STRENGTH TRAINING IN PATIENTS WITH FIBROMYALGIA: A FEASIBILITY STUDY

TREINAMENTO DE FORÇA EM PACIENTES COM FIBROMIALGIA: UM ESTUDO DE VIABILIDADE

ENTRENAMIENTO DE FUERZA EN PACIENTES CON FIBROMIALGIA: UN ESTUDIO DE FACTIBILIDAD

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

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ABSTRACT

Introduction: Fibromyalgia syndrome (FM) is characterized by the presence of diffuse pain lasting for more than three months and is often associated with sleep disorders. Studies have investigated the effect of strength training (ST) on pain and sleep quality in FM patients, but there continue to be diverse perspectives on the effects of this intervention in this population. Objective: The aim of the study was to examine the effects of strength training (ST) on pain and sleep quality in FM patients. Methods: Forty-eight women with FM participated in the study between August and October, 2012. Six (55±6.5 years) performed ST, conducted at Santa Catarina State University, and eight (47±9 years) comprised the control group. The Socio-Demographic and Clinical Questionnaire, the visual analog scale (VAS) for pain, and the Pittsburgh Sleep Quality Index were used. Data were collected before the first session and after the eight-week intervention and were analyzed using descriptive statistics and inferential tests. Results: The eight- week ST intervention decreased pain ($p< 0.05$) and significantly diminished the daytime sleep dysfunctions ($p< 0.05$), demonstrating that the proposed program contributes to improving patient quality of life. Conclusion: ST is a feasible treatment for patients with fibromyalgia. ***Level of evidence II; Therapeutic study.***

Keywords: Exercise program; Sleep wake disorders; Musculoskeletal pain; Feasibility studies.

RESUMO

Introdução: A síndrome da fibromialgia (FM) é caracterizada pela presença de dor difusa com duração de mais de três meses e, frequentemente, é associada a distúrbios do sono. Estudos investigaram o efeito do treinamento de força (ST) sobre a dor e a qualidade do sono dos pacientes com FM, mas ainda existem diversas perspectivas quanto aos efeitos da intervenção nessa população. Objetivos: O objetivo do estudo foi examinar os efeitos do treinamento de força (ST) sobre a dor e a qualidade do sono de pacientes com FM. Métodos: Quarenta e oito mulheres com FM participaram do estudo entre agosto e outubro de 2012. Seis (55 ± 6,5 anos) realizaram treinamento de força, conduzido na Universidade Estadual de Santa Catarina, e oito (47 ± 9 anos) constituíram o grupo controle. Foram empregados o Questionário Sociodemográfico e Clínico, a escala visual analógica (EVA) para dor e o Índice de Qualidade do Sono de Pittsburgh. Os dados foram coletados antes da primeira sessão e depois da intervenção de oito semanas e foram analisados por meio de estatística descritiva e testes inferenciais. Resultados: A intervenção de 8 semanas com ST diminuiu a dor ($p < 0,05$) e reduziu significativamente as disfunções diurnas do sono ($p <0,05$), demonstrando que o programa proposto contribui para melhorar a qualidade de vida dos pacientes. Conclusão: O ST é um tratamento viável para pacientes com fibromialgia. ***Nível de evidência II; Estudo terapêutico.***

Descritores: *Programa de exercício; Distúrbios do sono; Dor musculoesquelética; Estudos de viabilidade.*

RESUMEN

Introducción: El síndrome de fibromialgia (FM) se caracteriza por la presencia de dolor difuso de más de tres meses de duración y suele asociarse a trastornos del sueño. Los estudios han investigado el efecto del entrenamiento de fuerza (ST) sobre el dolor y la calidad del sueño en pacientes con FM, pero todavía existen diversas perspectivas respecto a los efectos de esta intervención en esta población. Objetivos: El objetivo del estudio fue examinar los efectos del entrenamiento de fuerza sobre el dolor y la calidad del sueño de los pacientes con FM. Métodos: Cuarenta y ocho mujeres con FM participaron en el estudio entre agosto y octubre de 2012. Seis (55 ± 6,5 años) se sometieron a un entrenamiento de fuerza realizado en la Universidad del Estado de Santa Catarina, y ocho (47 ± 9 años) constituyeron el grupo de control . Se utilizó el Cuestionario sociodemográfico y Clínico, la escala visual analógica (EVA) para el dolor y el Índice de Calidad del Sueño de Pittsburgh. Los datos fueron recopilados antes de la primera sesión y después de la intervención de ocho semanas y se analizaron mediante estadísticas descriptivas y pruebas de inferencia. Resultados: La intervención de ocho semanas con ST disminuyó el dolor ($p <0,05$) y redujo significativamente los trastornos del sueño durante el día ($p <0,05$), lo que demuestra que el programa propuesto contribuye a mejorar la calidad de vida de los pacientes. Conclusión: El entrenamiento de fuerza es un tratamiento viable para pacientes con fibromialgia. ***Nivel de evidencia II; Estudios terapéuticos.***

