Resistance training on physical fitness, balance, and fibromyalgia impact: a pilot study of online intervention

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Abstract

Fibromyalgia is a chronic disease with diverse physical and psychological symptoms and impairments. The present pilot study aims to evaluate the implementation of a previously protocoled online resistance training program in postural balance, physical fitness, and fibromyalgia impact, as well as adaptations and strategies necessary for a better follow-up of the participant during the program. Three participants with an average age of 53.67 (SD=5.51) years and medical diagnosis of fibromyalgia performed eight weeks of online resistance training exercises (2/week). Physical fitness and postural balance (force platform), fibromyalgia impact (FIQ), and symptoms (VAS) were evaluated before the exercises and after 16 sessions. The variation from pre- to post-training intervention was determined by calculating the percentage of change in each variable. All participants showed gains in countermovement jump (11 to 46%) and reduced pain intensity (10 to 19%). Two out of three participants showed improvement in the countermovement jump with free arms (4 and 28%), medicine ball throw (2 and 42%), mood state (20 to 32%), also a reduction in FIQ (4 and 27%), center of pressure (COP) velocity with eyes open (10 and 7%), COP displacement with eyes open (6 and 9%), anxiety (15 to 84%) and fatigue (10 to 41%). Only one participant has shown improvements in sleep quality (6%). Changes in balance with eyes closed were not found. The online resistance training program protocol showed promising results in this pilot study, with potential gains in neuromuscular performance and balance, and reducing the negative symptoms associated with fibromyalgia. Adaptations were necessary throughout the program for better applicability.

Keywords: Exercise, Strength, Rheumatic diseases, Pain, Fatigue, Sleep, Balance

Introduction

Fibromyalgia is a chronic condition characterized by widespread musculoskeletal pain (1). In the last five years, there has been an increase in the number of studies focused on fibromyalgia (2-4). The widespread pain and tenderness seen in fibromyalgia have been associated with alterations in pain processing (1). In addition to pain, other frequent symptoms are fatigue, joint pain, morning stiffness, changes in balance, and paresthesia (5). Despite such findings, a solution found along with drug therapy is the practice of physical exercise as a tool to control fibromyalgia symptoms (3).

It is known that a sedentary lifestyle is a public health problem that can generate chronic comorbidities and even worsen symptoms (6, 7). A sedentary lifestyle also has consequences at the motor level, leading to disabilities in the performance of daily activities, in the work environment, balance, and consequently in physical independence (8, 9). Several specific guidelines for fibromyalgia have been created to reduce the risks associated with a sedentary lifestyle (5, 10, 11). These guidelines provide moderate to high evidence for the benefits of aerobic, strength, and mixed exercises in people with fibromyalgia (10, 12, 13). However, the most common practice adopted by individuals with chronic pain is inactivity (14, 15). Factors associated with disinterest in physical exercises should be considered for a better direction to solve such issues. Despite such guidelines, the lack of updating and the divergences between protocols make their implementation difficult, especially in a population resistant to practice (14). Increased pain during or after exercise, as well as intolerance to high-intensity exercise, are factors that make it easier to give up the practice (16).

In physical exercise, resistance training has shown promise in the beneficial effects associated with fibromyalgia physical and psychological symptoms (3, 17). However, interventions targeting chronic patients must be well structured in terms of time, intensity, and frequency of exercise (14), factors that are not yet well consolidated in the literature (3). Most of the existing protocols in the literature work with high training volumes, an intervention protocol without major adaptations (3, 18). In addition, interventions are face-to-face, requiring the participant to go to a gym. It is necessary to evaluate and create

studies with different protocols, with simple implementation, which allows greater adherence by participants, ensuring individuality and reducing the risk of dropout. With this in mind, a protocol consisting of online resistance training was published (19) and the current pilot study aims to evaluate the implementation of that resistance training program as well as adaptations and strategies necessary for a better follow-up of the participant during the program.

