Effects of a land and aquatic exercise-based program on pain and functional disability in patients with chronic low back pain

Master´s Thesis

Joana Catarina Carvalho Borges

This thesis was accomplishment under the guidance of:

Professor Doutor Pedro Duarte-Mendes, Department of Sports and Well-being, Polytechnic Institute of Castelo Branco

Professor Doutor Diogo Monteiro, School of Education and Social Sciences, Polytechnic University of Leiria

Leiria, June 2025

Master's degree in Exercise Prescription and Health Promotion

SCHOOL OF EDUCATION AND SOCIAL SCIENCES

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Abstract

Chronic low back pain is a clinical condition that significantly affects individuals' functionality, emotional well-being, and social life. Various interventions are recommended for its management, with physical exercise, whether land- or water-based, standing out as one of the most effective.

Thus, in this study, we initially conducted a randomized controlled trial protocol aimed to compare the effect of a combined aquatic and land-based exercise program with an aquatic-exercise program in adults with chronic low back pain. The findings could offer valuable insights for the management of chronic low back pain.

Subsequently, and based on the previously established protocol, we conducted a randomized controlled study with both exercise programs described earlier, over a period of 8 weeks. The aim was to assess the effect on pain, functional disability, fear of movement, and lumbar mobility. Additionally, the impact of the exercise programs on these same variables was analyzed after a 4-week detraining period.

The results showed that, after 8 weeks, both exercise programs contributed significantly to the reduction of pain, functional disability, and fear of movement, as well as to the improvement of lumbar mobility. Nevertheless, the combined exercise program appeared to yield significantly better results compared to the aquatic-exercise program on pain, functional disability, and fear of movement. After the 4-week detraining period, participants in both groups experienced a significant increase in pain, functional disability, and fear of movement, along with a decrease in lumbar mobility.

Further research should be conducted considering a detraining period longer than the one analyzed.

Keywords

Aquatic Therapy, Disability, Exercise, Kinesiophobia, Low Back Pain.

Resumo

A dor lombar crónica é uma condição clínica que afeta de forma significativa a funcionalidade, o bem-estar emocional e a vida social dos indivíduos. Diversas estratégias terapêuticas são recomendadas para a sua gestão, destacando-se, o exercício físico, realizado tanto em meio terrestre como em meio aquático, como uma das mais eficazes.

Assim, neste trabalho, realizámos inicialmente um protocolo de estudo randomizado controlado que procuraria comparar o efeito de um programa de exercício combinado aquático e terrestre com um programa de exercício aquático, em adultos com dor lombar crónica. Os resultados poderiam oferecer informações valiosas para a gestão da dor lombar crónica.

Posteriormente, e com base no protocolo efetuado, desenvolvemos um estudo randomizado controlado, com os dois programas de exercício previamente descritos, ao longo de 8 semanas. Procurou-se avaliar o efeito na dor, incapacidade funcional, medo de movimento e mobilidade lombar. Adicionalmente, analisou-se o efeito dos programas de exercício nas mesmas variáveis após um período de destreino de 4 semanas.

Os resultados demonstraram que ao final das 8 semanas, os dois programas de exercício contribuíram significativamente para a redução da dor, incapacidade funcional e medo do movimento, bem como para o aumento da mobilidade lombar. Ainda assim, o programa de exercício combinado aparentou ter resultados significativamente superiores comparativamente ao programa de exercício aquático na dor, incapacidade funcional e medo do movimento. Após as 4 semanas de destreino verificou-se que os participantes dos dois grupos aumentaram significativamente a dor, incapacidade funcional e medo do movimento e diminuíram a mobilidade lombar.

Mais investigação deve ser desenvolvida considerando um período de destreino superior ao analisado.

Palavras chave

Cinesiofobia, Dor Lombar, Exercício, Incapacidade, Terapia Aquática.

Publications

The present thesis is composed of the following papers:

- **Borges, J**., Monteiro, D., Silva, F., Jacinto, M., Pastilha, T., & Duarte-Mendes, P. (2025). Effects of a land and aquatic exercise-based program on pain, mobility and quality of life in patients with chronic low back pain: A study protocol for a randomized controlled trial. PLoSONE, 20(5): e0320858. https://doi.org/10.1371/journal.pone.0320858

- **Borges, J**., Monteiro, D., Silva, F., Jacinto, M., Pastilha, T., & Duarte-Mendes, P. (Under Review in Journal of Sport and Health Science). Effects of a land and aquatic exercise-based program on pain and functional disability in patients with chronic low back pain: a randomized controlled trial.

Oral communications and e-posters

The first study of this thesis was presented in the following events:

- **Efeito de um programa de exercício em terra e aquático na dor, mobilidade e qualidade de vida de indivíduos com dor lombar crónica: Um Estudo Randomizado Controlado** oral communication presented in Ondas de Conhecimento: Jornadas de Fisioterapia Aquática, promoted by Associação Portuguesa de Fisioterapeutas, on March 15th, 2025 (Appendix 1).

- **Study Protocol for a Randomized Controlled Trial: Effects of a Land and Aquatic Exercise Program on Chronic Low Back Pain** E-poster presented in CIDESD International Congress 2025, held at Universiy of Beira Interior, Faculty of Health Sciences, Portugal, on June 5-7th, 2025 (Appendix 2).

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Introduction

This thesis was conducted as part of the requirements for the master's degree in Exercise Prescription and Health Promotion, of the School of Education and Social Sciences, Polytechnic University of Leiria. The main content of this work is organized into two parts, namely: Chapter 1 - Effects of a land and aquatic exercise-based program on pain, mobility and quality of life in patients with chronic low back pain: a study protocol for a randomized controlled trial; and Chapter 2 – Effects of a land and aquatic exercise-based program on pain and functional disability in patients with chronic low back pain: a randomized controlled trial.

Chronic low back pain constitutes one of the most prevalent public health challenges worldwide. It has a significant impact on functionality, well-being, and quality of life, leading to limitations in both social and professional life for affected individuals, with economic implications and associated direct and indirect annual costs related to healthcare resource utilization. Therefore, it is essential to investigate therapeutic strategies for the relief of this condition. Exercise is recommended as a first-line treatment for reducing pain and disability levels. However, there is still insufficient research detailing all its parameters. Accordingly, Chapter 1 presents a study protocol for a randomized controlled trial that aimed to analyze the effects of an 8-week aquatic and land-based exercise program compared to an aquatic-only exercise program in adults with chronic low back pain. Additionally, the detraining effects after 4 weeks were also assessed in both groups.

In Chapter 2, based on the study protocol established in Chapter 1, we conducted a randomized controlled trial to evaluate the effects of an 8-week aquatic and land-based exercise program compared to an aquatic-only exercise program in adults with chronic low back pain. Additionally, the detraining effects after 4 weeks were assessed in both groups. The variables analyzed included pain at rest, at movement, and at night through the Visual Analogue Scale, disability level through the Oswestry Disability Index, fear of movement through the Tampa Scale of Kinesiophobia-13 and lumbar mobility through the Modified-Modified Schober Test.

Chapter 1 - Effects of a land and aquatic exercise-based program on pain, mobility and quality of life in patients with chronic low back pain: a study protocol for a randomized controlled trial

Abstract

Background: Chronic low back pain (CLBP) is a disease with significant functional, emotional and social impact. Several interventions are proposed for its management and exercise is one of main, land-based or water-based. This study describes a randomized controlled trial that will analyze the effect of a combined aquatic and land-based exercise program compared to an aquatic based program on pain, functional incapacity and quality of life in adults with CLBP. Additionally, it will analyze the effects of exercise cessation in the same outcomes.

Methods and design: A blind randomized controlled trial will be developed with a 1:1 allocation ratio. Around 30 adults with mechanical CLBP will be randomly allocated in two groups. The experimental group (ALG) will complete an aquatic and land-based exercise program and control group (AG) will carry out only an aquatic program, both for 8 weeks. Participants will be assessed with Visual Analogue Scale, Oswestry Disability Index, Short-Form 36, Tampa Scale of Kinesiophobia-13 and Modified-Modified Schober Test, collected at baseline (M0), after 8 weeks (M1) and 4 weeks after the end of the intervention (M2).

Discussion: This study may provide a relevant contribution to understand the potential effect of a combined land and aquatic exercise program on pain, functional disability, fear of movement, quality of life and lumbar mobility. The results may provide important information for CLBP management.

Trial registration: This trial is registered with ClinicalTrials.gov (registration number: NCT06641570; date of registration: October 14, 2024).

Introduction

Chronic low back pain (CLBP) is considered as "pain tension or stiffness localized below the costal margin and above the inferior gluteal folds", lasting more than 12 weeks (GBD, 2023; Knezevic et al., 2021; Violante et al., 2015). It can be distinguished in two main categories: specific, when the cause is attributed to a pathology or structural lesion and non-specific (accounts for about 90% of cases), when it is not possible to determine a recognizable known cause (GBD, 2023). Low physical activity levels, obesity, smoking and high stress constitute risk factors for its occurrence (Stevans et al., 2021).

This is one of the most frequent public health problems with a high prevalence in the world population (Freburger et al., 2009). According to GBD (2023), CLBP in 2020 affected around 619 million people worldwide, and it is estimated that more than 80% of the population will have at least one episode of low back pain in their life (Freburger et al., 2009). The prevalence of CLBP is 4.2% in people aged between 24 and 39 years old and 19.6% between 20 and 59 years old, noting that women have CLBP more frequently than men (Meucci et al., 2015). Therefore, CLBP has a strong impact on functionality, well-being and quality of life, leading to limitations in social and work life of who suffers from this health condition, with economy implications and direct and indirect annual costs associated with health care resources usage (Balagué et al., 2012; Dagenais et al., 2008; Vlaeyen et al., 2018).

These justify the need to study therapeutic strategies to manage this chronic condition. Some guidelines for the management of CLBP recommend physical exercise as a first-line treatment to reduce pain and disability, with programs duration superior than twenty hours for higher benefits, not mentioning the most appropriate type or intensity (National Collaborating Centre for Primary Care, 2009; Savigny et al., 2009; WHO, 2023). A systematic review with meta-analysis conducted by Hayden et al. (2021) concluded that exercise can provide benefits in pain and disability caused by CLBP, compared to controls without treatment or with placebo intervention. Additionally, the same authors added that few studies report side effects associated with exercise.

On the other hand, prolonged periods of physical inactivity negatively impact the recovery from pain and functional disability caused by CLBP, so it is recommended that these individuals remain physically active (NHS, 2022). Some authors suggest a variety

of exercise types for managing CLBP, including aerobic exercise (from light to high intensity) (Chan et al., 2011; Chatzitheodorou et al., 2007), muscle strengthening exercises (Inani & Selkar, 2013; Stankovic et al., 2012), and flexibility exercises (Kuukkanen & Mälkiä, 2000). Furthermore, Psycharakis et al. (2022) highlight core stability exercises, as they recruit lumbar spine and pelvis stabilizing muscles. These exercises aim to counteract the decreased spine and pelvis neuromotor control and the muscle weakness of the abdominal and hip muscles observed in individuals with CLBP (D'Hooge et al., 2013; Nourbakhsh & Arab, 2002). However, there is no consensus on the most suitable type of exercise, making it a controversial topic that requires further scientific research (Hayden, et al., 2005b; Smith & Osborn, 2007).

The reduction of lumbar spine stability due to decreased core muscle activity can lead to CLBP, with some studies indicating that activation exercises for the abdominal and spinal extensor muscles may play an important role in this condition management (Danneels et al., 2000; Gordon & Bloxham, 2016; Willson et al., 2005). In turn, decreased lumbar spinal joint mobility and reduced flexibility in muscles such as the spinal extensors, hip flexors, and hamstrings may also contribute to CLBP persistence, justifying the inclusion of stretching exercises in exercise programs (Gordon & Bloxham, 2016; Turci et al., 2023).

Another proposed modality is aquatic exercise, which utilizes the properties and characteristics of water for physical activity, aiming to reduce pain, strengthen muscles, and promote relaxation, among other benefits (Camilotti et al., 2009; Cimbiz et al., 2005). Thus, aquatic exercise is of particular interest, as the unique properties of water, such as buoyancy and hydrostatic pressure, reduce joint stress on the spine and other joints, and enhance balance, mobility, and pain control (Baena-Beato et al., 2014; Bressel et al., 2011; Camilotti et al., 2009). Additionally, the aquatic environment allows individuals to perform movements that are typically difficult or impossible on land (Becker & Cole, 2004). Beyond this, continuous movement of the limbs against the resistance of the water leads to increased muscle strength and cardiovascular benefits (Campbell et al., 2003; Pöyhönen et al., 2002; Yozbatiran et al., 2004). A systematic review by Ma et al. (2022) found that aquatic exercise programs were effective in reducing pain and improving quality of life and functional capacity in patients with CLBP, compared to other interventions or control groups with no intervention. Some authors argue that the buoyancy achieved during aquatic exercise can reduce the impact

of gravity on the body, decreasing joint stress during exercise and pain (Abadi et al., 2019; Louw et al., 2016; Waller et al., 2009). Other researchers found that aquatic may be more beneficial than land-based programs in lumbar pain, health related quality of life, and functional disability (Bello et al., 2010; Dundar et al., 2009; Yücesoy et al., 2021). In contrast, Yalfani et al. (2020) compared a Pilates exercise program performed in water with the same program conducted on land and found that both significantly reduced pain and dysfunction, with no significant differences between the programs. In light of these differences in the literature, no study has yet investigated whether there is an additional effect from combining land-based and water-based exercises on the same variables, compared to an exclusive water exercise program.

Moreover, few authors have investigated the effects of cessation of exercise (Glass et al., 2004; Mujika & Padilla, 2000). Mujika & Padilla (2000) argue that detraining can be divided into two study periods: short-term, less than 4 weeks, and long-term, more than 4 weeks. Therefore, Toraman & Ayceman (2005) found that after 4 weeks of interruption following a 9-week aerobic, strength, and flexibility training program, conducted 3 times a week, participants showed a reduction in performance levels on various functional tests, standing out the Chair Sit and Reach, compared to the end of the intervention, although the changes were not statistically significant. Thus, the impact of aquatic exercise, core stability exercise, and trunk and lower limb stretching cessation on individuals with CLBP remains unclear.

This trial aims to assess the effect of a combined aquatic and land-based exercise program compared to an aquatic program on pain, functional disability, and quality of life in adults with CLBP. Secondary objectives include investigating the effects on lumbar mobility and fear of movement, as well as the impact of training cessation on these variables 4 weeks after the end of the intervention. We hypothesize that combined aquatic and land-based exercise decreases significantly pain, and functional disability, and increases quality of life in adults with CLBP.

Materials and methods

Study design

This investigation will follow a quantitative model and a randomized controlled trial (RCT) study design, according to the Statement guidelines for standard protocol items in clinical trials (SPIRIT) and the Consolidated Standards of Reporting Trials (CONSORT) statement (Chan et al., 2013; Schulz et al., 2010). Appendix 3 shows the SIPRIT checklist. This study protocol is registered in the Clinicaltrials. gov ID: NCT06641570 (date of registration: October 14, 2024).

Participants

The study sample will consist of both gender Portuguese participants, over 18 years, with CLBP lasting three months or longer and with an intensity of 3 or higher on the visual analogue scale (VAS) at rest. Individuals who refuse to participate or do not provide informed consent will be excluded, as well as those with pain radiating to the lower limb, recent pregnancy or childbirth (less than 8 weeks ago) (Kalra et al., 2017), ongoing physical therapy treatments, severe rheumatological, neurological, neoplastic, cardiovascular diseases, or other conditions that could prevent full participation in the intervention, a history of spinal surgery, inflammatory, infectious, or malignant spinal diseases, and psychiatric disorders that may affect adherence and symptom assessment (Bello et al., 2010; Dundar et al., 2009; Yücesoy et al., 2021).

The sample will be randomly divided into two groups: the experimental group, which will undergo the aquatic and land-exercise program (ALG), and the control group, which will perform the aquatic-exercise program (AG).

The required sample size was calculated using the G*Power software (3.1.9.4; Heinrich Heine University Düsseldorf, DE), based on a study with 65 participants by Dundar et al. (2009) and corroborated by other studies (Assis et al., 2006; Geneen et al., 2017; Hayden, et al., 2005a). The aim was to detect differences in pain intensity (VAS) between the aquatic exercise program group and the control group (land exercise), with an effect size of 1.079, α=0.05, and a power of 80%. The total sample size needed to achieve the objective will be 30 participants (15 in each group).

Thus, the study should start with an additional 15% of the planned sample size for each group to account for potential dropouts and as well as adopt cognitive-behavioral strategies to reduce dropout rates, such as setting flexible and participant-driven goals or providing positive and individualized feedback (Collado-Mateo et al., 2021; Robison & Rogers, 1994).