Descriptores: *Programa de ejercicios; Trastornos del sueño; Dolor musculoesquelético; Estudios de factibilidad.*

DOI: http://dx.doi.org/10.1590/1517-869220232901176543
Article received on 03/05/2017 accepted on 11/04/2019

INTRODUCTION

Fibromyalgia syndrome (FM) is characterized by the presence of diffuse pain lasting for more than three months, the presence of multiples specific points (tender points), located in the muscle and joints and painful on palpation, and its basic clinical diagnosis.[1] The pain reported by patients is defined generally as bilateral; above and below the waist and spinal region.[2]

This syndrome is often associated with sleep disorders, which has relation with other symptoms such as fatigue, depression and anxiety.[3,4] FM patients usually complain of having short sleep periods at night, feeling tired when waking, and having insomnia.[5] Non-restorative sleep occurs in between 76% to 90% of cases.

Sleep disorders can play a significant role not only in the etiology of chronic pain, but also in perpetuating the symptoms. According Piedra et al.,[6] the relationship of sleep disorders and pain is most common that the relationship pain and sleep disorders. To Olsen et al.,[7] the causal relationship between sleep and pain remains uncertain; however, it is widely accepted as bidirectional.[8] Andrade et al.[9] (2018) found that pain symptoms were associated with all PSQI domains, including the total score.

Physical exercises can help in the treatment of chronic pain, prevention of some the sleep-wake cycle disorders by decreasing the sleep fragmentation, increased slow wave sleep time, and decreased latency to sleep onset.[3,10] Driver and Taylor[11] emphasize that physical exercise has an important role to play as a treatment for sleep disorders. According to Lira et al.,[12] a moderate exercise program induces the recovery of troubled sleep, and this improvement is partly due to aerobic capacity and metabolic improvement.

Studies investigated the effect of strength training (ST) on pain and quality of FM patients' sleep,[13-17] but there continue to be diverse perspectives on the effects of this intervention in this population. However, recently Andrade, Vilarino and Bevilacqua[18] concluded that ST is safe and effective in treating people with FM and that a significant decrease in sleep disturbances occurs after 8 wks of intervention. Moreover, Andrade, Scieczkowska and Vilarino[19] found that after 4 weeks of ST, patients with FM showed significant reduction in pain.

The study of ST in people with FM in Brazil is a recent topic; it is considered as an innovative area, causing insecurity among professionals who assist these patients. Taking this into consideration, the study objective was to verify the feasibility of a ST program for patients with FM and analyze the effects of eight weeks of ST exercises on pain and sleep quality in patients with FM.

METHODS

This feasibility study was an experimental controlled study, with a pre- and post-treatment design. The study was conducted within the ethical standards of the Declaration of Helsinki and according to Resolution 196/96 of the Ministry of Health. This study was approved by the Ethics Committee on Research Involving Human Subjects in writing form (No. 103/2010).

Participants

All patients participated in the extension program, "Psychology of sport and exercise applied to health", which is linked to the Psychology of Sport and Exercise Laboratory (LAPE) of the Health Sciences Centre and Sports (CEFID), Santa Catarina State University (UDESC). The criteria for inclusion in the study were have had a medical diagnosis by medical specialists in rheumatology, orthopedics or general practitioners, age over 18 years, and participated in 50% of the training sessions. At the end of the screening of participants' process, 34 patients were excluded due to not having attended the initial interview or the initial evaluation, had practice the exercise in other local areas, and declined to participate (personal problems and time limitations). At the end of the draw, there were eight patients in the Strength Training Group (STG) and six in the Control Group (CG). (Figure 1)

Procedures

The questionnaires were administered once per month by the study researchers, and always on different days of the training sessions. All patients in the study were informed about all study procedures and signed the Consent Form in this research.