Methods

This experimental longitudinal pilot study was conducted between March 2023 and June 2023. The present research project was approved by the Ethics Committee of the University of Beira Interior, Portugal (CE-UBI-Pj-2021-017). For this pilot study, three participants with an average age of 53.67 (SD=5.51) and fibromyalgia diagnosis volunteered to participate. The eligible criteria were to have a medical diagnosis of fibromyalgia and age over 18 years old. Participants with severe comorbidity or any other type of condition that negatively influences participation in the training program; cognitive disorders; heart problems; surgeries or fractures in the last 6 months were not eligible to participate. All participants reported not having done any physical activity in the last three months of the intervention. Before the data collection all procedures, evaluations, and interventions were thoroughly explained. If the participant agreed to participate, the informed consent form was signed. The data collection was conducted in person and at domicile, in one day at two different moments in time. The first assessment moment was before the intervention (baseline) and the second was after 16 sessions (T1). All the participants completed the training period consisting of 16 sessions. The sample was composed of three individuals, two were female (66.6%) and one male (33.3%). Table 1 shows the descriptive analyses.

- Please, include Table 1 about here.

Anthropometric

The first data registered was the age recorded in years. For weight and height measurements a portable digital bioimpedance scale (TANITA BC-601, Japan) and a wall

stadiometer (Gima, Italy) were used, respectively. The body mass index (BMI) was calculated using the standard formula: BMI = weight (kg)/height2 (m).

Fibromyalgia Impact Questionnaire

The Fibromyalgia impact questionnaire (FIQ) was used to quantify and classify the fibromyalgia severity (20). This questionnaire is composed of 10 items (physical function, feel good, work miss, work, pain, fatigue, morning tiredness, stiffness, anxiety, and depression) with a total of 20 questions. The total score will be the sum of the standardized items. Scoring results range from 0 to 100, where higher scores indicate more impairment.

Associated Symptoms

For the assessment of the symptoms associated with fibromyalgia, data regarding pain intensity, anxiety, fatigue, mood, and sleep quality were obtained from the 100 mm VAS scale. For pain, anxiety, and fatigue, the higher the value, the greater the intensity of the symptom. Conversely, for mood and sleep quality, the higher the value, the better the mood and/or sleep quality.

Neuromuscular performance

Neuromuscular assessment for lower limbs consisted of countermovement jump (CMJ), countermovement jumps with free arms (CMJFA) and medicine ball throw for upper limbs. Two force platforms (PS-2142) (PASCO® Scientific, Roseville, CA) were used during the CMJ and CMJFA tests. Three tests with 2 minutes rest between attempts were made following a previous protocol (19). For the medicine ball throw (2kg), three attempts were made with 30 seconds of rest between each repetition. The greater distance from the wall to the first ball contact with the floor was considered.

Balance

During the balance assessment, participants were instructed to stand on a force plate (PS-2142) (PASCO® Scientific, Roseville, CA) with their feet aligned hip-width apart. For the assessment, two trials were performed for each test (eyes open and eyes closed) for 60 seconds for each trial. The mean of the attempts was used for the variables center of pressure (COP) velocity and COP displacement.

Intervention

The participants performed a total of 16 sessions of online resistance training (19). Participants performed online resistance training twice a week until they completed 16 sessions. No external equipment was used, besides the body weight. The training sessions lasted between 50 minutes and 70 minutes depending on the session. All training sessions included 10 minutes of warm-up and 5 minutes of cool-down. The main part of the sessions lasted 35 to 40 minutes in the first eight sessions and 50 to 55 minutes in the following eight sessions. All the exercises and the training program were implemented according to a previous protocol (19).

Statistical analysis

A descriptive analysis was carried out primarily using Microsoft Office Excel 16 program and the Statistical Package of Social Science (version 28.0; SPSS, Chicago, IL, USA) to observe the data under analysis, presenting the mean, standard deviation, minimum, and maximum for quantitative variables and frequencies for qualitative variables. To evaluate the variables, the percentage of change between the baseline and after training was determined ([T1 - baseline/baseline) × 100]).