Ethics

According to the Helsinki Declaration protocol (1964), written informed consent (Appendix 4) will be obtained from the participants (WMA, 2013). All participants receive a signed copy. Each participant will receive a unique coded alphanumeric identification ensuring data anonymity in accordance with the General Data Protection Regulation (GDPR), following Regulation (EU) 2016/679 of the European Parliament of April 27, 2016, and the Personal Data Protection Law, according to Law No. 58/2019 of August 8. The files that connect alphanumeric codes to participants identifying information will be stored in a separate locked file protected by a password access system, only known by the principal investigator (Chan et al., 2013).

This study will be based on the ethical standards required in scientific research and was submitted for review by the Ethics Committee of the Polytechnic University of Leiria (Appendix 5) and approved on March 27, 2024 (reference: CE/IPLEIRIA/47/2024). Study procedures, protocol risks voluntary character of participation and expected results will be explained to the participants. The right to withdraw without any prejudice or consequence will be ensured.

Intervention

The intervention will take place over 8 weeks at the Municipal Pool of Paião, located in Figueira da Foz, Portugal. The AG will conduct the aquatic exercise program, while the ALG will carry out both aquatic and land-based exercise programs. The intervention will begin after a one-week washout period, during which participants will cease any additional physical exercise, which they will maintain throughout the intervention weeks.

To monitor the intensity of the interventions, Borg CR-10 scale will be used. This is a tool to rate dyspnea and/or perceived exertion (RPE) experienced by an individual. The

scale consists of a numerical list with 10 points (0–10), an adaptation of the original scale (6–20), that assesses and monitors the intensity/severity of shortness of breath/fatigue. Its use requires explaining that "0" means not experiencing dyspnea/fatigue at the moment and that "10" means the worst dyspnea/fatigue they have ever experienced or the worst imaginable dyspnea/ fatigue (Borg, 1998; Williams, 2017). This instrument will not be used during the assessment moments before and after the exercise programs but only to monitor the intensity during the sessions of both aquatic and land-based exercise programs. This scale is validated for monitoring dyspnea and fatigue, showing an excellent correlation with heart rate (r = 0.92) and VO2 (r=0.92–0.93) and moderate reliability (ICC=0.50–0.66) (Grant et al., 1999).

Participants will be encouraged to maintain their daily activities as usual outside of the study. The participants may not participate in any other exercise programs.

Aquatic-exercise program

This intervention will consist of an aquatic-exercise program (Table 1), administered by a physiotherapist. It will include 16 sessions, twice a week, over 8 weeks at a water temperature between 32–34ºC. Each session will be conducted in groups of 8–12 patients and will last about 45 minutes. The aquatic exercise sessions will include a warm-up phase (5 minutes): walking forwards, sideways, and backwards; a training phase (35 minutes): active range of motion exercises (10 minutes) for the spine, upper and lower limbs; aerobic exercises (5 minutes) with jumps and static running at various speeds; muscle strengthening (10–15 minutes), (8–12 repetitions), 1–2 sets, 8–10 exercises including hip flexion, extension, adduction, and abduction, knee flexion and extension, knee cycling, shoulder flexion, extension, and abduction, elbow flexion, extension, and pronation-supination, squatting, and stretching exercises (5–10 minutes) for the neck, trunk, and limbs; and a relaxation/cool-down phase (5 minutes): including lying supine and low-impact exercises such as slow walking, squatting, and standing (Abadi et al., 2019; Bello et al., 2010; Dundar et al., 2009; Ma et al., 2022; Psycharakis et al., 2022). For participants who cannot complete any exercise due to difficulty or discomfort, a modified version of each exercise will be offered. The load progression will be managed using auxiliary equipment, including flotation devices, plates, balls, pull-buoys, and dumbbells, according to each participant's RPE on the Borg CR-10 scale.

Table 1 - Aquatic-exercise program

Type	Frequency and duration	Intensity	
		Week 1-4	**Week 5-8**
Aquatic exercise: aerobic, resistance, and flexibility training performed in water.	2 times per week. Session duration: 40-45 min (warm-up phase: 5 min, training phase: 30-35 min; and relaxation/cool-down phase: 5 min).	**Warm-up phase:** Low-intensity aerobic exercise: walking forwards, sideways, and backwards. RPE: 3-4 (Borg CR-10 Scale). **Training phase:** Active range of motion exercises: spine, upper and lower limbs. RPE: 3-4 (Borg CR-10 Scale). Moderate-intensity aerobic exercise: jumps and static running at various speeds. RPE: 5-6 (Borg CR-10 Scale). Muscle strengthening exercises: 8-12 reps, 1 set, 8-10 exercises (hip flexion, extension, adduction, and abduction, knee flexion and extension, knee cycling, shoulder flexion, extension, and abduction, elbow flexion, extension, and pronation-supination, squatting). RPE: 5-6 (Borg CR-10 Scale). Static stretching exercises: stretching for 30-45s, 1 rep, 8-10 exercises (neck, trunk, and limbs). RPE: 3-4 (Borg CR-10 Scale). **Relaxation/cool-down phase:** Low-intensity exercise: slow walking, squatting and standing. RPE: 2-4 (Borg CR-10 Scale). Diaphragmatic breathing/ Floating. RPE: 0-2 (Borg CR-10 Scale).	**Warm-up phase:** Low-intensity aerobic exercise: walking forwards, sideways, and backwards. RPE: 3-4 (Borg CR-10 Scale). **Training phase:** Active range of motion exercises: spine, upper and lower limbs. RPE: 3-4 (Borg CR-10 Scale). Moderate-to-high intensity aerobic exercise: jumps and static running at various speeds. RPE: 6-8 (Borg CR-10 Scale). Muscle strengthening exercises: 8-12 reps, 2 sets, 8-10 exercises (hip flexion, extension, adduction, and abduction, knee flexion and extension, knee cycling, shoulder flexion, extension, and abduction, elbow flexion, extension, and pronation-supination, squatting). RPE: 6-7 (Borg CR-10 Scale). Static stretching exercises: stretching for 45-60s, 1 rep, 8-10 exercises (neck, trunk, and limbs). RPE: 3-4 (Borg CR-10 Scale). **Relaxation/cool-down phase:** Low-intensity exercise: slow walking, squatting and standing. RPE: 2-4 (Borg CR-10 Scale). Diaphragmatic breathing/ Floating. RPE: 0-2 (Borg CR-10 Scale).
Notes: min, minutes; RPE, rate of perceived exertion; reps, repetitions; s, seconds.			

Land-exercise program.

This program will include specific land-based exercises (Table 2), guided by a physiotherapist. This intervention will include 8 sessions in 8 weeks, once a week, on a different day from the aquatic exercise program. Each session will last between 25 to 35 minutes and will be divided into two components: core stability exercises and stretching of the trunk and lower limbs (Kim & Yim, 2020). Core stability exercises (15–20 minutes): these will consist of isometric exercises which contraction was maintained for 7–8 seconds, 8–12 repetitions, 1 set, with brief rest intervals of 3 seconds between repetitions and 30 seconds to 1 minute between exercises (ASPN, 2022; Kim & Yim, 2020). Exercises will include abdominal hollowing, side bridge (both sides), supine extension bridge, lower limb extension from prone (both sides), and alternate arm and leg raise from quadruped. Intensity will increase gradually by reducing rest time between exercises and increasing repetitions, based on participants' performance. Participants will be instructed to contract and hold their abdominal muscles while maintaining normal breathing patterns (Saleh et al., 2019). Stretching exercises (10–15 minutes): participants will perform muscle stretching exercises, holding the maximum stretch for 30 seconds to 1 minute, and returning to the original position, followed by 5–10 seconds of rest. Each exercise will be repeated two to three times (Han et al., 2016). Stretches will target the hamstrings, iliopsoas, piriformis, and tensor *fasciae latae*.

Participants will be instructed to minimize tension in other body muscles and maintain their usual breathing pattern during stretching (Castellote-Caballero et al., 2014; Gulledge et al., 2014; Umehara et al., 2015; Wakefield & Cottrell, 2015).

Procedures

The experimental procedures will be conducted at the Municipal Pool of Paião, in Figueira da Foz. The research team will consist of a principal investigator, an examiner, a data analyst, and two intervention administrators. The SPIRIT schedule of the study protocol is presented in Table 3.

Table 2 – Land-based exercise program

Type	Frequency and duration	Intensity	
		Week 1-4	**Week 5-8**
Core stability exercises: abdominal hollowing, side bridge (both sides), supine extension bridge, lower limb extension from prone (both sides), and alternate arm and leg raise from quadruped.	1 time per week. Session duration: 25 to 35 min (Core stability exercises: 15-20 min, and stretching exercises: 10-15 min).	**Isometric strength exercises:** contraction held for 7-8s, 8-10 reps, 1 set. Rest between reps: 3s Rest between exercises: 1min. RPE: 5-6 (Borg CR-10 Scale)	**Isometric strength exercises:** Contraction held for 9-10s, 10-12 reps, 1 set. Rest between reps: 3s Rest between exercises: 30s. RPE: 6-7 (Borg CR-10 Scale)
Stretching exercises: stretching the hamstrings, iliopsoas, piriformis, and tensor *fasciae latae*.		**Static stretching exercises:** stretching for 30-45s. 2 reps. Rest between reps: 5-10s. RPE: 5-6 (Borg CR-10 Scale)	**Static stretching exercises:** stretching for 45-60s. 3 reps. Rest between reps: 5-10s. RPE: 5-6 (Borg CR-10 Scale)
Notes: min, minutes; s, seconds; reps, repetitions; RPE, rate of perceived exertion.			

Table 3 - Schedule of enrolment, interventions and assessments.

	STUDY PERIOD					
	Baseline			**Intervention**	**Follow-ups**	
	Visit 1	**Visit 2**	**Visit 3**	**Sessions**	**Visit 4**	**Visit 5**
Week	-4 a -3	-3 a - 1	-1 a 0	0 a 8	9	12
Baseline Screening						
Informed consent, review inclusion and exclusion criteria	X					
Sociodemographic information and PARQ	X					
Interventions						
Aquatic and land – exercise group				X		
Aquatic – exercise group				X		
Assessments						
Visual Analogue Scale		X			X	X
Oswestry Disability Index		X			X	X
MOS Short Form Health Survey 36		X			X	X
Tampa Scale of Kinesiophobia-13		X			X	X
Modified-Modified Schober Test		X			X	X
Randomization			X			

Feasibility study

To assess the need for any adjustments in the experimental procedures and evaluate the feasibility of the clinical study methodology, a trial of the data collection protocol will be conducted with two to three individuals who meet the study's eligibility criteria.

Sample selection and characterization

Participant recruitment has begun in September 2024 and is expected to be completed in January 2025. Participants will be invited and recruited to the study through posters, which will include a brief explanation of the study's aims and procedures. Interested individuals will complete a written selection and characterization questionnaire, and the principal investigator will provide detailed information about all procedures involved in the study.

Randomization and Blinding

Participants who meet eligibility criteria will be given an alphanumeric code to maintain data confidentiality and anonymity. Participants will be randomly assigned to either ALG or AG, with a 1:1 allocation. Randomization will be performed by the principal investigator using a block randomization method generated by a computer program to ensure equal sample sizes in both groups. The block size will not be disclosed to maintain concealment. Participants will be informed of their group allocation (ALG or AG) via telephone contact. The principal investigator will not be actively involved in the intervention, data collection or data analysis. Randomization will only be known to the physiotherapists responsible for the intervention and the principal investigator. The examiner will evaluate participants before the intervention and after 8 weeks of intervention, ensuring blinding to group allocation, and participants will be asked not to disclose this information to the examiner. Each intervention will have a physiotherapist responsible for its execution, who will be instructed not to reveal participants' group allocation to other research team members. Both data collector and data analyst will be unaware of the participants' group distribution and will also be considered blinded. Only the principal investigator will have full knowledge of the entire research flow.

Data Collection

After enrollment, participants will complete three evaluation phases: before the intervention (M0), after the intervention (M1), and 4 weeks after the end of the intervention (M2). Data collection started in November 2024 and is expected to be completed in April 2025. During data collection, participants will start each data collection session by filling out the questionnaires (Oswestry Disability Index, MOS Short Form Health Survey 36 Item, and Tampa Scale of Kinesiophobia-13) and the

Visual Analog Scale for pain at rest, during movement, and at night, which will take approximately 30 minutes. Following this, the physiotherapist responsible for the assessment will measure weight and height, and then assess lumbar spine mobility using the Modified-Modified Schober Test, taking the best of three measurements. To standardize data collection, each participant will be asked to stand barefoot on a paper where the outline of their feet will be drawn to ensure consistent positioning across all measurements. This procedure will be repeated three times, with a 30 second break between repetitions. Participants will be instructed to place their feet at hip width apart and their upper limbs relaxed along the body in the test starting position (Amjad et al., 2022; Cidem et al., 2012). Figure 1 shows the study design with key moments of the intervention and data collection.

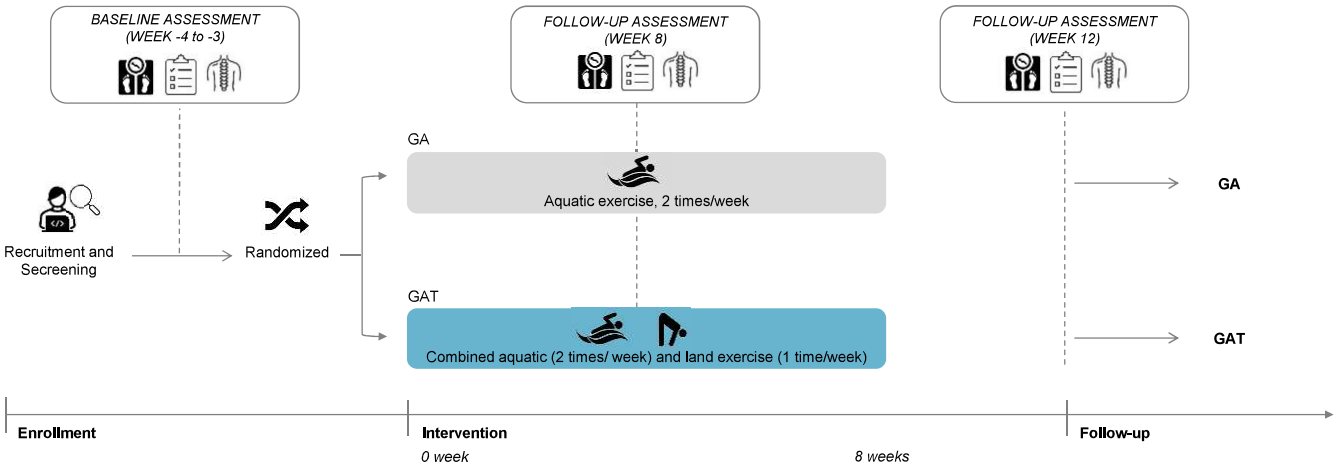

Figure 1 - Study design with key moments of the intervention and data collection.

Outcome measures

Sample Selection and Characterization Questionnaire

A questionnaire (Appendix 6) will be developed to select and characterize the study sample. It will collect personal data (age and sex), anthropometric data (height and weight), symptom duration, comorbidities, and professional status.

Primary outcomes

Visual Analogue Scale (VAS) (Appendix 7). The VAS is a unidimensional measure of pain intensity used to track its progression over time. This instrument consists of a 100-

millimeter line, presented either vertically or horizontally, with an initial value of 0 indicating “No Pain” and an end value of 10 representing “Worst Pain.” Participants are asked to mark a perpendicular line on the scale that corresponds to their level of pain. The scale is recorded on a single-use sheet of paper, and the value is obtained by measuring the distance from the origin (0) to the mark (Hawker et al., 2011). The VAS is a validated tool for assessing the intensity of CLBP, with moderate to strong construct validity (0.50–0.81), moderate to excellent testretest reliability [Intraclass Correlation Coefficient (ICC) = 0.49–0.90], and a standard error of measurement (SEm) of 0.1% (Chiarotto et al., 2019). Additionally, the minimal clinically important difference (MCID) for this instrument is 20mm for CLBP (Ostelo & de Vet, 2005).

Oswestry Disability Index – version 2.0 (ODI) (Appendix 8). The ODI is a tool used to measure and assess the disability caused by low back pain. It consists of 10 questions, each rated on a Likert scale from 0 to 5, where 0 represents no dysfunction and 5 represents the highest level of dysfunction. The final score is expressed as a percentage, indicating the level of disability experienced by the individual with low back pain: 0%–20% (minimal disability); 21%–40% (moderate disability); 41%–60% (severe disability); 61%–80% (very severe disability); 81%–100% (exaggerated symptoms) (Davidson & Keating, 2002; Fairbank et al., 1980). This instrument has been translated and validated for the Portuguese population, showing a good correlation with the MOS Short Form Health Survey 36 (r = –0.59 to –0.75) and excellent internal consistency (Cronbach’s α = 0.95) and reproducibility (ICC = 0.90) (Martins, 2002; Pereira, 2003). The MCID for this questionnaire was established at 10% (Hägg et al., 2003; Ostelo & de Vet, 2005).