The patients performed only the exercises applied in the study, not getting additional treatment. The ST sessions comprised 10 min of warm-up, with specific exercises for the muscles being worked during the session, 40 min of ST and 10 min of final stretches.

The ST comprised 24 treatment sessions, three times per week, and an individualized load was set for each participant in a subjective way in which the participant arrived at the 12th repetition of each exercise series at its maximum limit. There were three sets of 12 repetitions and the interval between each series was one min. During the session, the main part involved exercises relating to the major muscle groups, such as chest, latissimus dorsi, biceps, triceps, quadriceps, hamstrings, shoulders, and calves. The following exercises were performed: knee extension, knee flexion, bench press, fly, adductors, low rowing, high pulley, triceps in the pulley, lateral raise, arm curl, standing calf raise, and abdominal crunch.

The control group did not perform any type of exercise. The inclusion criterion for the study was involvement in 50% of the 24 sessions of training and having no impeditive diseases.

Instruments

The following instruments were used: (a) to assess pain intensity, the FIQ was used; (b) The polysomnography is considered the gold standard for the evaluation of sleep. But, owing to its high cost and low availability, the Pittsburgh Sleep Quality Index is often used as an effective alternative that provides quantitative and qualitative information on sleep quality.[20] The Pittsburgh Sleep Quality Index (PSQI)[21] was used.

The Fibromyalgia Impact Questionnaire (FIQ) is an instrument used to measure the impact of FM on patient health status and quality of life and was developed by Burckhardt et al.[22] This instrument is divided into 10 items, totaling 19 questions, with scores of 0 to 10; the higher the score, the greater the impact of FM on Quality of life. The items assessed functional ability: sense of well-being, absence from work, ability to work, pain, fatigue, morning tiredness, and stiffness; and psychological aspects: anxiety and depression during the prior week.

The PSQI is a self-reported instrument developed by Buysse et al.,[21] which evaluates the quality of sleep in the prior month. The PSQI provides information about sleep duration, quality, and sleep latency. Our study used a short version of the PSQI that was adapted and validated for Brazil, already used in another study.10 This version evaluates the quality of sleep in the prior 7 days; it consists of 9 questions that evaluate the quality, latency, duration, and efficiency of sleep. The PSQI score ranges from 0 to 21; the higher the score, the worse the quality of sleep. A score >5 indicates difficulty in at least 2 domains.

Data analysis

The data were analyzed using descriptive statistics (mean, frequency, and standard deviation) and inferential tests. The Shapiro-Wilk test was performed to verify the normality of the data. To verify the differences in the average of the dependent variables (pre- and post-test), the Wilcoxon test for nonparametric data and the Student's t test for paired parametric data were used. The comparison between the SG and the CG in relation to pain and sleep quality was assessed using the Mann-Whitney U test for nonparametric data and the t test for independent parametric data. The significance level used in this study was $p < 0.05$.

