dores. Em baixo encontra-se uma lista com treze afirmações que descrevem diferentes pensamentos e sentimentos que podem estar associados à dor. Usando a escala seguinte, por favor indique em que medida tem estes pensamentos e sentimentos quando está com dores.

0 – Nunca 1 – Ligeiramente 2 – Moderadamente 3 – Bastante 4 – Sempre

Quando estou com dores ...

1	☐	Estou constantemente preocupado(a) em saber se a dor terá fim.
2	☐	Sinto que não consigo continuar.
3	☐	É terrível e penso que nunca mais vai melhorar.
4	☐	É horrível e sinto que me ultrapassa completamente.
5	☐	Sinto que já não aguento mais.
6	☐	Fico com medo que a dor piore.
7	☐	Estou sempre a pensar noutras situações dolorosas.
8	☐	Quero ansiosamente que a dor desapareça.
9	☐	Não consigo deixar de pensar nisso.
10	☐	Estou sempre a pensar no quanto dói.
11	☐	Estou sempre a pensar que quero muito que a dor passe.
12	☐	Não há nada que eu possa fazer para reduzir a intensidade da dor.
13	☐	Pergunto -me se poderá acontecer algo grave.

Versão portuguesa do *Pain Catastrophizing Scale*. Tradução, adaptação cultural e validação da responsabilidade da Faculdade de Medicina da Universidade do Porto, com a autorização do autor Michael JL Sullivan, PhD.

E. MEDO DO MOVIMENTO: TAMPA SCALE OF KINESIOPHOBIA– VERSÃO PORTUGUESA

1 = Discordo Plenamente
2 = Discordo
3 = Concordo
4 = Concordo plenamente

LEIA CADA PERGUNTA E ASSINALE O NÚMERO QUE MELHOR CORRESPONDE AO QUE SENTE

Nº		1	2	3	4
1	Tenho medo de me magoar se fizer exercício.				
2	Se tentasse ultrapassar a dor, a intensidade dela iria aumentar.				
3	O meu corpo está a dizer-me que tenho algo de errado e grave.				
4	As outras pessoas não levam o meu estado de saúde a sério.				
5	O acidente que sofri colocou o meu corpo em risco para o resto da vida.				
6	A dor significa sempre que me magoei.				
7	Tenho medo de magoar-me acidentalmente.				
8	Tentar não fazer movimentos desnecessários é a melhor coisa que eu posso fazer para evitar que a dor se agrave.				
9	Não sentiria tanta dor se não se passasse algo de potencialmente grave no meu corpo.				
10	A dor avisa-me quando devo parar de fazer actividade física, evitando assim que me magoe.				
11	Não é seguro para uma pessoa com a minha condição física ser fisicamente activa.				
12	Não posso fazer tudo o que as outras pessoas fazem, porque me magoo muito facilmente.				
13	Ninguém deveria ter que fazer actividade física quando sente dor.				

Versão Portuguesa:

Jácome, C. & Cruz, E., 2004. Adaptação Cultural e contributo para a Validação da Pain Catastrophizing Scale (PCS). Instituto Politécnico de Setúbal.

F. FEAR-AVOIDANCE BELIEFS QUESTIONNAIRE VERSÃO PORTUGUESA

Em seguida, estão algumas das coisas que outros doentes disseram a respeito da sua dor.
Para cada Frase, por favor, assinale com um círculo num dos números de 0 a 6, de forma a indicar o quanto actividades físicas tais como, dobrar-se, levantar objectos, andar ou guiar, afectam ou podem vir a afectar a sua dor nas costas.

	DISCORDO COMPLETAMENTE			NÃO TENHO A CERTEZA			CONCORDO COMPLETAMENTE
1. A minha dor foi causada por actividade física	0	1	2	3	4	5	6
2. A actividade física faz piorar a minha dor	0	1	2	3	4	5	6
3. A actividade física poderá prejudicar as minhas costas	0	1	2	3	4	5	6
4. Eu não devo fazer actividades físicas que fazem (poderão fazer) piorar a minha dor	0	1	2	3	4	5	6
5. Eu não posso fazer actividades físicas que fazem (poderão fazer) piorar a minha dor	0	1	2	3	4	5	6

As frases seguintes referem-se ao modo como a sua profissional/trabalho afecta ou poderá afectar a sua dor nas costas.

	DISCORDO COMPLETAMENTE			NÃO TENHO A CERTEZA			CONCORDO COMPLETAMENTE
6. A minha dor foi causada pelo meu trabalho ou por um acidente de trabalho	0	1	2	3	4	5	6
7. O meu trabalho fez agravar a minha dor	0	1	2	3	4	5	6
8. O meu trabalho é muito pesado para mim	0	1	2	3	4	5	6
9. O meu trabalho faz ou poderá vir a fazer com que a minha dor piore	0	1	2	3	4	5	6
10. O meu trabalho poderá prejudicar as minhas costas	0	1	2	3	4	5	6
11. Actualmente, com esta dor, eu não deveria fazer o meu trabalho normal	0	1	2	3	4	5	6
12. Eu não consigo fazer o meu trabalho com a dor que tenho actualmente	0	1	2	3	4	5	6
13. Eu não posso continuar o meu trabalho normal até a minha dor estar tratada	0	1	2	3	4	5	6
14. Eu não acredito que vou voltar ao meu trabalho normal nos próximos 3 meses	0	1	2	3	4	5	6
15. Eu não acredito que seja alguma vez capaz de voltar ao meu trabalho normal	0	1	2	3	4	5	6

Questionário de Crenças de Medo-evitamento – QCME
Adaptado e validado para a população Portuguesa por Eurico Gonçalves e Eduardo Cruz. Área Disciplinar da Fisioterapia. Escola Superior de Saúde – Instituto Politécnico de Setúbal. 2004.
Original: WADDELL G, *et al*. A Fear Avoidance Beliefs Questionnaire (FABQ) and the role of fear avoidance beliefs in chronic low back pain and disability. *Pain*. Vol. 52, (1993), 157-168.

G. PPT (*PREENCHER PELO INVESTIGADOR*)

	Direita			**Esquerda**		
Nível	1 – 2 cm à direita entre C1 – C2	1 – 2 cm à direita entre C5 – C6	Meio entre C7 e acrómio (no musculo trapézio) à direita	1 – 2 cm à esquerda entre C1 – C2	1 – 2 cm à esquerda entre C5 – C6	Meio entre C7 e acrómio (no musculo trapézio) à esquerda
Trial #1						
Trial #2						
Trial #3						