MOS Short Form Health Survey 36 Item v2 (SF-36 v2) (Appendix 9). The SF-36 v2 questionnaire is an assessment tool primarily designed to measure and evaluate the health status and quality of life of populations and individuals, whether they have health conditions or not. It consists of 36 items, rated on a scale from 1 to 5 (Likert scale). The questionnaire is divided into 8 dimensions (physical functioning, physical role limitations, bodily pain, general health perceptions, energy/vitality, social functioning, emotional role limitations and mental health), which can be grouped into two components (physical health and mental health). Scores for each dimension are presented on a positively oriented scale from 0 (worst health state) to 100 (best health

state) (Ware & Sherbourne, 1992). The instrument was previously validated and translated for the Portuguese population, demonstrating good content validity (r>0.401) and moderate to excellent levels of internal consistency (Cronbach's α = 0.60–0.87) and test-retest reliability (ICC = 0.45-0.84) across its various domains (Ferreira, 2000a, 2000b). For this instrument, the MCID has been established at 6 for mental health and 14 for physical health (Jayadevappa et al., 2017).

Secondary outcomes

Tampa Scale of Kinesiophobia-13 (TSK-13) (Appendix 10). The TSK-13 is a simple tool designed to quantify fear of movement or (re)injury. The questionnaire consists of 13 items, rated on a 4-point Likert scale (strongly disagree, disagree, agree, and strongly agree), with a final score ranging from 13 to 52 points (Miller et al., 1991). The final classification of fear of movement can be categorized as subclinical (13–22), mild (23–32), moderate (33–42), and severe (43–52) (Neblett et al., 2016). The questionnaire has been translated for the Portuguese population, with construct validity established through its correlation with the VAS for pain intensity (r = 0.691) and confidence in movement (r = –0.772). The instrument shows excellent reliability (ICC = 0.94–0.98) and internal consistency (Cronbach's α = 0.82) (Cordeiro et al., 2013). The MCID for this questionnaire has been established at 5.5 points (Monticone et al., 2016).

Modified-Modified Schober Test (MMST). The MMST is a test originally designed to determine whether there is a reduction in lumbar spine range of motion due to various health conditions such as CLBP. It has subsequently been used to measure the effects of therapeutic interventions on lumbar mobility (Macrae & Wright, 1969). To perform this test, the participant should be in an upright position so that the examiner can mark both Posterior Superior Iliac Spines (PSIS) using a skin marker, then draw a horizontal line between them and mark a point at the intersection of this line with the spine (center of both marks). Next, the examiner should mark a second point 15 cm above the first. The participant is then instructed to bend the trunk as if trying to "touch their toes", and the examiner should measure the distance between the upper and lower lines again. An increase of less than 5 cm in the measured distance indicates a decrease in lumbar spine range of motion (Hershkovich et al., 2022). The MMST is a validated test for individuals with CLBP, showing a moderate correlation (r = 0.67) with the gold standard metric (X-ray) and excellent reliability, specifically in interclass correlations (r

= 0.91) and intraclass correlations (r = 0.95) (Tousignant et al., 2005). For this test, the minimal detectable difference is 1 cm (Sakulsriprasert et al., 2011).

Anthropometry. Body mass will be assessed using a portable scale (Inbody 270, USA) with an accuracy of 0.1kg, while participants will be asked to wear minimal clothes. Height will be measured using a portable stadiometer (SECA Bodymeter 208, Germany), with an accuracy of 1 millimeter, following standardized procedures (Lohman & Roche, 1998). Body Mass Index (BMI) will be calculated using the formula: BMI = (weight/height^2) (Ferreira et al., 2022). Skeletal muscle mass (kg), fat mass (kg), bone mineral mass (%), and body fat (%) will be assessed using the tetrapolar bioimpedance (Inbody 270, USA). The impedance measurements will be performed according to the literature and manufactory recommendations (Khalil et al., 2014).

Adverse events

During the procedures, participants may experience some adverse events and should be aware of the potential risks during both the assessment phase and the intervention. To address this, a cardiovascular risk assessment will be conducted to contraindicate the performance of physical exercise/activity according to the American College of Sports Medicine flowchart, and the PAR Q questionnaire will be administered. Participants classified as high risk will be excluded from the study to minimize the risk associated with physical exercise. For the remaining risk categories, the risk of a cardiovascular event is null or reduced (Hayden et al., 2021). Participants will be instructed to regularly check their skin and contact the principal investigator if they experience a rash, redness, itching, or any other sign of an allergic reaction, although such adverse reactions are rare (Ma et al., 2022). Thus, the physiotherapist will record any adverse events that may occur by asking participants if they have experienced any health issues (injuries, pain, etc.) since the previous session. All adverse events will be reviewed by the research team and appropriately referred for clinical treatment or rest.

Participant adherence

Individual participation in each exercise session (both land and aquatic) will be recorded by the physiotherapist responsible for the intervention with a “0” if the participant does not attend or a “1” if the participant is present and participates. Strategies will be

adopted to promote adherence to the exercises, including text messages and/or email (Connelly et al., 2013). If a participant misses two consecutive sessions, he/she will be contacted to resume the exercise sessions, as lack of adherence may affect the results obtained (Sherrington et al., 2011). At the end of the interventions, participants who do not achieve at least 80% of the total sessions will be excluded from data analysis (Brellenthin et al., 2019; Ferreira et al., 2022).

Statistical analysis

An inspection of the data will be made for missing values or univariate outliers. A priori power analysis through G*Power (3.1.9.7) and ANOVA repeated measures, within-between interaction will be use to determine the required sample size considering the following input parameters: (effect size $f = 0.4$; α err prob = 0.05; statistical power = 0.95) (Faul et al., 2007; Flores et al., 2024). Data analyses will be performed using SPSS Statistics version 29.0 (SPSS Inc., IBM Company, Chicago, Illinois, USA). Descriptive statistics (mean ± SD) will be performed for all variables in the analysis. Assuming data normality, a 2 × 3 within-between interaction factorial ANOVA will be applied for intra and inter group comparisons. To control for Type I errors, multiple comparisons will be adjusted using the Bonferroni correction (i.e., alpha level divided by the number of tests) as suggested by several authors (e.g., Ho, 2014). The magnitude of the global effect size will be calculated using Cohen's effect size. The Cohen's *d* effect size is categorized according to the following criteria: $d = < 0.20$ (small), 0.21–0.79 (medium) and > 0.80 (large) (Cohen, 1988; Silva et al., 2022; Silva et al., 2024). Significance level set at $P \leq 0.05$. Full statistical analysis and results are expected to be completed in May 2025.

Discussion

This study will investigate and compare the effectiveness of a water-based and land-based exercise program versus a solely water-based program on pain levels, functional disability, quality of life, lumbar mobility, and fear of movement in adults with CLBP. Additionally, an effort will be made to assess the effect of the cessation of exercise on the mentioned variables, 4 weeks after the end of the intervention. A minimum of 15 participants per group is expected to ensure the calculated sample power. However, a higher number of participants should be ensured, as it is known that approximately 50%

of participants drop out within the first six months due to personal characteristics, environmental factors, or issues with the programs (Robison & Rogers, 1994). On the other hand, in order to maintain the methodological quality of the study, according to the Physiotherapy Evidence Database (PEDro) Scale, the variables should be measured at the end in more than 85% of the participants who were initially randomized (Maher et al., 2003).

Previously, an author conducted a RCT with 12 participants (6 in the experimental group and 6 in the control group) in which the effect of an aquatic exercise program (experimental) was compared with that of a land-based program (control) on the level of pain and mobility of the lumbar spine (Bello et al., 2010). At the end of the interventions (6 weeks), no statistically significant differences were observed in pain (VAS) ($P = 0.523$), nor in the lumbar spine mobility test (Modified-Modified Schober Test) ($P = 0.56$). Another author also studied in a RCT the differences between a group of participants who engaged in an aquatic exercise program (experimental) and a group who engaged in a land-based program (control) with 65 individuals with LBP (32 in the experimental group and 33 in the control group) (Dundar et al., 2009). After 4 weeks of intervention, statistically significant differences were observed favoring the experimental intervention in the ODI score ($P < 0.001$) and in the physical function ($P < 0.001$) and physical performance ($P < 0.001$) domains of the SF-36 questionnaire. No statistically significant differences were found between the groups in rest pain, pain during movement, or nocturnal pain (VAS), in lumbar mobility test (Modified-Modified Schober Test), or in the remaining domains of the SF-36 questionnaire.

The study (RCT) with the most similar methodology was conducted with 66 participants (33 in each group) and aimed to examine the effect of an experimental aquatic and land-based exercise program compared to a control program of exclusively land-based (home-based) (Yücesoy et al., 2021). After two weeks of intervention, statistically significant differences were observed favoring the experimental intervention in pain: VAS at rest ($P < 0.001$), during exercise ($P < 0.001$), and overall in the lumbar spine ($P < 0.001$); in the ODI score ($P = 0.045$); and in the SF-36 domains of physical performance ($P = 0.033$), mental health ($P = 0.021$), pain ($P = 0.014$), and general health ($P = 0.05$). No statistically significant differences were found between the groups in the

remaining domains of the SF-36 questionnaire or in the Modified-Modified Schober Test.

No study with a similar methodology has reported results for the TSK-13 questionnaire to date. Thus, it is challenging to predict the results of the study, as the methodologies differ and the sample sizes and intervention durations vary considerably among authors. It is not possible to project whether the group that will undertake the additional land-based exercise session will achieve better outcomes than the experimental group at the end of the intervention, in the studied variables. However, the variables most sensitive to the presented interventions appear to be pain, measured by VAS, functional disability measured by ODI, and some domains of the SF-36 related to pain and physical performance. These are likely to be the variables with the greatest variability at the end of the study. On the other hand, it is difficult to predict the trend of changes in the studied variables after 1 month of exercise cessation due to the lack of reference literature.

Thus, this study aims to provide implications for the practice and prescription of physical exercise and effective strategies that may contribute to potential benefits for individuals with LBP. Like all studies, this one will have some limitations: it will be impossible to fully control activities outside of the protocol, which may affect the studied variables either positively or negatively, and aquatic exercise limits the calculation of exercise intensity, which will be monitored only through perceived exertion.

Dissemination of results

Upon completion of the study, regardless of the direction and magnitude of the results, they will be published. The results will be communicated to the participants and their families, the scientific community, and the general public, through oral presentations and publications in recognized journals in the field.

Authorship of the manuscripts resulting from this study will be based on: significant contributions to the study conceptualization or design, formal analysis and/or interpretations of the data, and revising and editing the manuscript critically.

Chapter 2 - Effects of a land and aquatic exercise-based program on pain and functional disability in patients with chronic low back pain: a randomized controlled trial

Abstract

Background: Chronic low back pain (CLBP) is a common musculoskeletal condition with significant global impact. Exercise programs, whether land-based or aquatic, are considered a primary treatment for reducing pain and disability. This study aimed to evaluate the effects of a combined aquatic and land-based exercise program to an aquatic-only program on pain, functional disability, fear of movement, and lumbar mobility in adults with CLBP. It also assessed the impact of training cessation 4 weeks post-intervention.

Methods: This randomized controlled trial included 58 participants, randomly assigned to either the control group (AG) or the study group (ALG). The AG performed 8-week of 45 minutes aquatic-exercise sessions, twice a week. The ALG followed the same aquatic program and added 8 weeks of 25-35 minutes land-based exercise sessions, once a week. Pain at rest, at movement and at night (Visual Analogue Scale), disability (Oswestry Disability Index), fear of movement (Tampa Scale of Kinesiophobia-13), and lumbar mobility (Modified-Modified Schober Test) were assessed at baseline, 8 weeks, and 12 weeks.

Results: A total of 41 participants completed the intervention (ALG, $n = 20$; AG, $n = 21$). Pain at rest, at movement and at night ($P < 0.001$), disability ($P < 0.001$), fear of movement ($P = 0.001$), and lumbar mobility ($P < 0.001$) were improved in both groups after interventions (time effect). ALG showed greater reductions in pain at rest ($P = 0.043$), at movement ($P = 0.005$) and at night ($P = 0.004$), and disability ($P = 0.014$) compared to the AG (interaction effect). All results significantly worsened following the detraining period ($P < 0.001$).

Conclusion: This study demonstrated that both exercise programs effectively improved the assessed outcomes, with the combined-exercise program showing a slightly better

response. Additionally, a 4-week detraining period negatively impacted all outcomes in CLBP patients.

Keywords: Aquatic Therapy, Disability, Exercise, Kinesiophobia, Low Back Pain.

Introduction

Chronic low back pain (CLBP) is one of the most frequent public health problems, affecting near 619 million people worldwide according to the GBD (2023) and it is estimated that over 80% of people will experience at least one episode of low back pain in their lifetime (Freburger et al., 2009). Usually, CLBP is distinguished in two main categories: specific, when the cause is linked to a specific pathology or structural injury, and non-specific, which accounts for approximately 90% of cases, when no identifiable cause can be determined (GBD, 2023). Studies show that CLBP is the single leading cause of disability worldwide (WHO, 2023a), leading to long-term work absence (Serranheira et al., 2020), and elevated direct and indirect annual costs associated with health care resources usage (Balagué et al., 2012; Dagenais et al., 2008; Vlaeyen et al., 2018).

CLBP is usually related to sedentary behavior activities, such as prolonged sitting time and driving time (Baradaran Mahdavi et al., 2021). Previous studies identified potential mechanisms connecting prolonged sitting to CLBP (Gupta et al., 2015; Korshøj et al., 2018; Sribastav et al., 2018), including increased intra-discal pressure (Roman-Liu et al., 2023), stiffness of the lumbar spine (Beach et al., 2005), and reduced skeletal muscle mass and strength of the spine muscles (Pinto et al., 2023). It is proposed that prolonged sitting position can increase the stress on passive lumbopelvic structures, leading to reduced requirement for trunk muscles activity (O'Sullivan et al., 2006), that simultaneously contributes to the decrease of the spinal passive and active stability (Howarth et al., 2013; Kett et al., 2021). To maintain the spinal stability, the neuromuscular system typically generates a hyperexcitability reflexive response of the spinal muscles (Solomonow, 2012). These changes can impede microcirculation in muscle tissue, potentially leading to the formation of weak but persistent cross-bridges between myosin heads and actin filaments (Kett et al., 2021). As a result, there may be an increase in muscle stiffness (Proske & Morgan, 1999), loss of lumbar lordosis (Chun

et al., 2017), and deficiencies in spinal muscle morphology and composition (Seyedhoseinpoor et al., 2022), which is significantly related to CLBP (Chun et al., 2017; Thomas et al., 1998).

In addition, the persistence of CLBP commonly results in high levels of disability, conducting to difficulties with carrying out the activities of daily living, the social and work-life (Sielski et al., 2017). Chronic pain can also result in activity avoidance, due to fear of movement associated with the pain (Foster, 2011). Nevertheless, there appears to be no clear connection between high levels of kinesiophobia and the severity of disability in people with CLBP (Alaca et al., 2020). Thus, any intervention for managing CLBP should aim to significantly improve outcomes that are relevant to the patients (National Collaborating Centre for Primary Care, 2009), including pain (Sakulsriprasert et al., 2011), disability (Maughan & Lewis, 2010; Sakulsriprasert et al., 2011), fear of movement (Alaca et al., 2020), and spinal mobility (Sakulsriprasert et al., 2011; Tousignant et al., 2005).

The significant impact of CLBP on these variables highlights the need for studying strategies to manage this condition. As prolonged periods of physical inactivity have high negative impact on CLBP (Alzahrani et al., 2020; NHS, 2022; Sribastav et al., 2018), some guidelines for the management of CLBP recommend physical exercise as a first-line treatment to reduce pain and disability, not specifying the most suitable type or intensity of exercise (National Collaborating Centre for Primary Care, 2009; Savigny et al., 2009; WHO, 2023b). In line with this, previous studies concluded that exercise can offer benefits in reducing pain and disability caused by CLBP, compared to controls receiving no treatment or a placebo intervention (Hayden et al., 2021; Roren et al., 2023). The most recent American College of Sports Medicine (ACSM) guidelines recommend people with CLBP to undertake aerobic exercise during a minimum of 150 min/week of moderate intensity, or 75 min/week of vigorous intensity, or some equivalent combination of both, and to complete 2 to 3 sessions per week of resistance training (ACSM, 2018). There is no agreement on which modality of exercise is the most effective for managing CLBP, as it varies depending on the outcome being considered (Owen et al., 2020).

Certain authors suggest different types of land-based exercises for controlling CLBP, which include aerobic (ranging from light to high intensity) (Chan et al., 2011;

Chatzitheodorou et al., 2007), muscle strengthening (Inani & Selkar, 2013; Stankovic et al., 2012), and flexibility exercises (Kuukkanen & Mälkiä, 2000). Furthermore, a study emphasizes the importance of core stability exercises, as they engage the stabilizing muscles of the lumbar spine and pelvis (Psycharakis et al., 2022). These exercises aim to address the impaired neuromotor control of the spine and pelvis, as well as the muscle weakness frequently observed in the abdominal and hip muscles of individuals with CLBP (D'Hooge et al., 2013; Nourbakhsh & Arab, 2002). However, there is no consensus on the most effective form of exercise, making it a debated issue that calls for further scientific investigation (Hayden, et al., 2005b; Smith & Osborn, 2007). As a reduction in core muscle activity, along with decreased lumbar spinal joint mobility and flexibility in muscles, can contribute to CLBP (Danneels et al., 2000; Gordon & Bloxham, 2016; Willson et al., 2005), some studies recommend activation exercises for the abdominal and spinal extensor muscles (Gordon & Bloxham, 2016; Willson et al., 2005), as well as flexibility exercises (Gordon & Bloxham, 2016; Turci et al., 2023), to help manage this condition.