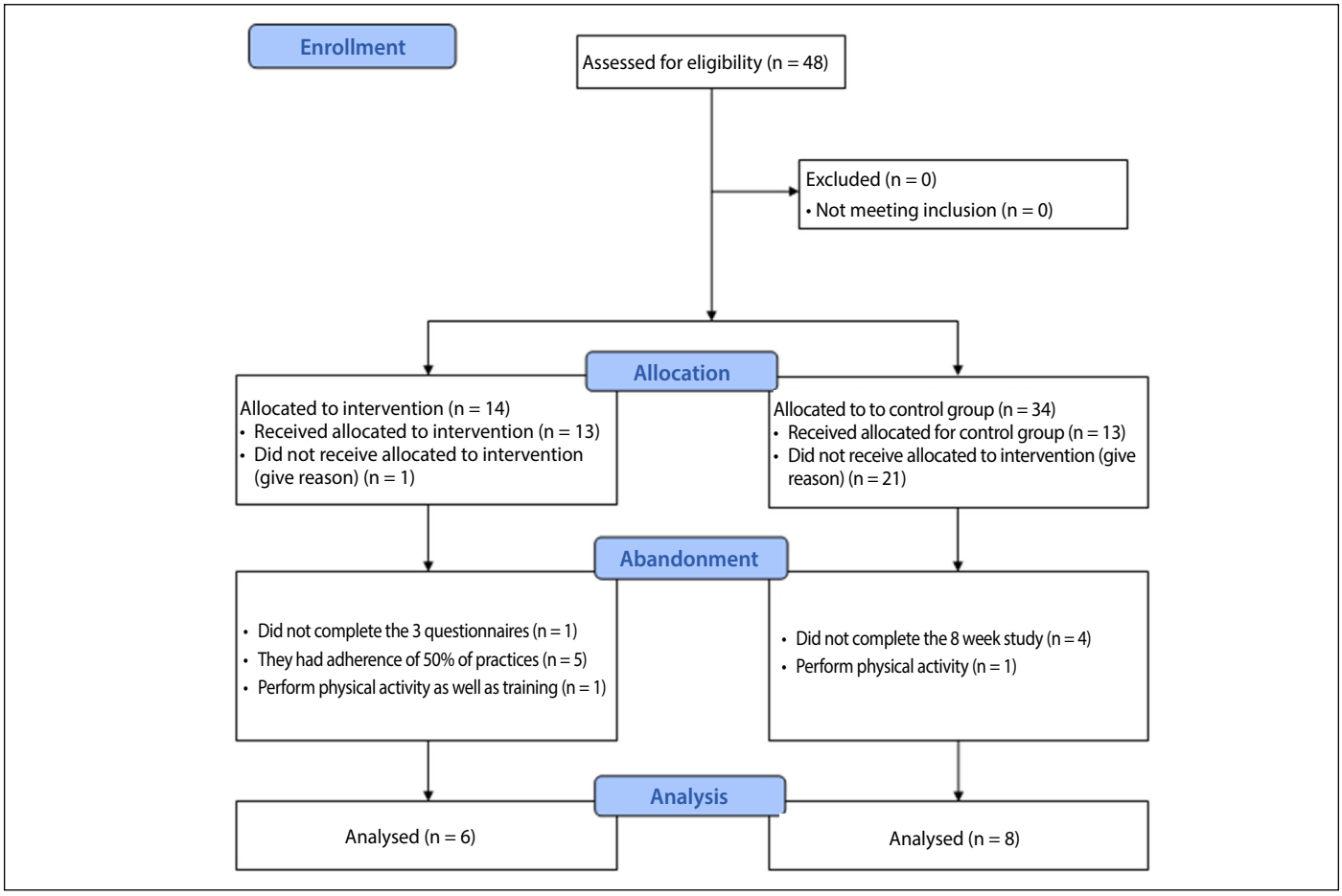

Figure 1. Flowchart of inclusion-exclusion of the 48 study participants.

RESULTS

The socio-demographic and clinical profile results are described in Table 1.

Patients of the SG and CG showed no significant differences before the first training session (pretest). This is a positive fact because it indicates that the groups included in the experiment started with similar characteristics in terms of the variables investigated, favoring the comparison between the groups after eight weeks of ST.

There were no significant differences in the pain intensity and sleep quality of the two groups after eight weeks of ST (post-test). However, the following relevant results were observed: reduction in most of the indices of sleep quality, of total sleep, and of the use of sleep medications, representing up to 50% improvement in comparison with the pretest scores. Moreover, we found a high reduction in the p-values when comparing the pretest pain score and those on most indices of sleep quality to those of the post test.

(Table 2) presents the results of the effects of ST on sleep quality after eight weeks. There were decreases in pain ($p<0.05$) and daytime sleep disorders ($p<0.05$) for the SG. The questions relating to daytime dysfunction are as follows: (a) 'During the last week, how often have you had trouble staying awake while driving the car, having meals, or taking part in social activities?' and (b) 'During the last week, how problematic was it to maintain enthusiasm in completing tasks?' In the CG, there were no significant changes.

When we compare the pain intensity of the SG patients before and after eight weeks of ST, we observed that there was a significant reduction in the media after the training period ($p<0.05$). Although we did not find significant differences in total sleep after eight weeks of treatment, we observed that this variable presented a behavior similar

Table 1. Characteristics of socio-demographic and clinical 14 FMS patients who participated in eight weeks of practicing strength training and 8 weeks in the control group.