Results

Regarding the FIQ, two out of three participants showed a reduction in the final score from 4 to 27% and one increased by 14%. The pain intensity was the variable that obtained a reduction in all three participants with a variation between 10% and 19%. Both anxiety and fatigue also showed a reduction in values after the intervention in at least two participants. Anxiety stood out as the variable with the greatest reduction (84%), followed by fatigue (41%). For the mood variable, an improvement of up to 32% was observed in one participant while another showed a reduction of 16%. Sleep quality has a variability of 6% for good and bad. The individualized effects can be verified in Table 2.

- Please, include Table 2 about here.

The assessment of neuromuscular performance was one of the most significant, as all participants showed a gain in vertical jump, more specifically in countermovement jump (11% to 46%). Regarding the countermovement jump with free arms, two of the participants increased the power of the jump by 6% and 28%. In the upper limbs evaluation, two of the three participants obtained an increase in distance when throwing the medicine ball, with gains of 2% and 42%, while the third participant showed a reduction of 2% compared to the initial throw. Regarding balance, only two participants showed a reduction of COP velocity with eyes open (7% to 10%), and the COP displacement (6% to 9%).

Discussion

The present pilot study aimed to evaluate the implementation of an online resistance training program, as well as adaptations and strategies necessary for a better follow-up of the participant during the program. We propose a discussion of the results of this pilot study dealing with 3 aspects: specific initial results, general descriptive analysis, adaptations, and limitations and contributions of the pilot study.

Specific initial results

Promising developments were found in almost all the variables evaluated, except for COP displacement with eyes closed. The positive percentage of change found in neuromuscular performance, balance, and symptoms in the variables CMJ, COP velocity with eyes closed, and pain intensity, respectively were very relevant.

The results of this study show an improvement in anxiety, depression, fatigue, and pain intensity. Confirming that the practice of physical exercise is beneficial in reducing various symptoms, including pain intensity (18, 21). One of the theories associated with fibromyalgia is the existence of a sensory-motor conflict (22). Moreover, when compared to healthy people, fibromyalgia patients present muscle weakness and reduced physical performance (23). These gaps create relevance for neuromuscular assessment, as has been conducted in different populations (24-26). The gains in neuromuscular variables from

this online protocol are promising for counteracting the effects of strength loss when compared to previous studies with on-site intervention (27, 28). Balance changes are directly related to the risk of falling, where women with fibromyalgia have a 45% higher chance of falls when compared to healthy women (29). Decreases found in the balance variables in this pilot study reinforce a better performance in postural control, being in accordance with other studies (30, 31). The withdrawal of a sensory stimulus (visual and/or vestibular system) reduces postural control capacity, especially in this population (32, 33). However, despite this characterization, the physical practice performed in the present study was able to demonstrate improvement in balance, more specifically in the COP velocity with eyes closed variable, suggesting that there was an improvement in the postural control of the participants compared to baseline, even with the temporary removal of a sensory input that helps in balance. This result has a relevant contribution to demonstrate the effects of training in the impairments presented by fibromyalgia.

General descriptive analysis and adaptations

As this was a pilot study based on a protocol (19), adaptations within what was previously described were necessary. During the implementation of the program, the incompatibility of the participants' schedules for the live practice arose, interfering with the previously scheduled dates for the exercises. One solution was to record content identical to the sequence contained in the live classes so that the participants could take the class at the time that was most convenient for them. To ensure the practice, the participant was asked to send a message to the evaluator with information about the variables (pain, anxiety, fatigue, mood, and sleep quality). In addition, after the class, the participant gave feedback to the evaluator, informing if any adaptation of exercise provided in the class was made. In case of non-receipt of information, participants were contacted for follow-up throughout the program. Another necessary adaptation is related to the limitation of a training program within a specific period (8 weeks). In some cases, the realization of 16 sessions at specific times (two per week) became difficult due to the participants' workload. To fit the program into their routine, in case of inability to perform the two classes in the week, the participants extended the period of the program. To ensure the effects of the training, participants could not stop doing the program for more than two weeks. It is worth mentioning that the existence of a sequence of adaptive exercises

proved to be fundamental for the practice since it did not demotivate the participant regarding the practice, facilitating the continuation of the exercises. Despite the need to implement such adaptations, all were well accepted by participants without major resistance.