Another suggested modality is aquatic exercise, which employs the characteristics and attributes of water for exercise, focusing on alleviating discomfort, enhancing muscle strength, and encouraging relaxation, along with other advantages (Camilotti et al., 2009; Cimbiz et al., 2005). Therefore, exercise in water is of specific interest, due to the distinctive characteristics of water, including buoyancy and hydrostatic (Baena-Beato et al., 2014; Bressel et al., 2011; Camilotti et al., 2009), which allows people to execute actions that are usually challenging or unattainable on land (Becker & Cole, 2004). Ma et al. (2022) stated that aquatic exercise programs were effective in alleviating pain, enhancing quality of life, and improving functional capacity in patients with CLBP, when compared to other interventions or control groups that did not receive any treatment. These achievements, according to some authors, can be attributed to the buoyancy provided during aquatic exercise, which may reduce joint stress during physical activity and alleviate pain (Abadi et al., 2019; Louw et al., 2016; Waller et al., 2009).

Comparing both modalities, researchers have discovered that water-based exercises might offer greater benefits than land-based programs for relieving low back pain, enhancing health-related quality of life, and decreasing functional disability (Bello et al., 2010; Dundar et al., 2009; Yücesoy et al., 2021). In contrast, Yalfani et al. (2020)

compared a Pilates' exercise program conducted in water against the same regimen executed on land and found that both effectively alleviated pain and dysfunction, showing no significant differences between the two programs.

Moreover, since aquatic exercise prevents individuals from training in a full weight-bearing condition, similar to what is experienced on land, some authors suggest a combined approach of aquatic exercise and land-based training for optimal progression and improvement (Carayannopoulos et al., 2020; Deng et al., 2024). However, no study has yet explored whether combining land-based and water-based exercises have an additional effect on the same variables, compared to an exclusive water-based exercise program in people with CLBP.

Additionally, few authors have explored the effects of exercise cessation (Glass et al., 2004; Mujika & Padilla, 2000). Toraman & Ayceman (2005) found that after a 9-week aerobic training program, a 4-week break led to a noticeable decline in functional mobility assessments, among others. However, these changes, while evident, did not reach statistical significance when compared to the results at the end of the intervention. Consequently, the impact of water-based exercises, core strengthening routines, and the trunk and lower limb stretching training cessation for individuals with CLBP remains uncertain.

Therefore, the purpose of this study was to evaluate the effects of a combined aquatic and land-based exercise program compared to an aquatic program on pain and functional disability in adults with CLBP. Additionally, this investigation aimed to analyze the effects on fear of movement and lumbar mobility, as well as the impact of training cessation on these variables 4 weeks after the end of the intervention.

Methods

Study design and participants

This study was a blinded, parallel-group, two-arm randomized controlled trial. Eligible participants were both gender Portuguese individuals (aged ≥ 18 years), with CLBP lasting three months or longer and with an intensity of 3 or higher on the visual analogue scale (VAS) at rest. Participants were excluded if they had pain radiating to

the lower limb, recent pregnancy or childbirth (≤ 8 weeks ago) (Kalra et al., 2017), ongoing physical therapy treatments, severe rheumatological, neurological, neoplastic, cardiovascular diseases, or other conditions that could prevent full participation in the intervention, a history of spinal surgery, inflammatory, infectious, or malignant spinal diseases, and psychiatric disorders that could affect adherence and symptom assessment (Bello et al., 2010; Dundar et al., 2009; Yücesoy et al., 2021).

Participants who met all the eligibility criteria were enrolled into either the experimental group, which underwent a combined aquatic and land-based exercise program (ALG), or the control group, which performed an aquatic-exercise program (AG), with a 1:1 allocation. Written informed consent was obtained from all participants following a comprehensive explanation of the study objectives, experimental protocols, and any associated risks. The study was reported according to the Consolidated Standards of Reporting Trials (CONSORT) statement (Schulz et al., 2010), registered in Clinicaltrials.gov (ID: NCT06641570; date of registration: October 14, 2024) and ethically approved (Ethics Committee of the Polytechnic University of Leiria; CE/IPLEIRIA/47/2024).

Intervention

A detailed description of the intervention protocol was published previously (Borges et al., 2025). Briefly, the intervention took place over 8 weeks at the Municipal Pool of Paião in Figueira da Foz, Portugal. The AG participated exclusively in the aquatic-exercise program, whereas ALG engaged in both aquatic and land-based exercise programs. The exercise sessions begun after a one-week washout period, during which participants were instructed to stop any additional physical exercise and to maintain their diet during the intervention period.

Adherence to the intervention was monitored and expressed as the percentage of total exercise sessions attended by each participant. Only those participants who achieved an adherence rate of 80% or higher were included in the final analysis (Brellenthin et al., 2019; Ferreira et al., 2022).

Aquatic-exercise program

Participants completed 8 weeks of aquatic-exercise training, twice a week, on nonconsecutive days (Monday and Wednesday), for 45 minutes per session at a water temperature between 32–34ºC. Exercise sessions were conducted in groups of 8–12 patients by a physiotherapist with extensive experience in aquatic training. Each exercise training session consisted of a warm-up (5 minutes), a training phase (35 minutes), and a relaxation/cool-down (5 minutes). The training phase included active range of motion exercises for the spine, upper and lower limbs, aerobic exercises (jumps and static running at various speeds), muscle strengthening exercises, performing 8–12 repetitions, 1–2 sets, 8-10 exercises, including hip flexion, extension, adduction, and abduction, knee flexion and extension, knee cycling, shoulder flexion, extension, and abduction, elbow flexion, extension, and pronation-supination, and squatting, and stretching exercises (5–10 minutes) for the neck, trunk, and limbs (Abadi et al., 2019; Bello et al., 2010; Dundar et al., 2009; Ma et al., 2022; Psycharakis et al., 2022). Exercise intensity was individualized and based on each participant's rate of perceived exertion (RPE) using the Borg CR-10 scale (Borg, 1998; Williams, 2017), with a progressive increase in intensity over time and the incorporation of auxiliary equipment (e.g. plates, pull-buoys). (Table 1) For participants unable to complete an exercise due to difficulty or discomfort, a modified version of the respective exercise was provided to accommodate their capabilities.

Land-based exercise program

This program included 8 weeks of specific land-based exercises training, once a week (Friday), for 25-35 minutes per session. All sessions were supervised by a physiotherapist with specialized expertise in therapeutic exercise and conducted in groups of 4-8 patients. Training sessions comprised core stability exercises (15–20 minutes) and stretching exercises of the trunk and lower limbs (10–15 minutes). Core stability exercises consisted of isometric exercises, each involving muscle contractions held for 7–8 seconds, performed for 8–12 repetitions in a single set, with brief rest intervals of 3 seconds between repetitions and 30 seconds to 1 minute between different exercises. (Table 2) (ASPN, 2022; Kim & Yim, 2020; Saleh et al., 2019; Turci et al., 2023). Stretching exercises were performed by holding each stretch at its maximum range for 30 seconds to 1 minute, returning to the original position, and resting for 5–10

seconds between repetitions. Each exercise was repeated 2-3 times (Han et al., 2016; Turci et al., 2023). Exercise intensity was progressively increased by reducing rest intervals between exercises and increasing the number of repetitions, based on participants' performance and RPE (Turci et al., 2023; Williams, 2017).

Procedures

Over a two-month period (September to October 2024), participants were invited and recruited for the study through informational posters distributed by the principal investigator, who also provided comprehensive details about all study procedures. Participants who meet the eligibility criteria were assigned an alphanumeric code to ensure data confidentiality and maintain anonymity throughout the study. Randomization was performed by the principal investigator using a block randomization (block size of 4) method generated by a computer program to ensure equal sample sizes in both groups. Group allocation was kept confidential and was only known to the physiotherapists overseeing the intervention and the principal investigator. The principal investigator was not actively involved in the intervention, data collection, or data analysis. An independent examiner assessed participants both prior to the intervention and after the 8-week intervention period, remaining blinded to group allocation. Both the data collector and data analyst were blinded to group assignments to ensure unbiased results. Only the principal investigator had full access to the entire research process and group allocation details.

Outcomes

All outcome measures were assessed in a consistent order between November 2024 and March 2025 across three time points: baseline (M0), 8-week follow-up (M1), and 12-week follow-up (4 weeks after the end of the intervention) (M2). At the beginning of each data collection session, participants completed several questionnaires, including the Visual Analog Scale to assess pain at rest, during movement, and at night, the Oswestry Disability Index, and the Tampa Scale of Kinesiophobia-13. Afterward, the physiotherapist in charge of the assessment measured the participants' weight and height, and evaluated lumbar spine mobility using the Modified-Modified Schober Test.

Primary outcomes

Visual Analogue Scale (VAS). The VAS is a unidimensional tool used to assess pain intensity and monitor its changes over time. It consists of a 100-millimeter line, which starts at 0, representing "No Pain," and ends at 10, indicating the "Worst Pain". Participants were asked to mark a perpendicular line on the scale that reflects their pain level at rest, during movement, and at night. The result was recorded on a single-use sheet of paper, and the pain intensity was determined in centimeters by measuring the distance from the origin (0) to the participant's mark (Chiarotto et al., 2019; Hawker et al., 2011). The minimal clinically important difference (MCID) for this instrument was determined to be 20mm for CLBP (Ostelo & de Vet, 2005).

Oswestry Disability Index – version 2.0 (ODI). A 10-item questionnaire was used to measure and assess the disability caused by low back pain, rated on a Likert scale ranging from 0 to 5, where 0 indicates no dysfunction and 5 represents the highest level of dysfunction. The final score was presented as a percentage, which indicates the degree of disability experienced by the individual with low back pain: 0%–20% (minimal disability), 21%–40% (moderate disability), 41%–60% (severe disability), 61%–80% (very severe disability), and 81%–100% (exaggerated symptoms) (Davidson & Keating, 2002; Fairbank et al., 1980). The MCID for this questionnaire was set at 10% (Hägg et al., 2003; Ostelo & de Vet, 2005).

Secondary outcomes

Tampa Scale of Kinesiophobia-13 (TSK-13). Fear of movement was assessed using a 13-item questionnaire, with each item rated on a 4-point Likert scale (strongly disagree, disagree, agree, and strongly agree) (Miller et al., 1991). The score ranges from 13 to 52 points, categorizing fear of movement as follows: subclinical (13–22), mild (23–32), moderate (33–42), and severe (43–52) (Neblett et al., 2016). The MCID calculated for this questionnaire was 5.5 points (Monticone et al., 2016).

Modified-Modified Schober Test (MMST). The MMST was used to assess the effects of the interventions on lumbar range of motion (ROM) (Macrae & Wright, 1969). The participants were instructed to stand in an upright position, enabling the examiner to mark both Posterior Superior Iliac Spines (PSIS) with a skin marker. The examiner then drew a horizontal line between the two marks, marking a point at the intersection of this

line with the spine (the center of both marks), and a second point was marked 15 cm above the first. Finally, the participant was instructed to bend their trunk as if attempting to "touch their toes" and the examiner measured the distance between the upper and lower lines once again. This measurement was used to indicate the amount of lumbar flexion, and the procedure was repeated three times, with a 30-second break between repetitions, taking the best result (Tousignant et al., 2005). To standardize data collection, each participant was instructed to stand barefoot on a piece of paper where the outline of their feet was drawn, ensuring consistent positioning for all measurements. Participants were instructed to place their feet at hip-width apart and their upper limbs relaxed along the body in the test starting position (Amjad et al., 2022; Cidem et al., 2012). The minimal detectable difference (MDC) for MMST was calculated to be 1 cm (Sakulsriprasert et al., 2011; Tousignant et al., 2005).

Sample size

The sample size calculation was based on a similar study by Dundar et al. (2009), and was corroborated by other studies (Assis et al., 2006; Geneen et al., 2017; Hayden, et al., 2005a), which included 65 participants and aimed to detect differences in pain intensity (VAS) between the aquatic-exercise program group and the control group (land exercise). In order to achieve a significant and an identical effect size of 1.079 with a power of 0.80, and an α of 0.05, 30 participants (15 in each group) were needed to complete the study. This sample size was calculated using the G*Power software (version 3.1.9.4; Heinrich Heine University Düsseldorf, DE). The expected drop-out rate was approximately 15% (Collado-Mateo et al., 2021; Robison & Rogers, 1994), indicating that a minimum of 36 participants (18 per group) needed to be enrolled at baseline.

Statistical Analysis

Sociodemographic variables were collected to describe the sample. Continuous variables are presented as mean ± SD and categorical variables as counts and percentages. The normality of the data was assessed through histograms, normal probability plots (P–P graphs), and the Shapiro–Wilk test. Leven's test was used to test the homogeneity of variances. The z values, calculated by dividing skewness and kurtosis by their corresponding standard error, were also analyzed to assess the

statistical significance of any deviations from normal distribution. A z value less than 1.96 indicated that the data followed a normal distribution (Field, 2024). Comparisons between groups at baseline were conducted using the Student's independent t-test for continuous outcomes and the chi-square test or Fisher's exact test for categorical outcomes. A 2 × 3 within-between interaction factorial ANOVA was used to examine the main effects of time, group, and interaction (time*group) and the Holm–Bonferroni *post hoc* test was conducted when significant differences were observed (Ho, 2014). The sphericity was confirmed using Mauchly's W test or the Greenhouse–Geisser correction when required. The magnitude of the global effect size was calculated using Cohen's effect size (d). The Cohen's d was categorized according to the following criteria: d = < 0.20 (trivial), 0.21-0.50 (small), 0.51–0.79 (medium) and > 0.80 (large) (Cohen, 1988; Silva et al., 2022; Silva et al., 2024). The mean change between time points (Δ) was calculated for each outcome (M1-M0, M2-M1, and M2-M0) and compared to the MCID to assess clinical differences. The IBM SPSS Statistics, version 29.0 (IBM Corporation, Armonk, NY) was used to perform all statistical analyses. Graphs were generated using GraphPad Prism 9.0 software (Dotmatics, Boston, MA). Significance level was set at $P \leq 0.05$.

Results

A total of 58 participants were initially assessed for eligibility. Seventeen participants were excluded from the study, leaving 41 individuals who were successfully randomized (ALG, n = 20; AG, n = 21) (Figure 2). The participants had a mean age of 61.66 ± 11.74 years, with 71.1% being female. No significant baseline differences were observed between the groups for continuous ($0.058 \leq P \leq 0.748$) and categorical ($0.139 \leq P \leq 1.000$) variables. Detailed baseline characteristics are outlined in Table 4. The drop-out rate was 4.88% at 8 weeks (ALG = 0%; AG = 9.52%) and 7.32% at 12 weeks (ALG = 0%; AG = 14.29%).

Adherence to the exercise programs was calculated, revealing an adherence rate of 95.56% (ALG) and 95.49% (AG) to the aquatic-exercise program and 94.38% (ALG) to the land-based exercise program. No adverse events related to the study intervention or procedures were reported.