Variable	Strength Group (G1 n=6)	Control Group (G2 n=8)
Age	55 ±6.5 years	47 ±9 years
Gender		
Womens	5 (83.3%)	7 (87.5%)
Men	1 (16.7%)	1 (12.5%)
Marital status		
Married	3 (50%)	6 (75%)
Not married (single, widowed, separated)	3 (50%)	2 (25%)
Educational level		
Incomplete primary	0 (0%)	3 (37.5%)
Complete primary	1 (16.7%)	1 (12.5%)
Complete high	3 (50%)	3 (37.5%)
Graduation	1 (16.7%)	1 (12.5%)
Graduate / specialization	1 (16.7%)	0
Employement		
Yes	2 (33.3%)	3 (37.5%)
No	4 (66.7%)	5 (62.5%)
Fibromyalgia diagnosis time (months)		
1 and 24 months	1 (16.7%)	1 (12.5%)
25 to 60 months	3 (50%)	4 (50%)
Over 61 months	2 (33.3%)	3 (37.5%)
Most common symptoms		
Tiredness	5 (83.3%)	8 (100%)
Difficulty concentrating	4 (66.7%)	8 (100%)
Non-restorative sleep	4 (66.7%)	8 (100%)
Memory failure	4 (66.7%)	8 (100%)
Fatigue	6 (100%)	7 (87.5%)
Joint stiffness	6 (100%)	5 (62.5%)
Excessive anxiety	4 (66.7%)	6 (75%)

to that of pain, in which the mean of the CG participants increased and that of the SG participants decreased considerably, as shown in (Figure 2) (mean and standard error).

(Figure 3) represents the delta total sleep and pain intensity variation in the pretest and post-test assessments in both groups. It is evident that the mean in the SG reduced by about 3.0 points and that in the CG increased by approximately 0.5 points, indicating that ST for eight weeks reduced the intensity of pain in FM patients. In relation to total sleep, CG patients increased by one point and that in the SG patients decreased by an average of two points after eight weeks of training.

Table 2. Effects of practice strength training on sleep quality after 8 weeks compared with the control group [(±)].

Variable	Strength pretest	Strength post-test	Control pretest	Control post-test	P value (pretest) SG x CG	P value (post-test) SG x CG
Subjective Quality	1.50(1.04)	1.16(0.40)	1.87(0.99)	1.62(0.51)	0.53	0.09
Latency	2.16(0.75)	1.83(1.16)	2.12(0.99)	2.25(1.03)	1.00	0.44
Duration	1.33(1.03)	1.33(1.21)	1.50(1.41)	1.87(1.24)	0.89	0.38
Efficiency	1.66(1.03)	1.16(0.98)	1.37(1.50)	1.37(1.06)	0.78	0.78
Disorders	2.00(0.89)	1.66(0.81)	2.12(0.83)	2.12(0.99)	0.79	0.36
Medication	0.50(1.22)	1.00(1.26)	1.87(1.55)	2.25(1.38)	0.09	0.09
Daytime Disfunctions	2.00(0.63)	1.00(1.09)*	1.37(0.91)	1.75(0.88)	0.20	0.18
Total Sleep	11.16(3.12)	9.17(4.02)	12.25(4.39)	13.25(4.13)	0.61	0.08

* Significant difference between pretest and post-test at p <0.05.

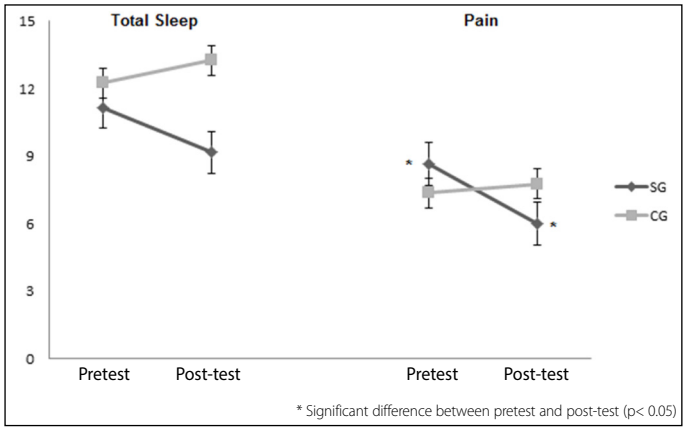

Figure 2. Total sleep and pain intensity of SG and CG patients in the pretest and post-test (mean and standard error).