During the conduction of this pilot study, two points stood out requiring further attention from the evaluator. The first was the use of the Borg scale. This scale should be clearly explained to ensure the participant's understanding. This information should be repeated before the beginning of each class, and the participant should be asked at each series how the perception of effort is. To facilitate understanding, the answer regarding the perception of fatigue could be given by numbers or colors representative of the Borg scale. The second point is associated with the practice of the exercise. As a novel protocol, in this case, focusing on performing the movement with the execution speed in a faster way in the concentric phase, the evaluator becomes a key piece to remind the participants to maintain the speed of the execution. As a solution, during practice, the evaluator performs the movement at the same time as the participant, giving verbal commands for the participant to perform the exercise quickly in the concentric phase.

Limitations and contributions of the pilot study

A limiting factor of this protocol is that as an online protocol, the participant needs to have a minimum notion of the technology to be able to participate in the program. However, the provision of guidance, demonstration, and prior support by the evaluator may be enough to integrate this participant into future implementations of the program. On the other hand, an exclusionary factor is the case of lack of network access by participants. Without a doubt, the development and applications of a new online resistance training protocol on postural balance, physical fitness, and impact on fibromyalgia will contribute to increasing the possibilities of intervention in patients with difficulties in performing resistance exercises in person, whether for reasons of commuting, distance, health conditions, among others.

Conclusion

In summary, the results of this pilot study demonstrated that the online strength training program protocol has some potential benefits on neuromuscular gain, balance, and reduction of negative symptoms associated with fibromyalgia, in addition to the impact of the disease. Beyond that, as it is a longitudinal program, the necessary adaptations were well accepted by the participants, ensuring their participation throughout the implementation of the protocol.

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Table 1. Participant's characteristics

Variables	Mean	SD	Minimum	Maximum
Age (years)	53.67	5.51	50	60
Height (m)	1.67	0.2	1.47	1.87
Body mass (kg)	78.70	19.87	59.4	99.1
BMI (kg/m2)	27.77	0.46	27.50	28.3

Table 2: Individual differences between baseline and after 16 sessions.

Variables	Baseline	16 sessions	Change	Percentage change
CMJ (cm)	8.48	10.89	2.41	28%
	8.0	11.7	3.67	46%
	26.9	29.9	3.06	11%
CMJFA (cm)	11.1	10.7	-0.44	-4%
	10.7	13.7	3.01	28%
	32.8	34.8	2.06	6%
Medicine ball throw (cm)	156	222	66.00	42%
	245	240	-5.00	-2%
	573	582	9.00	2%
FIQ	71.86	69.33	-2.53	-4%
	72.57	52.68	-19.89	-27%
	47.0	53.8	6.81	14%
COP velocity Eyes open	0.44	0.54	0.10	23%
	0.58	0.52	-0.06	-10 %
	0.86	0.80	-0.06	-7%
COP displacement Eyes open	38.13	45.19	7.06	19%
	49.98	45.35	-4.63	-9%
	75.68	70.84	-4.83	-6%
COP velocity Eyes closed	0.66	0.71	0.05	8%
	0.70	0.75	0.05	7%
	1.11	1.13	0.02	2%
COP displacement Eyes closed	56.84	62.61	5.78	10%
	59.41	64.90	5.5	9%
	96.17	100.03	3.86	4%
Pain intensity	94.00	76.00	-18.00	-19%
	55.0	48.0	-7.00	-13%
	50.0	45.0	-5.00	-10%
Anxiety	82.00	70.00	-12.00	-15%
	55.0	9.0	-46.00	-84%
	0.0	69.0	69.00	0%
Fatigue	84.00	76.00	-8.00	-10%
	79.0	47.0	-32.00	-41%
	81.0	83.0	2.00	2%
Mood State	62.00	52.00	-10.00	-16%
	70.0	84.0	14.00	20%
	50.0	66.0	16.00	32%
Quality of sleep	44.00	44.00	0.00	0%
	78.0	83.0	5.00	6%
	78.0	73.0	-5.00	-6%

CMJ: Countermovement jump; CMJFA: Countermovement jump with free arms; FIQ: Fibromyalgia Impact Questionnaire; COP: Center of pressure