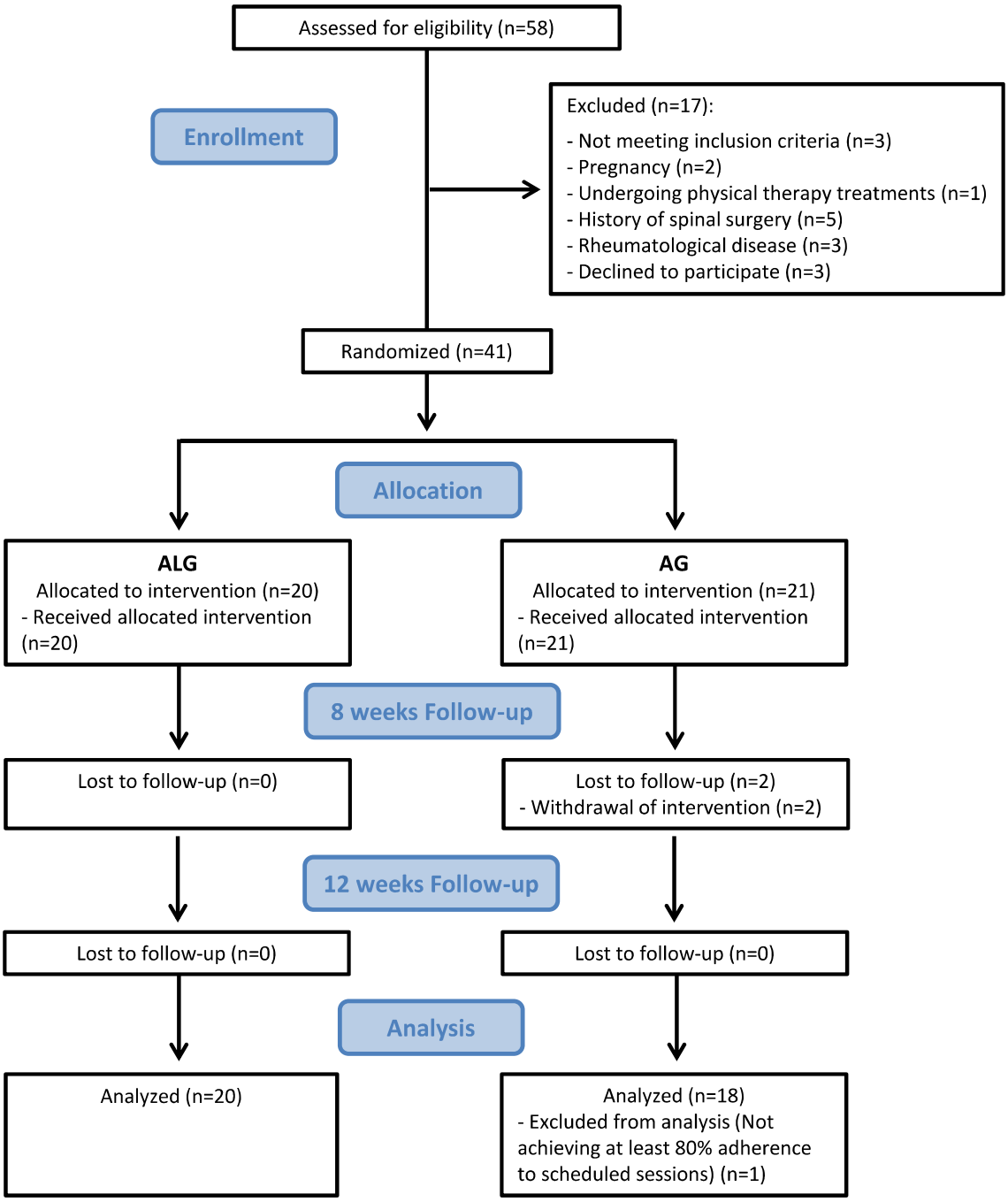

Figure 2 - Flowchart of participant enrolment, allocation, and analysis.

Table 4 - Baseline characteristics of all study participants.

	All (n = 38)	**Aquatic-exercise group** (n = 18)	**Aquatic and land-exercise group** (n = 20)	***P value***
Age (years)	61.66 ± 11.74	61.00 ± 12.65	62.25 ± 11.16	0.748[a]
Height (m)	1.62 ± 0.07	1.63 ± 0.07	1.61 ± 0.07	0.385[a]
Weight (Kg)	74.21 ± 12.85	72.27 ± 12.74	75.97 ± 13.03	0.383[a]
BMI (Kg.m^{-2})	28.28 ± 4.55	27.24 ± 4.84	29.21 ± 4.17	0.187[a]
Gender, *n* (%)				0.572[b]
Male	11 (28.9)	6 (33.3)	5 (25.0)	
Female	27 (71.1)	12 (66.7)	15 (75.0)	
Comorbidities, *n* (%)				
Hypertension	13 (34.2)	4 (22.2)	9 (45.0)	0.139[b]
Dyslipidemia	21 (55.3)	9 (50.0)	12 (60.0)	0.536[b]
Diabetes	8 (21.1)	4 (22.2)	4 (20.0)	1.000[b]
Gastrointestinal disease	2 (5.3)	0 (0.0)	2 (10.0)	0.488[b]
Respiratory disease	1 (2.6)	1 (5.6)	0 (0.0)	0.474[b]
Osteoarticular disease	3 (7.9)	2 (11.1)	1 (5.0)	0.595[b]
Mental Disorder	3 (7.9)	2 (11.1)	1 (5.0)	0.595[b]
Smoking habits, *n* (%)				0.482[b]
Smoker	3 (7.9)	1 (5.6)	2 (10.0)	
Non-smoker	31 (81.6)	14 (77.8)	17 (85.0)	
Ex-smoker	4 (10.5)	3 (16.7)	1 (5.0)	
Pain				
Disease duration (years)	10.49 ± 10.71	7.47 ± 7.25	13.20 ± 12.64	0.093[a]
Pain at rest (VAS) (cm)	5.79 ± 1.65	5.95 ± 1.74	5.65 ± 1.61	0.584[a]
Pain at movement (VAS) (cm)	5.99 ± 2.26	5.76 ± 2.48	6.20 ± 2.08	0.557[a]
Pain at night (VAS) (cm)	4.44 ± 2.71	4.18 ± 2.64	4.67 ± 2.82	0.583[a]
Disability level				
ODI (%)	39.89 ± 14.43	43.56 ± 15.74	36.60 ± 12.63	0.140[a]
Fear of movement				
TSK-13 (score)	33.24 ± 4.59	34.50 ± 4.34	32.10 ± 4.62	0.109[a]
Lumbar mobility				
MMST (cm)	20.69 ± 1.11	20.33 ± 1.21	21.01 ± 0.92	0.058[a]
Adherence to exercise program (%)				
Aquatic-exercise program	96.05 ± 4.91	95.49 ± 5.17	95.56 ± 4.74	0.507[a]
Land-exercise program	94.38 ± 6.38	-	94.38 ± 6.38	-

Notes: Values are expressed in mean ± SD or n (%).

[a] Independent Samples t Test.

[b] Chi-squared test or Fisher's exact test.

Abbreviations: BMI = body mass index; VAS = Visual Analogue Scale; ODI = Oswestry Disability Scale; TSK-13 = Tampa Scale for Kinesiofobia-13; MMST = Modified-Modified Schober Test.

Primary outcomes

Pain and disability level outcomes at baseline, after 8- and 12-week follow-ups are presented in Table 5. The analysis revealed a significant effect of time on pain at rest, movement, and night, indicating noticeable differences across the various time points. Pairwise comparisons showed that pain at rest, at movement and at night decreased from baseline to 8-week ($P < 0.001$, for all 3 variables), and from baseline to 12-week follow-up ($P < 0.001$, for all 3 variables). Furthermore, between the 8- and 12-week follow-ups pain significantly increased ($P < 0.001$, for all 3 variables).

Additionally, mean change results showed that participants in the ALG experienced a greater reduction compared to the AG in pain at rest (ALG: $\Delta = -3.90$, $d = -2.69$, large; AG: $\Delta = -2.45$, $d = -1.25$, large), at movement (ALG: $\Delta = -4.02$, $d = -2.62$, large; AG: $\Delta = -1.71$, $d = -0.75$, medium) and at night (ALG: $\Delta = -3.77$, $d = -1.99$, large; AG: $\Delta = -1.46$, $d = -0.62$, medium) from baseline to the 8-week follow-up. When comparing the mean change between baseline and the 12-week follow-up, the ALG sustained a greater reduction than the AG in pain at rest (ALG: $\Delta = -2.63$, $d = -1.82$, large; AG: $\Delta = -1.53$, $d = -0.74$, medium), at movement (ALG: $\Delta = -2.63$, $d = -1.53$, large; AG: $\Delta = -1.41$, $d = -0.61$, medium) and at night (ALG: $\Delta = -2.96$, $d = -1.48$, large; AG: $\Delta = -1.12$, $d = -0.48$, small). On the other hand, between the 8- and 12-week follow-ups, the ALG showed a greater increase than the AG in pain at rest (ALG: $\Delta = 1.27$, $d = 0.99$, large; AG: $\Delta = 0.92$, $d = 0.40$, small), at movement (ALG: $\Delta = 1.39$, $d = 1.18$, large; AG: $\Delta = 0.29$, $d = 0.14$, trivial) and at night (ALG: $\Delta = 0.82$, $d = 0.76$, medium; AG: $\Delta = 0.33$, $d = 0.16$, trivial). The mean change values in the ALG exceeded the MCID for EVA (20 mm) from baseline to the 8- and 12-week follow-ups in pain at rest, at movement and at night. In the AG, the MCID was only surpassed in pain at rest between baseline and the 8-week follow-up.

All pain-related outcomes showed a significant time-group interaction (Table 5). In addition, a significant difference between groups was found for pain at rest (Table 5). After the 8-week follow-up, the ALG was significantly lower than the AG for pain at rest ($d = -0.94$, large; $P = 0.004$) (Figure 3A), at movement ($d = -1.18$, large; $P < 0.001$) (Figure 3B), and at night ($d = -1.14$, large; $P = 0.001$) (Figure 3C). The ALG remained significantly lower than the AG after the 12-week follow-up for pain at rest ($d = -0.74$, medium; $P = 0.028$) (Figure 3A), and at night ($d = -0.82$, large; $P = 0.016$) (Figure 3C).

Table 5 - Differences between baseline, after 8- and 12-week follow-ups, and between groups on pain, disability level, fear of movement and lumbar mobility outcomes, calculated with mixed ANOVA with repeated measures.

	Aquatic-exercise group (*n* = 18)						Aquatic and land-exercise group (*n* = 20)						Time		Group		Interaction	
Outcome	Baseline (M0)	8 weeks (M1)	12 weeks (M2)	Δ (M1 - M0)	Δ (M2 - M1)	Δ (M2 - M0)	Baseline (M0)	8 weeks (M1)	12 weeks (M2)	Δ (M1 - M0)	Δ (M2 - M1)	Δ (M2 - M0)	*F*	*P*	*F*	*P*	*F*	*P*
Pain																		
Pain at rest (VAS) (cm)	5.95 ± 1.74	3.50 ± 2.19	4.42 ± 2.38	-2.45[a]	0.92	-1.53	5.65 ± 1.61	1.76 ± 1.28	3.02 ± 1.28	-3.90[a]	1.27	-2.63[a]	70.561	**<0.001**	5.627	**0.023**	3.872	**0.043**
Pain at movement (VAS) (cm)	5.76 ± 2.48	4.06 ± 2.05	4.35 ± 2.14	-1.71	0.29	-1.41	6.20 ± 2.08	2.19 ± 0.99	3.57 ± 1.36	-4.02[a]	1.39	-2.63[a]	45.401	**<0.001**	2.141	0.152	7.009	**0.005**
Pain at night (VAS) (cm)	4.18 ± 2.64	2.72 ± 2.09	3.06 ± 2.03	-1.46	0.33	-1.12	4.67 ± 2.82	0.90 ± 0.97	1.72 ± 1.17	-3.77[a]	0.82	-2.96[a]	45.045	**<0.001**	2.356	0.134	8.908	**0.004**
Disability level																		
ODI (%)	43.56 ± 15.74	32.33 ± 11.65	36.33 ± 8.82	-11.22[b]	4.00	-7.22	36.60 ± 12.63	12.40 ± 6.51	20.70 ± 8.24	-24.20[b]	8.30	-15.90[b]	45.385	**<0.001**	25.355	**<0.001**	6.132	**0.014**
Fear of movement																		
TSK-13 (score)	34.50 ± 4.34	32.50 ± 5.72	34.44 ± 5.29	-2.00	1.94	-0.06	32.10 ± 4.62	27.40 ± 4.55	29.15 ± 4.60	-4.70	1.75	-2.95	10.405	**0.001**	10.246	**0.003**	2.418	0.122
Lumbar mobility																		
MMST (cm)	20.33 ± 1.21	20.97 ± 1.18	20.18 ± 1.24	0.63	-0.78	-0.15	21.01 ± 0.92	21.50 ± 1.24	20.29 ± 1.76	0.49	-1.22	-0.73	11.430	**<0.001**	1.642	0.208	1.020	0.355

Notes: Values are expressed in mean ± SD. Bold *P* values mean significant differences.

[a] Value greater than the minimal clinically important difference calculated for VAS (20mm) (Ostelo & de Vet, 2005).

[b] Value greater than the minimal clinically important difference calculated for ODI (10%) (Hägg et al., 2003; Ostelo & de Vet, 2005).

Abbreviations: Δ = mean change between time points; VAS = Visual Analogue Scale; ODI = Oswestry Disability Scale; TSK-13 = Tampa Scale for Kinesiofobia-13; MMST = Modified-Modified Schober Test.

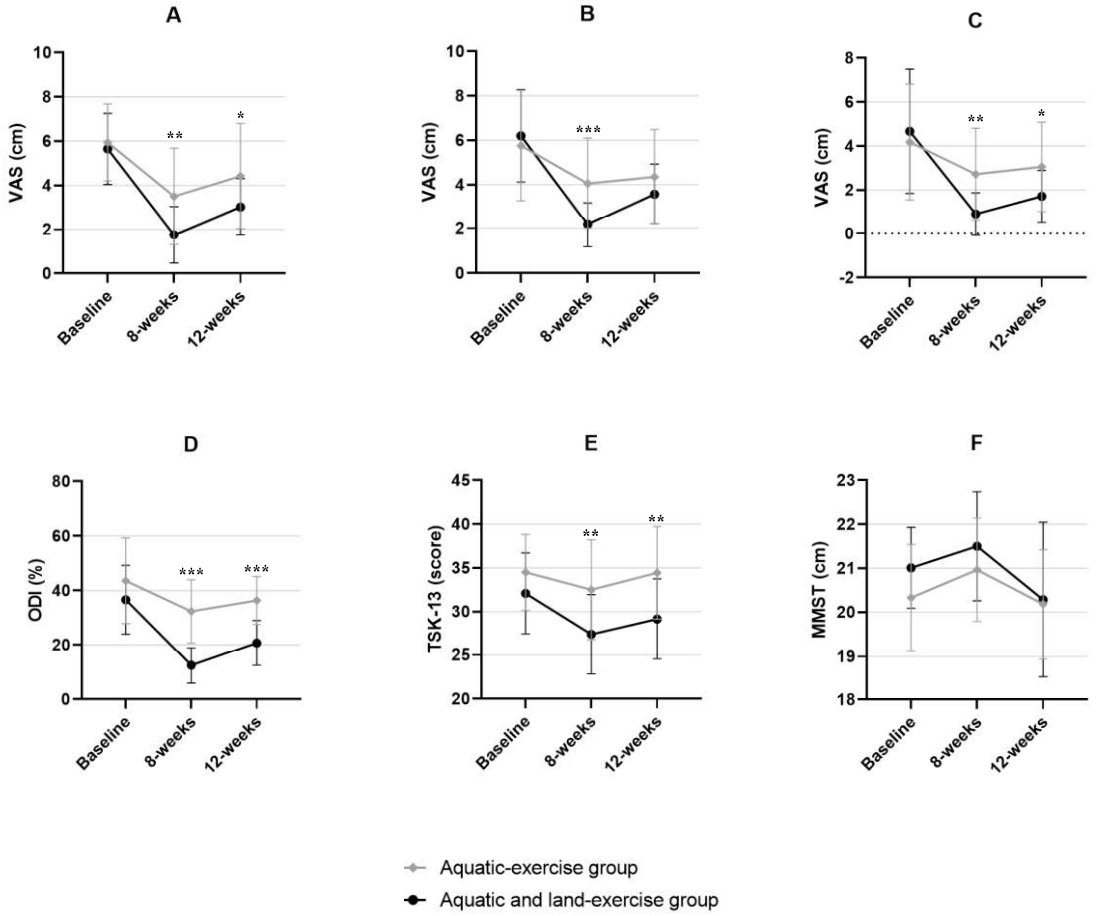

Figure 3 - Differences between baseline, 8- and 12-week follow-ups, and between groups on (A) Pain at rest, (B) Pain at movement, (C) Pain at night, (D) Disability level, (E) Fear of movement and (F) Lumbar mobility.

The light gray line represents the aquatic-exercise group and the black line represents the aquatic- and land based-exercise group. All values are presented as mean ± SD. A 2 x 3 within-between interaction factorial ANOVA with Holm–Bonferroni *post hoc* test was used. **P* < 0.05, ***P* < 0.01, ****P* < 0.001 difference between groups. VAS = Visual Analogue Scale; ODI = Oswestry Disability Index; TSK-13 = Tampa Scale of Kinesiophobia-13; MMST = Modified-Modified Schober Test.

Regarding disability level, the analyses revealed a significant effect of time (Table 5). Pairwise comparisons indicated that disability decreased from baseline to the 8-week and 12-week follow-ups ($P < 0.001$, for both comparisons). Between the 8- and 12-week follow-ups, disability increased significantly over time ($P < 0.001$). Moreover, the ALG showed a larger reduction in mean change than the AG in disability level from baseline to the 8-week follow-up (ALG: $\Delta = -24.20$, $d = -2.53$, large; AG: $\Delta = -11.22$, $d = -0.82$, large) and to the 12-week follow-up (ALG: $\Delta = -15.90$, $d = -1.52$, large; AG: $\Delta = -7.22$, $d = -0.59$, medium). The ALG ($\Delta = 8.30$, $d = 1.13$, large) had a greater increase in disability than the AG ($\Delta = 4.00$, $d = 0.39$, small) between the 8 and 12-week follow-ups. Additionally, the mean change in the ALG overtook the MICD for ODI (10%) from baseline to the 8- and 12-week follow-ups. In contrast, the AG only exceeded the MCID between baseline and the 8-week follow-up.

A significant time-group interaction was also observed for disability level (Table 5). The between-groups analysis revealed a significant difference between both groups (Table 5). Disability level in the ALG was significantly lower compared to the AG at the 8-week ($d = -2.25$, large; $P < 0.001$) and 12-week ($d = -1.84$, large; $P = 0.001$) follow-ups (Figure 3D).

Secondary outcomes

Fear of movement and lumbar mobility outcomes at baseline, after 8- and 12-week follow-ups are displayed in Table 5. A significant effect of time was found for fear of movement. A significant decrease in fear of movement was evidenced from baseline to 8-week follow-up ($P = 0.002$). In contrast, this outcome significantly increased between the 8- and 12-week follow-ups ($P < 0.001$).

The mean change results demonstrated a greater reduction in the ALG compared to the AG between baseline and the 8-week (ALG: $\Delta = -4.70$, $d = -1.03$, large; AG: $\Delta = -2.00$, $d = -0.40$, small) and the 12-week follow-ups (ALG: $\Delta = -0.95$, $d = -0.64$, medium; AG: $\Delta = -0.06$, $d = -0.01$, trivial). Nevertheless, from the 8- to the 12-week follow-ups, the AG ($\Delta = 1.94$, $d = 0.35$, small) experienced a greater increase compared to ALG ($\Delta = 1.75$, $d = 0.38$, small). When mean changes were compared to the MCID for TSK-13 (5.5 points), no clinical differences were observed in both groups.

No significant time-group interaction was found for this outcome (Table 5). However, fear of movement revealed significant differences between groups (Table 5). Further analysis revealed that fear of movement levels were significantly lower in the ALG compared to the AG at the 8- (d = -0.99, large; P = 0.004) and 12-week (d = -1.07, large; P = 0.002) follow-ups (Figure 3E).

The analysis of lumbar mobility showed a significant effect of time (Table 5). Pairwise comparisons revealed a significant increase in this outcome between baseline and the 8-week follow-up (P = 0.002). However, a significant decrease (P < 0.001) was observed for this outcome from the 8- to the 12-week follow-ups.

In addition, the mean change results showed a slightly larger increase in the AG (Δ = 0.63, d = 0.53, medium) compared to the ALG (Δ = 0.49, d = 0.45, small), between baseline and the 8-week follow-up. Furthermore, the ALG revealed a higher decrease than the AG from baseline to the 12-week follow-up (ALG: Δ = -0.73, d = -0.54, medium; AG: Δ = -0.15, d = -0.12, trivial) and between the 8- and 12-week follow-ups (ALG: Δ = -1.22, d = -0.81, large; AG: Δ = -0.78, d = -0.65, medium). Comparison of mean change values with the MDC for MMST (1 cm) revealed no clinically relevant changes.

Time-group interaction (Table 5) and between groups (Figure 3F) analysis presented no significant differences.

Discussion

The current study examined the effects of a combined aquatic and land-based exercise program compared to an aquatic-exercise program on pain and disability in participants with CLBP. Therefore, this study aimed to explore the effects on fear of movement and lumbar mobility, as well as the impact of training cessation on these variables 4 weeks after the end of the intervention. The main finding of this study shows that both combined and aquatic 8-week exercise programs reduce pain and disability in people with CLBP.

These findings are consistent with previous studies that demonstrated the effects of aquatic (Abadi et al., 2019; Dundar et al., 2009; Han et al., 2011; Heidari et al., 2023;

Ma et al., 2022), and land-based (Fernández-Rodríguez et al., 2022; Hayden et al., 2021; Kim & Yim, 2020) exercise programs on pain and disability in people with CLBP. A previous study found that a 10-week aquatic-exercise program reduced VAS pain in people with CLBP (Han et al., 2011). Abadi et al. (Abadi et al., 2019) also revealed that a 12-week aquatic-exercise program may be effective to decrease functional disability in obese women with CLBP. Furthermore, both core stability exercise and hip muscle stretching 6-week land-based exercise programs had greater improvements in pain intensity and disability level than sham intervention (Kim & Yim, 2020). These findings are particularly significant, as both forms of exercise appear to contribute substantively to the reduction of the impact of CLBP (Hayden et al., 2021). However, when comparing aquatic to land-based exercise programs, the differences appear to be minimal regarding pain intensity and disability level, as both appear to be equally effective (Bello et al., 2010; Sjogren et al., 1997; Yalfani et al., 2020). Firstly, aquatic-exercise can enhance blood flow velocity and promote muscle relaxation, which aids in reducing pain stimuli (Kamioka et al., 2010). On the other hand, evidence suggests that land-based exercises may induce greater improvements in muscle performance compared to water-based exercises (Booth et al., 2017), particularly when targeting the abdominal, spinal, and pelvic muscles, which is a crucial factor to manage CLBP (Kim & Lee, 2017; Lee et al., 2014).

The observed reductions in pain and disability exceeded the MICD thresholds for both VAS and ODI, with the most pronounced improvements noted in the ALG group. This finding is particularly important, as a statistically significant mean difference does not necessarily reflect a clinically meaningful change from the perspective of the patients receiving treatment (Cook, 2008; Malec & Ketchum, 2020). This suggests that participants in this study may have experienced perceptible changes in pain and disability, indicating improvements of relevant clinical significance in the management of CLBP (Sedaghat, 2019).

Another key finding of this study was that the combined-exercise program led to significantly greater improvements than aquatic-exercise program in pain intensity and disability. These results are in line with similar previous studies that that reported a decrease in pain intensity at rest and during exercise, and disability level in patients with CLBP (Dundar et al., 2009; Yücesoy et al., 2021). The study of Yücesoy et al. (2021) observed that a 2-week combined training significantly reduced VAS and ODI scores

compared to a home exercise program. These findings may be attributed to the combined advantages offered by both aquatic- and land-based exercise modalities. On one hand, water temperature and immersion play significant roles in influencing the expression of Interleukin (IL)-10 (Gálvez et al., 2018). IL-10 is known to enhance endogenous anti-cytokines and suppress pro-inflammatory cytokine receptors, potentially playing a key role in chronic pain management (Uçeyler et al., 2006; Zhang & An, 2007). On the other hand, land-based exercise programs that emphasize the strengthening of trunk and lumbopelvic musculature contribute to the maintenance of spinal stability during upper and lower limb movements, and promote more efficient neuromuscular recruitment patterns (Fernández-Rodríguez et al., 2022). In addition, core stability exercises enhance the functional synergy between the transversus abdominis and multifidus muscles, potentially leading to significant improvements in lumbar stability (Kim & Yim, 2020; Smrcina et al., 2022). These factors may have collectively accounted for the greater efficacy of combined-exercise interventions in reducing pain and disability in this study.

These findings are particularly significant, as elevated pain intensity is associated with an increased risk of developing persistent and disabling CLBP (Hartvigsen et al., 2018). Thus, the implemented exercise programs may help interrupt the negative cycle of pain-functional incapacity, which is often associated with reduced ability to perform daily activities and diminished quality of life, impacting physical, emotional, and social well-being (Campbell et al., 2013; Dubois et al., 2014).

Another notable finding of this study was the reduction in fear of movement observed in both groups. Previous studies have also reported significant reductions in kinesiophobia following a 12-week aquatic-exercise program (Peng et al., 2022) or a 12-week core stability land-based intervention (Cruz-Díaz et al., 2018). This reduction is particularly important for patients with CLBP within the framework of the fear-avoidance model, which posits that fear of pain leads to the avoidance of physical activities, ultimately contributing to functional disability (Hartvigsen et al., 2018). Therefore, increased patient confidence and engagement in physically demanding tasks may contribute to improved neuromuscular function, which in turn could positively influence levels of kinesiophobia (Cruz-Díaz et al., 2018).

Although the ALG demonstrated significantly greater improvements than the AG after the 8-week follow-up, neither group achieved changes exceeding the MICD. A possible explanation for the lack of effect is that pain beliefs are shaped by cognitive mechanisms influenced by prior experiences, cultural background, and educational factors (Alaca et al., 2020). Thus, incorporating cognitive-behavioral therapy or pain education may enhance the clinically relevant benefits of exercise interventions (Alaca et al., 2020; Sidiq et al., 2024).

Both groups showed an increase in lumbar mobility after the 8-week interventions, though neither exceeded the MDC. These results align with previous studies showing increased lumbar mobility, measured by the Modified Schober Test, after 2 weeks of aquatic-exercise (Yücesoy et al., 2021), and 12 weeks of land-based stretch and strength training (Yildirim & Gultekin, 2022). Stretching and strengthening exercises improve the strength of weakened muscles and enhance hip and spinal ROM, which may reduce pressure on the spine and provide pain relief (Kang & Kim, 2019; Kim & Yim, 2020). Withal, water's buoyancy makes it easier to perform movements with greater ROM and intensity (Yalfani et al., 2020). Still, there were no differences between the groups post-intervention. The study of Yücesoy et al. (2021) also found no differences in lumbar mobility between land-based exercise and combined aquatic- and land-based exercise after the intervention. Although the MMST is a valid and reliable measure of lumbar mobility (Amjad et al., 2022; Tousignant et al., 2005), a recent study suggested it may not fully reflect the mobility of the entire lumbar spine due to anatomical variations among participants (Taheri et al., 2024).

In this study, the 4-week detraining period was enough to significantly increase pain, disability, and fear of movement, while decreasing mobility. However, all outcome measures after the detraining period showed better results than baseline, except for mobility. Previous studies show similar results when comparing baseline to 1-, 3-, and 12-month follow-ups after treatment; although, none analyzed the detraining period (Dundar et al., 2009; Peng et al., 2022; Yücesoy et al., 2021). The worsening of results after the detraining period may be attributed to the decrease in physical activity among the participants. Insufficient physical activity is known to increase fat mass, decrease muscle mass, and cause lumbar spine stiffness, all of which play a significant role in the persistence of CLBP (Beach et al., 2005; Park et al., 2024; Seyedhoseinpoor et al., 2022). Moreover, pro-inflammatory cytokines such as IL-6, tumor necrosis factor

(TNF)-α, and C-reactive protein, which increase inflammation, are strongly linked to low physical activity levels (Park et al., 2024), and contribute to higher pain intensity and dysfunction in CLBP patients (Koch et al., 2007; Kraychete et al., 2010).

Regarding the strengths of our study, we conducted an 8-week blinded, randomized controlled trial featuring supervised aquatic- and land-based exercise sessions. Another strength of the study was the participants' high adherence to the exercise programs. In addition, the magnitude of the effect observed provided the study with considerable robustness in the inferences made. Finally, incorporating an analysis of the detraining period introduces an innovative element to this study relative to prior research.

However, the current investigation presents several limitations that justify discussion. First, the administration of anti-inflammatory or analgesic medications, as well as other non-pharmacological interventions that could influence CLBP symptoms, was not controlled. Future research should take this aspect into consideration. Second, the reduced sample size limited the ability to explore subgroup differences. More participants would make the study stronger. Finally, the effect of the intervention was not analyzed considering the risk factors for the occurrence of CLBP (low physical activity level, obesity, smoking, and high stress levels) (Stevans et al., 2021). A new investigation should incorporate these variables into their analyses.

Further research should also be conducted to investigate the effects of an extended detraining period and to better understand its impact on CLBP.

Conclusion

This study suggests that both aquatic- and combined-exercise programs effectively reduce pain, disability, and kinesiophobia, while improving lumbar mobility. However, the combined-exercise program appears to have a greater effect than the aquatic program on pain, disability, and fear of movement. Additionally, a 4-week detraining period is sufficient to negatively impact all evaluated outcomes. Importantly, the study highlights the need for continuous exercise interventions, as interruptions may have negative clinical implications in CLBP patients.

General Conclusions

The present work investigates the effects of a combined aquatic- and land-based exercise program compared to an aquatic-only exercise program in adults with chronic low back pain, including outcomes after a 4-week detraining period. So, we initially conducted a randomized controlled trial protocol that compared the previously described programs. Following the previously established protocol, we carried out an 8-week randomized controlled study comparing the two exercise programs described earlier. The study aimed to evaluate their effects on pain, functional disability, fear of movement, and lumbar mobility. Furthermore, we analyzed how these variables were affected after a 4-week detraining period.

The randomized controlled trial shows that both aquatic and combined exercise programs significantly decrease pain, disability, and kinesiophobia, while enhancing lumbar mobility. However, the combined-exercise program seems to produce greater improvements in pain, disability, and fear of movement compared to the aquatic program. Furthermore, a 4-week detraining period is enough to cause a decline in all measured outcomes.

Thus, the data presented highlights the importance of continuous exercise interventions in managing CLBP. Further research with a larger sample size is needed to examine the effects of a prolonged detraining period and to gain a deeper understanding of its impact on chronic low back pain. Additionally, the administration of anti-inflammatory medications, analgesics, and other non-pharmacological interventions should be carefully controlled.

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Chapter 1

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Appendices

Appendix 1 - Oral communication certificate

APFISIO
ASSOCIAÇÃO PORTUGUESA DE FISIOTERAPEUTAS

CERTIFICADO DE PALESTRANTE

Certifica-se que

Joana Catarina Carvalho Borges

Foi Palestrante na Jornada de Fisioterapia Aquática

Ondas de Conhecimento

que decorreu no dia 15 de Março de 2025, via Zoom, com duração de 2,30 horas.

Maria João Bigode
Presidente do CDN

APFISIO

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Appendix 2 – CIDESD International Congress 2025 - E-Poster

CIDESD International Congress 2025

Study Protocol for a Randomized Controlled Trial: Effects of a Land and Aquatic Exercise Program on Chronic Low Back Pain

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Background

Chronic low back pain (CLBP) is a condition with substantial functional, emotional, and social impacts [1-3]. Various interventions have been proposed for its management [4, 5], with either land-based [6] or water-based [7] being one of the most recommended approaches. This study outlines a randomized controlled trial designed to evaluate the effects of a combined land and aquatic exercise program compared to an exclusively aquatic exercise program on pain, functional disability, and quality of life in adults with CLBP. Additionally, the study will examine the effects of exercise cessation on these outcomes.

Methods and Design

A single-blind randomized controlled trial will be conducted with a 1:1 allocation ratio. Approximately 30 adults with mechanical CLBP will be randomly assigned to one of two groups. The experimental group (ALG) will participate in a combined land and aquatic exercise program, while the control group (AG) will follow an aquatic-only exercise program, both lasting 8 weeks. Assessments will be performed using the Visual Analogue Scale, Oswestry Disability Index, Short-Form 36, Tampa Scale of Kinesiophobia-13, and Modified-Modified Schober Test. Data will be collected at three time points: baseline (M0), post-intervention at 8 weeks (M1), and 4 weeks after intervention cessation (M2) as presented in **Figure 1**.

Discussion

This study aims to provide valuable insights into the potential benefits of a combined land and aquatic exercise program for individuals with CLBP. It will assess the program's impact on pain, functional disability, fear of movement, quality of life, and lumbar mobility.

Trial Registration

The trial is registered at ClinicalTrials.gov (registration number: NCT06641570; registration date: October 14, 2024).

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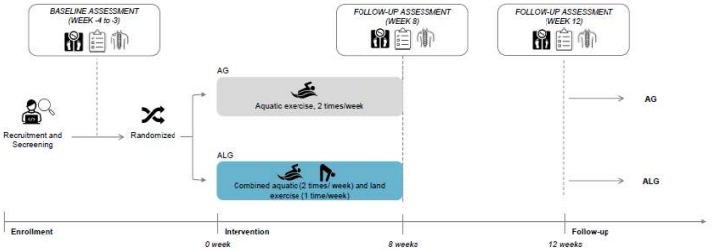

Figure 1 - Study design with key moments of the intervention and data collection.

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Appendix 3 – Standard Protocol Items: Recommendations for Interventional Trials - Checklist

SPIRIT
STANDARD PROTOCOL ITEMS: RECOMMENDATIONS FOR INTERVENTIONAL TRIALS

SPIRIT 2013 Checklist: Recommended items to address in a clinical trial protocol and related documents*

Section/item	Item No	Description	Addressed on page number
Administrative information			
Title	1	Descriptive title identifying the study design, population, interventions, and, if applicable, trial acronym	1
Trial registration	2a	Trial identifier and registry name. If not yet registered, name of intended registry	2
	2b	All items from the World Health Organization Trial Registration Data Set	2
Protocol version	3	Date and version identifier	N/A
Funding	4	Sources and types of financial, material, and other support	13
Roles and responsibilities	5a	Names, affiliations, and roles of protocol contributors	1
	5b	Name and contact information for the trial sponsor	N/A
	5c	Role of study sponsor and funders, if any, in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication, including whether they will have ultimate authority over any of these activities	13
	5d	Composition, roles, and responsibilities of the coordinating centre, steering committee, endpoint adjudication committee, data management team, and other individuals or groups overseeing the trial, if applicable (see Item 21a for data monitoring committee)	13
Introduction			
Background and rationale	6a	Description of research question and justification for undertaking the trial, including summary of relevant studies (published and unpublished) examining benefits and harms for each intervention	2-3
	6b	Explanation for choice of comparators	2-3
Objectives	7	Specific objectives or hypotheses	3
Trial design	8	Description of trial design including type of trial (eg, parallel group, crossover, factorial, single group), allocation ratio, and framework (eg, superiority, equivalence, noninferiority, exploratory)	3, 8
Methods: Participants, interventions, and outcomes			
Study setting	9	Description of study settings (eg, community clinic, academic hospital) and list of countries where data will be collected. Reference to where list of study sites can be obtained	4, 7
Eligibility criteria	10	Inclusion and exclusion criteria for participants. If applicable, eligibility criteria for study centres and individuals who will perform the interventions (eg, surgeons, psychotherapists)	3-4
Interventions	11a	Interventions for each group with sufficient detail to allow replication, including how and when they will be administered	4-7
	11b	Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease)	10
	11c	Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests)	11
	11d	Relevant concomitant care and interventions that are permitted or prohibited during the trial	4-5
Outcomes	12	Primary, secondary, and other outcomes, including the specific measurement variable (eg, systolic blood pressure), analysis metric (eg, change from baseline, final value, time to event), method of aggregation (eg, median, proportion), and time point for each outcome. Explanation of the clinical relevance of chosen efficacy and harm outcomes is strongly recommended	8-10
Participant timeline	13	Time schedule of enrolment, interventions (including any run-ins and washouts), assessments, and visits for participants. A schematic diagram is highly recommended (see Figure)	7

Sample size	14	Estimated number of participants needed to achieve study objectives and how it was determined, including clinical and statistical assumptions supporting any sample size calculations	4
Recruitment	15	Strategies for achieving adequate participant enrolment to reach target sample size	8
Methods: Assignment of interventions (for controlled trials)			
Allocation:			
Sequence generation	16a	Method of generating the allocation sequence (eg, computer-generated random numbers), and list of any factors for stratification. To reduce predictability of a random sequence, details of any planned restriction (eg, blocking) should be provided in a separate document that is unavailable to those who enrol participants or assign interventions	8
Allocation concealment mechanism	16b	Mechanism of implementing the allocation sequence (eg, central telephone; sequentially numbered, opaque, sealed envelopes), describing any steps to conceal the sequence until interventions are assigned	8
Implementation	16c	Who will generate the allocation sequence, who will enrol participants, and who will assign participants to interventions	8
Blinding (masking)	17a	Who will be blinded after assignment to interventions (eg, trial participants, care providers, outcome assessors, data analysts), and how	8
	17b	If blinded, circumstances under which unblinding is permissible, and procedure for revealing a participant's allocated intervention during the trial	8
Methods: Data collection, management, and analysis			
Data collection methods	18a	Plans for assessment and collection of outcome, baseline, and other trial data, including any related processes to promote data quality (eg, duplicate measurements, training of assessors) and a description of study instruments (eg, questionnaires, laboratory tests) along with their reliability and validity, if known. Reference to where data collection forms can be found, if not in the protocol	8-10
	18b	Plans to promote participant retention and complete follow-up, including list of any outcome data to be collected for participants who discontinue or deviate from intervention protocols	10
Data management	19	Plans for data entry, coding, security, and storage, including any related processes to promote data quality (eg, double data entry; range checks for data values). Reference to where details of data management procedures can be found, if not in the protocol	4
Statistical methods	20a	Statistical methods for analysing primary and secondary outcomes. Reference to where other details of the statistical analysis plan can be found, if not in the protocol	11
	20b	Methods for any additional analyses (eg, subgroup and adjusted analyses)	11
	20c	Definition of analysis population relating to protocol non-adherence (eg, as randomised analysis), and any statistical methods to handle missing data (eg, multiple imputation)	N/A
Methods: Monitoring			
Data monitoring	21a	Composition of data monitoring committee (DMC); summary of its role and reporting structure; statement of whether it is independent from the sponsor and competing interests; and reference to where further details about its charter can be found, if not in the protocol. Alternatively, an explanation of why a DMC is not needed	N/A
	21b	Description of any interim analyses and stopping guidelines, including who will have access to these interim results and make the final decision to terminate the trial	N/A
Harms	22	Plans for collecting, assessing, reporting, and managing solicited and spontaneously reported adverse events and other unintended effects of trial interventions or trial conduct	10
Auditing	23	Frequency and procedures for auditing trial conduct, if any, and whether the process will be independent from investigators and the sponsor	N/A
Ethics and dissemination			
Research ethics approval	24	Plans for seeking research ethics committee/institutional review board (REC/IRB) approval	4
Protocol amendments	25	Plans for communicating important protocol modifications (eg, changes to eligibility criteria, outcomes, analyses) to relevant parties (eg, investigators, REC/IRBs, trial participants, trial registries, journals, regulators)	12

Consent or assent	26a	Who will obtain informed consent or assent from potential trial participants or authorised surrogates, and how (see Item 32)	4
	26b	Additional consent provisions for collection and use of participant data and biological specimens in ancillary studies, if applicable	N/A
Confidentiality	27	How personal information about potential and enrolled participants will be collected, shared, and maintained in order to protect confidentiality before, during, and after the trial	4
Declaration of interests	28	Financial and other competing interests for principal investigators for the overall trial and each study site	13
Access to data	29	Statement of who will have access to the final trial dataset, and disclosure of contractual agreements that limit such access for investigators	12-13
Ancillary and post-trial care	30	Provisions, if any, for ancillary and post-trial care, and for compensation to those who suffer harm from trial participation	N/A
Dissemination policy	31a	Plans for investigators and sponsor to communicate trial results to participants, healthcare professionals, the public, and other relevant groups (eg, via publication, reporting in results databases, or other data sharing arrangements), including any publication restrictions	12
	31b	Authorship eligibility guidelines and any intended use of professional writers	12
	31c	Plans, if any, for granting public access to the full protocol, participant-level dataset, and statistical code	12-13
Appendices			
Informed consent materials	32	Model consent form and other related documentation given to participants and authorised surrogates	N/A
Biological specimens	33	Plans for collection, laboratory evaluation, and storage of biological specimens for genetic or molecular analysis in the current trial and for future use in ancillary studies, if applicable	N/A

*It is strongly recommended that this checklist be read in conjunction with the SPIRIT 2013 Explanation & Elaboration for important clarification on the items. Amendments to the protocol should be tracked and dated. The SPIRIT checklist is copyrighted by the SPIRIT Group under the Creative Commons "Attribution-NonCommercial-NoDerivs 3.0 Unported" license.

Appendix 4 - Written informed consent

POLITÉCNICO DE LEIRIA

CONSENTIMENTO INFORMADO, ESCLARECIDO E LIVRE PARA PARTICIPAÇÃO EM ESTUDOS DE INVESTIGAÇÃO NOS TERMOS DA NORMA N.º 015/2013 da Direção-Geral da Saúde (de acordo com a Declaração de Helsínquia e a Convenção de Oviedo)

Este procedimento é chamado "consentimento informado" e pretende descrever a finalidade do estudo, os procedimentos e os possíveis benefícios e riscos.
Antes de decidir se quer participar, é importante que compreenda o motivo da realização deste estudo, o modo como a sua informação será utilizada e o que é que o estudo envolve.
Por favor, demore o tempo necessário para ler atentamente a informação que se segue e a esclarecer todas as dúvidas acerca do projeto de investigação, antes de decidir se vai ou não participar no estudo. Se achar que algo está incorreto ou que não está claro, não hesite em solicitar mais informações. Se concordar, solicita-se que assine no final.

Identificação dos Investigadores: Dra. Joana Catarina Carvalho Borges; Prof. Doutor Diogo Manuel Teixeira Monteiro; Prof. Doutor Pedro Alexandre Duarte Mendes; Prof. Doutor Miguel Ângelo Susano Jacinto; Mestre Tiago Miguel dos Santos Pastilha; Mestre Fernanda Maria Antunes da Silva.

Título do estudo: "Efeito de um programa de exercício em terra e aquático na dor, mobilidade e qualidade de vida de indivíduos com dor lombar crónica: Estudo Randomizado Controlado"

Enquadramento: Este estudo realiza-se no âmbito da unidade curricular de Projeto do 2º ano do mestrado em Prescrição do Exercício e Promoção da Saúde, da Escola Superior de Educação e Ciências Sociais do Instituto Politécnico de Leiria, com a orientação do Professor Doutor Diogo Manuel Teixeira Monteiro e Professor Doutor Pedro Alexandre Duarte Mendes.

Explicação do estudo: Este estudo terá como principal objetivo estudar o efeito de um programa de exercício aquático e terrestre, comparativamente a um programa meramente aquático no nível de dor, incapacidade funcional e qualidade de vida em adultos com dor lombar crónica. Como objetivo secundário procurar-se-á investigar o seu efeito ao nível da mobilidade lombar e medo do movimento.
A intervenção decorrerá ao longo de 8 semanas na Piscina Municipal do Paião. O programa de exercício aquático, sob a supervisão de um fisioterapeuta consistirá em 16 sessões, 2 vezes por semana, com duração média de 45 minutos, com uma fase de aquecimento, uma fase de treino e uma fase de relaxamento/retorno à calma. O programa de exercício terrestre será realizado por um fisioterapeuta e terá 8 sessões, 1 vez por semana, com duração entre 25-35 minutos, consistindo em exercícios de estabilidade do *Core* e exercícios de alongamento do tronco e membros inferiores.
A participação no estudo envolverá três momentos de avaliação: antes da realização da intervenção, no final da intervenção (após 8 semanas) e 8 semanas após a intervenção (após 16 semanas).
Primeiramente e apenas no momento inicial (M0), será convidado a responder a um questionário individual de participante, no qual lhe serão colocadas questões relacionadas com alguns dados sociodemográficos, clínicos e hábitos de vida, com previsão de duração de

preenchimento de 5 minutos. Seguidamente (e em todas as fases de avaliação – M0, M1 e M2) ser-lhe-á solicitado que responda a 3 questionários, 1 escala e realize um teste físico:
- O Oswestry Disability Index – version 2.0 (ODI) é um questionário que procura mensurar e avaliar a incapacidade gerada pela dor lombar.
- O MOS Short Form Health Survey 36 Item v2 (SF-36 v2) é um questionário que pretende medir e avaliar o estado de saúde e a qualidade de vida.
- O Tampa Scale of Kinesiophobia-13 (TSK-13) é um questionário que tem como objetivo quantificar o medo do movimento ou de (nova) lesão.
- A Escala Visual Analógica (EVA) é uma medida unidimensional da intensidade da dor, usada para registar a sua progressão ao longo do tempo.
- O Modfied-Modified Schober Test (MMST) é um teste para determinar se há diminuição na amplitude de movimento da coluna lombar decorrente de diversas condições de saúde como a dor lombar crónica.
Todos os questionários estão em anexo a este consentimento informado para que possa consultar, analisar e expor as suas dúvidas. Os dados recolhidos serão destruídos assim que estiverem cumpridos os seus propósitos académicos e de investigação.

Benefícios e Riscos: Os benefícios imediatos de participar no estudo serão os inerentes à prática de exercício físico, nomeadamente aumento da força muscular, diminuição da dor, melhoria da qualidade de vida, redução do peso, melhoria da autoestima e promoção da sensação de bem-estar. O estudo não envolverá qualquer risco potencial, quer sejam sociais, legais ou financeiros além do tempo despendido. No entanto, serão adotados procedimentos para monitorizar a segurança dos participantes e minimizar os riscos, nomeadamente a avaliação de risco cardiovascular que contraindique a realização de exercício físico/atividade física, bem como a instrução para a verificação regular da pele e, em caso de *rash*, rubor, comichão ou outro sinal de alergia, deverá contactar o investigador, muito embora sejam raras este tipo reações adversas.

Condições e financiamento: A participação neste estudo é voluntária, sendo não haverá qualquer tipo de prejuízo, assistenciais ou outros, caso decida não participar no mesmo. Caso decida participar, poderá desistir a qualquer momento, sem necessidade de justificação, podendo apenas comunicar, por qualquer via, sem que dessa intenção advenha qualquer tipo de prejuízo, assistencial ou outro. O estudo mereceu o parecer favorável da Comissão de Ética do Instituto Politécnico de Leiria. Caso pretenda algum esclarecimento adicional poderá contactar diretamente a Comissão de Ética do Politécnico de Leiria através do seguinte endereço eletrónico: comissao.etica@ipleiria.pt

Confidencialidade e anonimato: Apenas os investigadores do projeto terão acesso aos dados. O acesso à informação recolhida será da responsabilidade do Professor Doutor Diogo Monteiro, o qual é também responsável pelo cumprimento de todas as obrigações legais em conformidade com o Regulamento Geral sobre a Proteção de Dados. Os dados recolhidos serão destruídos no prazo máximo de 5 anos após a conclusão do estudo.
Agradecemos, desde já, a sua sincera colaboração no preenchimento de todos os itens deste questionário, estando disponível para qualquer esclarecimento adicional, através dos contactos abaixo:

POLITÉCNICO DE LEIRIA

Diogo Monteiro – diogo.monteiro@ipleiria.pt e Pedro Mendes - pedromendes@ipcb.pt

Disponibilidade: Na qualidade de investigadora do presente estudo, venho por este meio manifestar a minha total disponibilidade para o esclarecimento de dúvidas e agradecer a sua participação no estudo.

Joana Catarina Carvalho Borges
Fisioterapeuta
Contactos: 964928447; 1230035@my.ipleiria.pt

Por favor, leia com atenção a seguinte informação. Se achar que algo está incorreto ou que não está claro, não hesite em solicitar mais informações. Se concorda com a proposta que lhe foi feita, queira assinar este documento.

Assinatura do investigador que pede consentimento:

… … … … … … … … … … … … … … … …… …

Data: …… /…… /……….

POLITÉCNICO DE LEIRIA

Consentimento do participante

Declaro ter lido e compreendido este documento, bem como as informações verbais que me foram fornecidas pela/s pessoa/s que acima assina/m. Foi-me garantida a possibilidade de, em qualquer altura, recusar participar no estudo "*Efeito de um programa de exercício em terra e aquático na dor, mobilidade e qualidade de vida de indivíduos com dor lombar crónica: Estudo Randomizado Controlado*" sem qualquer tipo de consequências. Desta forma, aceito participar neste estudo e permito a utilização dos dados, que de forma voluntária forneço, confiando em que apenas serão utilizados para fins científicos e publicações que delas decorram e nas garantias de confidencialidade e anonimato que me são dadas pela investigadora.

Nome: ... ...

Assinatura: ... ...

Data: …… /…… /……….

SE NÃO FOR O PRÓPRIO A ASSINAR POR IDADE OU INCAPACIDADE (se o menor tiver discernimento deve também assinar em cima, se consentir)

NOME: ... ...
BI/CC N.º: ... ...
DATA OU VALIDADE …… /…… /……….
GRAU DE PARENTESCO OU TIPO DE REPRESENTAÇÃO: ... ...

ASSINATURA ... ...

Appendix 5 – Ethics Committee approval

instituto politécnico de leiria

COMISSÃO DE ÉTICA DO POLITÉCNICO DE LEIRIA

PARECER N.º CE/IPLEIRIA/47/2024 Data: 22/03/2024

Título do estudo – Efeito de um programa de exercício em terra e aquático na dor, mobilidade e qualidade de vida de indivíduos com dor lombar crónica: Estudo Randomizado Controlado.

Nome do (s) proponente (s): Joana Catarina Carvalho Borges.

Investigadores Principais: Diogo Manuel Teixeira Monteiro e Pedro Alexandre Duarte Mendes.

Membros da equipa de investigação: Joana Catarina Carvalho Borges, Diogo Manuel Teixeira Monteiro, Pedro Alexandre Duarte Mendes, Miguel Ângelo Susano Jacinto, Tiago Miguel dos Santos Pastilha, Fernanda Maria Antunes da Silva. ----------

O estudo tem como objetivos: ----------
Estudar o efeito de um programa de exercício aquático e terrestre, comparativamente a um programa meramente aquático no nível de dor, incapacidade funcional e qualidade de vida em adultos com dor lombar crónica. Como objetivo secundário procurar-se-á investigar o seu efeito ao nível da mobilidade lombar e medo do movimento relacionado com a dor. ----------
A data de início do estudo/projeto está definida e está adequada, 1 maio 2024. ----------
A data de fim (prevista) do estudo/projeto está definida e está adequada, 31 março 2025. ----------
A data prevista de início da recolha de dados está definida, 1 setembro 2024. ----------
A data prevista de fim da recolha de dados está definida e está adequada, 28 fevereiro 2025. --------
Metodologia: ----------
O tipo de estudo está corretamente descrito e justificado, investigação seguirá um modelo quantitativo e o desenho de estudo experimental longitudinal, do tipo estudo randomizado controlado. ----------
A população-alvo está identificada e corretamente justificada. A amostra está identificada e corretamente justificada. ----------
Os critérios de inclusão estão definidos e corretamente justificados. ----------
Os critérios de exclusão estão definidos e corretamente justificados. ----------
Os procedimentos para a recolha de autorizações estão descritos e corretamente justificados. ------
Os instrumentos de recolha de dados estão devidamente descritos e anexos ao formulário submetido à CE. ----------
Os procedimentos para a garantia de confidencialidade estão devidamente descritos. ----------
Os procedimentos para garantir a voluntariedade e autonomia dos participantes estão devidamente descritos. ----------
Não foram identificados danos para os participantes. ----------
Os procedimentos para monitorização e segurança dos participantes e/ou minimizar riscos estão devidamente descritos e justificados. ----------
Os benefícios previstos para os participantes no estudo estão devidamente descritos e justificados.
Não existem custos de participação associados por parte dos participantes no estudo. ----------
O termo de responsabilidade foi apresentado e em conformidade com o solicitado. ----------

1

Comissão de Ética do Politécnico de Leiria
Edifício Sede – Rua General Norton de Matos
Apartado 4133 | 2411-901 Leiria

Tel._ (+351) 244 830 010 | Ext._800 114
comissao.etica@ipleiria.pt

O consentimento informado, esclarecido e livre para participação em estudos de investigação foi apresentado e em conformidade com o solicitado. ----------

O compromisso de honra dos investigadores principais foi apresentado e em conformidade com o solicitado. ----------

No consentimento informado foi referido como responsável pelo cumprimento de todas as obrigações legais decorrente do RGPD, o investigador principal. ----------

Após a reformulação da proposta submetida, no seguimento dos esclarecimentos adicionais solicitados, a CE emite parecer favorável. ----------

P'la CE a Presidente

Assinado por: **SUSANA LUÍSA DA CUSTÓDIA MACHADO MENDES**
Data: 2024.03.27 13:36:36+00'00'

Comissão de Ética do Politécnico de Leiria
Edifício Sede – Rua General Norton de Matos
Apartado 4133 | 2411-901 Leiria

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Appendix 6 - Sample selection and characterization questionnaire

POLITÉCNICO DE LEIRIA

Código participante _____

Questionário

Efeito de um programa de exercício em terra e aquático na dor, mobilidade e qualidade de vida de indivíduos com dor lombar crónica: Estudo Randomizado Controlado

No âmbito da Unidade Curricular de Projeto do 2º ano do mestrado em Prescrição do Exercício e Promoção da Saúde, da Escola Superior de Educação e Ciências Sociais do Instituto Politécnico de Leiria, foi elaborado este questionário com o objetivo de selecionar participantes para integrarem a amostra do estudo supracitado. Este questionário é anónimo, pelo que o seu nome não será referido em nenhum momento ao longo de todo o trabalho. Os dados recolhidos serão tratados e analisados com o objetivo puramente académico, sendo garantida a confidencialidade das respostas. O seu preenchimento dura cerca de 5 minutos.

Obrigada pela colaboração!

1. Idade_____
2. Género: F ☐ M ☐
   a. Se F, está atualmente grávida ou esteve nas últimas 8 semanas?
      Sim ☐ Não ☐
3. Altura_____ Peso_____
4. Apresenta dor na região lombar (abaixo das costelas e acima das nádegas)?
   Sim ☐ Não ☐
   a. Se sim, há quanto tempo? _____
   b. A dor irradia para uma/ambas a(s) perna(s)? Sim ☐ Não ☐
   c. Classifique a sua dor lombar neste momento, assinalando com um "X" na escala abaixo.

Sem dor |——————————————————————| **Pior dor imaginável**

1

POLITÉCNICO DE LEIRIA

Código participante _____

5. Já foi submetido a alguma cirurgia à coluna vertebral?
   Sim ☐ Não ☐
   Se sim, qual? _____

6. Tem, ou já teve alguma doença inflamatória, infeciosa ou maligna na coluna?
   Sim ☐ Não ☐
   Se sim, qual? _____

7. Tem, ou já teve alguma doença reumatológica, neurológica ou oncológica?
   Sim ☐ Não ☐
   Se sim, qual? _____

8. Tem, ou já teve alguma doença cardiovascular?
   Sim ☐ Não ☐
   Se sim, qual? _____

9. Apresenta outra(as) doença(s)?
   Sim ☐ Não ☐
   Se sim, qual? _____

10. Tabagismo: Fumador(a) ☐ Não-Fumador(a) ☐ Ex-Fumador(a) ☐

11. Encontra-se disponível para participar neste estudo? Sim ☐ Não ☐

Se sim, deixe-nos o(s) seu(s) contacto(s)!

Telefone: _____ Email: _____

Obrigada pela sua colaboração!

Appendix 7 – Visual Analogue Scale

POLITÉCNICO DE LEIRIA

Código participante _____

ESCALA VISUAL ANALÓGICA

Dor em repouso

Sem Dor ——— Pior dor imaginável

Dor em movimento

Sem Dor ——— Pior dor imaginável

Dor durante a noite

Sem Dor ——— Pior dor imaginável

M___ 1

Appendix 8 – Oswestry Disability Index – version 2.0

POLITÉCNICO DE LEIRIA

Código participante _____

Índice de Incapacidade Oswestry, versão 2.1b (ODI)

Este questionário foi concebido para nos fornecer informações sobre o modo como o seu problema de costas (ou pernas) afeta a sua capacidade de lidar com a vida no dia-a-dia.
Por favor, responda a todas as secções. Em cada secção, assinale apenas a resposta que melhor descreve o que está a sentir hoje.

Secção 1 - Intensidade da dor

- ☐ Neste momento, não sinto dor.
- ☐ Neste momento, a dor é muito ligeira.
- ☐ Neste momento, a dor é moderada.
- ☐ Neste momento, a dor é relativamente intensa.
- ☐ Neste momento, a dor é muito intensa.
- ☐ Neste momento, a dor é a pior que se pode imaginar.

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

- ☐ Consigo cuidar de mim normalmente sem causar mais dor.
- ☐ Consigo cuidar de mim normalmente, mas é muito doloroso.
- ☐ É doloroso cuidar de mim e faço-o devagar e com cuidado.
- ☐ Preciso de alguma ajuda, mas consigo assegurar a maior parte dos meus cuidados pessoais.
- ☐ Preciso de ajuda diariamente na maioria dos cuidados pessoais.
- ☐ Não me visto, lavo-me com dificuldade e fico na cama.

Secção 3 - Levantar objetos

- ☐ Consigo levantar objetos pesados sem sentir mais dor.
- ☐ Consigo levantar objetos pesados, mas isto causa-me mais dor.
- ☐ A dor impede-me de levantar objetos pesados do chão, mas consigo pegar-lhes se estiverem convenientemente posicionados, por exemplo, numa mesa.
- ☐ A dor impede-me de levantar objetos pesados, mas consigo pegar em coisas leves ou de peso médio, se estiverem convenientemente posicionadas.
- ☐ Só consigo levantar coisas muito leves.
- ☐ Não consigo levantar nem transportar nada.

Secção 4 - Andar

- ☐ A dor não me impede de andar qualquer distância.
- ☐ A dor impede-me de andar mais de 1 km.
- ☐ A dor impede-me de andar mais de 500 metros.
- ☐ A dor impede-me de andar mais de 100 metros.
- ☐ Só consigo andar de bengala ou de muletas.
- ☐ Passo a maior parte do tempo na cama e tenho de ir à casa de banho de gatas.

ODI - Portugal/Portuguese - Version of 13 Sep 2022 - ICON.
ID0389-TR-0020 / ODI_AU2.1b_por-PT.doc

M___ 1

POLITÉCNICO DE LEIRIA

Código participante _____

Secção 5 - Estar sentado(a)

- ☐ Consigo estar sentado(a) em qualquer cadeira o tempo que eu quiser.
- ☐ Consigo estar sentado(a) na minha cadeira preferida o tempo que eu quiser.
- ☐ A dor impede-me de estar sentado(a) durante mais de 1 hora.
- ☐ A dor impede-me de estar sentado(a) durante mais de meia hora.
- ☐ A dor impede-me de estar sentado(a) durante mais de 10 minutos.
- ☐ A dor impede-me totalmente de estar sentado(a).

Secção 6 - Estar em pé

- ☐ Consigo estar em pé o tempo que eu quiser sem sentir mais dor.
- ☐ Consigo estar em pé o tempo que eu quiser, mas isto causa-me mais dor.
- ☐ A dor impede-me de estar em pé mais de uma hora.
- ☐ A dor impede-me de estar em pé mais de meia hora.
- ☐ A dor impede-me de estar em pé mais de 10 minutos.
- ☐ A dor impede-me totalmente de estar em pé.

Secção 7 - Dormir

- ☐ A dor nunca me perturba o sono.
- ☐ Ocasionalmente, a dor perturba-me o sono.
- ☐ Por causa da dor, durmo menos de 6 horas.
- ☐ Por causa da dor, durmo menos de 4 horas.
- ☐ Por causa da dor, durmo menos de 2 horas.
- ☐ A dor impede-me totalmente de dormir.

Secção 8 - Vida sexual (se aplicável)

- ☐ A minha vida sexual é normal e não aumenta a dor.
- ☐ A minha vida sexual é normal, mas causa mais alguma dor.
- ☐ A minha vida sexual é quase normal, mas muito dolorosa.
- ☐ A minha vida sexual é muito limitada pela dor.
- ☐ A minha vida sexual é quase inexistente devido à dor.
- ☐ A dor impede-me totalmente de ter vida sexual.

Secção 9 - Vida social

- ☐ A minha vida social é normal e não aumenta a dor.
- ☐ A minha vida social é normal, mas aumenta o grau de dor.
- ☐ A dor não tem uma influência significativa na minha vida social além de limitar as atividades mais enérgicas, como, por exemplo, o desporto, etc.
- ☐ A dor limitou a minha vida social e não saio com tanta frequência.
- ☐ Apenas tenho vida social em casa devido à dor.
- ☐ Não tenho vida social por causa da dor.

Secção 10 - Viajar

- ☐ Consigo viajar para qualquer lado sem sentir dor.
- ☐ Consigo viajar para qualquer lado, mas isso causa mais dor.
- ☐ A dor é forte, mas consigo fazer viagens superiores a duas horas.
- ☐ A dor só me permite fazer viagens inferiores a uma hora.
- ☐ A dor só me permite fazer viagens curtas e necessárias, inferiores a 30 minutos.
- ☐ A dor impede-me de viajar a menos que seja para os tratamentos.

Appendix 9 – MOS Short Form Health Survey 36 v2

POLITÉCNICO DE LEIRIA

Código participante _____

QUESTIONÁRIO DE ESTADO DE SAÚDE (SF-36v2)

INSTRUÇÕES: As questões que se seguem pedem-lhe opinião sobre a sua saúde, a forma como se sente e sobre a sua capacidade de desempenhar as atividades habituais.

Pedimos que leia com atenção cada pergunta e que responda o mais honestamente possível. Se não tiver a certeza sobre a resposta a dar, dê-nos a que achar mais apropriada e, se quiser, escreva um comentário a seguir à pergunta.

Para as perguntas 1 e 2, por favor coloque um círculo no número que melhor descreve a sua saúde.

1. Em geral, diria que a sua saúde é:

Excelente	Muito boa	Boa	Razoável	Fraca
1	2	3	4	5

2. Comparando com o que acontecia há um ano, como descreve o seu estado geral actual:

Muito melhor	Com algumas melhoras	Aproximadamente igual	Um pouco pior	Muito pior
1	2	3	4	5

3 As perguntas que se seguem são sobre actividades que executa no seu dia-a-dia. Será que a sua saúde o/a limita nestas actividades? Se sim, quanto?

(Por favor assinale com um círculo um número em cada linha)

	Sim, muito limitado/a	Sim, um pouco limitado/a	Não, nada limitado/a
a. Actividades violentas, tais como correr, levantar pesos, participar em desportos extenuantes	1	2	3
b. Actividades moderadas, tais como deslocar uma mesa ou aspirar a casa	1	2	3
c. Levantar ou pegar nas compras de mercearia	1	2	3
d. Subir vários lanços de escada	1	2	3
e. Subir um lanço de escadas	1	2	3
f. Inclinar-se, ajoelhar-se ou baixar-se	1	2	3
g. Andar mais de 1 Km	1	2	3
h. Andar várias centenas de metros	1	2	3
i. Andar uma centena de metros	1	2	3
j. Tomar banho ou vestir-se sozinho/a.....	1	2	3

M___ 1

POLITÉCNICO DE LEIRIA

Código participante _____

4. Durante as últimas 4 semanas teve, no seu trabalho ou atividades diárias, algum dos problemas apresentados a seguir como consequência do seu estado de saúde físico?

Quanto tempo, nas **últimas quatro semanas...**	**Sempre**	**A maior parte do tempo**	**Algum tempo**	**Pouco tempo**	**Nunca**
a. Diminuiu o tempo gasto a trabalhar ou noutras atividades	1	2	3	4	5
b. Fez menos do que queria?	1	2	3	4	5
c. Sentiu-se limitado/a no tipo de trabalho ou outras actividades.....	1	2	3	4	5
d. Teve dificuldade em executar o seu trabalho ou outras actividades (por exemplo, foi preciso mais esforço).....	1	2	3	4	5

5. Durante as últimas 4 semanas, teve com o seu trabalho ou com as suas atividades diárias, algum dos problemas apresentados a seguir devido a quaisquer problemas emocionais (tal como sentir-se deprimido/a ou ansioso/a)?

Quanto tempo, nas **últimas quatro semanas...**	**Sempre**	**A maior parte do tempo**	**Algum tempo**	**Pouco tempo**	**Nunca**
a. Diminuiu o tempo gasto a trabalhar ou noutras actividades.....	1	2	3	4	5
b. Fez menos do que queria?	1	2	3	4	5
c. Executou o seu trabalho ou outras actividades menos cuidadosamente do que era costume	1	2	3	4	5

Para cada uma das perguntas 6, 7 e 8, por favor ponha um círculo no número que melhor descreve a sua saúde.

6. Durante as últimas 4 semanas, em que medida é que a sua saúde física ou problemas emocionais interferiram no seu relacionamento social normal com a família, amigos, vizinhos ou outras pessoas?

Absolutamente nada	**Pouco**	**Moderadamente**	**Bastante**	**Imenso**
1	2	3	4	5

POLITÉCNICO DE LEIRIA

Código participante _____

7. Durante as últimas 4 semanas teve dores?

Nenhumas	Muito fracas	Ligeiras	Moderadas	Fortes	Muito fortes
1	2	3	4	5	6

8. Durante as últimas 4 semanas, de que forma é que a dor interferiu com o seu trabalho normal (tanto o trabalho fora de casa como o trabalho doméstico)?

Absolutamente nada	Pouco	Moderadamente	Bastante	Imenso
1	2	3	4	5

9. As perguntas que se seguem pretendem avaliar a forma como se sentiu e como lhe correram as coisas nas últimas quatro semanas.

Para cada pergunta, coloque por favor um círculo à volta do número que melhor descreve a forma como se sentiu.

Certifique-se que coloca um círculo em cada linha.

Quanto tempo, nas **últimas quatro semanas...**	**Sempre**	**A maior parte do tempo**	**Algum tempo**	**Pouco tempo**	**Nunca**
a. Se sentiu cheio/a de vitalidade?	1	2	3	4	5
b. Se sentiu muito nervoso/a?	1	2	3	4	5
c. Se sentiu tão deprimido/a que nada o/a animava?	1	2	3	4	5
d. Se sentiu calmo/a e tranquilo/a?	1	2	3	4	5
e. Se sentiu com muita energia?	1	2	3	4	5
f. Se sentiu deprimido/a?	1	2	3	4	5
g. Se sentiu estafado/a?	1	2	3	4	5
h. Se sentiu feliz?	1	2	3	4	5
i. Se sentiu cansado/a?	1	2	3	4	5

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Código participante _____

10. Durante as últimas quatro semanas, até que ponto é que a sua saúde física ou problemas emocionais limitaram a sua actividade social (tal como visitar amigos ou familiares próximos)?

Sempre	A maior parte do tempo	Algum tempo	Pouco tempo	Nunca
1	2	3	4	5

11. Por favor, diga em que medida são verdadeiras ou falsas as seguintes afirmações. Ponha um círculo para cada linha.

	Absolutamente verdade	Verdade	Não sei	Falso	Absolutamente falso
a. Parece que adoeço mais facilmente do que os outros	1	2	3	4	5
b. Sou tão saudável como qualquer outra pessoa ..	1	2	3	4	5
c. Estou convencido/a que a minha saúde vai piorar	1	2	3	4	5
d. A minha saúde é óptima	1	2	3	4	5

MUITO OBRIGADO

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Appendix 10 – Tampa Scale of Kinesiophobia-13

POLITÉCNICO DE LEIRIA

Código participante _____

ESCALA DE TAMPA DE CINESIOFOBIA (13 Itens)

THE TAMPA SCALE
MILLER, KORI & TODD
TAMPA, FLORIDA
1991

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 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 atividade física, evitando assim que me magoe.				
11	Não é seguro para uma pessoa com a minha condição física ser fisicamente ativa.				
12	Não posso fazer tudo o que as outras pessoas fazem, porque me magoo muito facilmente.				
13	Ninguém deveria ter que fazer atividade física quando sente dor.				

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