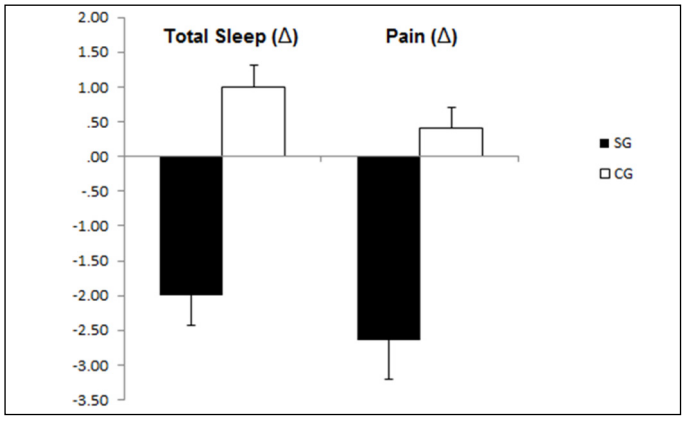

Figure 3. Delta variation in the total sleep and intensity of pain in the SG and CG.

DISCUSSION

In the present study, patients with FM showed significant improvements regarding a reduction in pain intensity after eight weeks of ST. Comparing to the literature, Valkeinen et al.[14] investigated the effects of ST in 13 elderly women with FM, which was held twice weekly for 21 weeks; there was also a decrease in the number of tender points (pain points), but not in pain intensity. Bircan et al.[15] conducted a study in which 13 women with FM performed ST three times per week for eight weeks and a pain reduction was found in these patients. Concerning the ST program for patients with FM, it has been proved that this program is feasible and tolerable, with no adverse effects.

Using other types of exercise, Bressan et al.[23] investigated 15 patients with FM. Eight performed muscle stretching and seven patients underwent treadmill walking for eight weeks. Both groups had a weekly exercise session and there was no decrease in pain intensity after the eight weeks. Bircan et al.[15] results are similar to those in this study, which used the same duration and number of sessions per week of the study. The three weekly sessions may have explained the pain reduction. In the study by Valkeinen et al.,[14] which involved two weekly sessions, and the study of Bressan et al.,[23] which involved only one session per week. This demonstrates that a low number of weekly training sessions may have had a weak effect on pain improvement.

In our study, there were significant improvements for daytime dysfunction in sleep quality after eight weeks of ST. In Bircan et al.[14] study, which used an 8-week strenght training program three times per week, they also found significant improvements in sleep quality; however, this differed from the present study, which featured the same number of sessions, in that there was only an improvement shown in daytime sleep disorders. In two studies that used ST, there were no improvements in sleep quality. Häkkinen et al.[13] followed a 21-week training period, performed twice per week, and no statistically significant improvements in sleep quality were found. Valkeinen et al.[14] conducted a study with 37 women (13 in the FM treatment group, 13 in the CG with FM, and 11 in the healthy CG) who underwent 21 weeks of ST, and there was no significant improvement in sleep quality.

Other forms of exercise can be more efficient in improving sleep quality in patients with FM than ST is. In a study performed with nine women with FM who underwent 32 sessions of joint walking and yoga practice, an improvement in overall sleep quality was found, which was different from the present study in which there was only an improvement in daytime dysfunction.[24] This may be due to the greater number of sessions held in the walking and yoga study.[24]

Steffens et al.[25] reported in their study, which involved a 16-week walking program, that if the exercises are held regularly, they can improve sleep quality in patients with FM. Richards et al.,[26] whose study involved an aerobic exercise program, found benefits for FM patients in relation to sleep. In a study by Pasqua et al.[27] involving eight sessions walking program and sleep in patients with FM, there was an improvement in subjective sleep quality and reduction in this disorder. It can be seen that even with only eight sessions, an improvement in the quality and reduction of subjective sleep disturbances is possible; this is different from the current study in that these improvements do not occur when there is a greater number of sessions (24 sessions).

Sañudo et al.[28] used an exercise program consisting of warm-up activities for 10 min, aerobic exercise (10–15 min), ST (15–20 min), and flexibility exercises (10 min) over two sessions per week. Patients alternated between six months of training and six months with no exercise over a 30-month period. Significant improvements were observed in the impact of FM on the participants' quality of life.

A tendency for aerobic exercises to provide a greater effect on sleep quality in patients with FM compared to ST exercises can be seen in the literature. This should be investigated in future studies.

In our study we found a significant difference in daytime sleep disorders. However, a strong trend in the improvement of up to 50% in other sleep variables after eight weeks of ST was observed. Moreover, there was a high reduction in the p-values when comparing the SG and CG groups in the pretest and post-test assessments. These two facts indicate that, though not significantly, ST for eight weeks shows improvements in the sleep quality of FM patients. Furthermore, this indicates that the proposed training program is effective in alleviating the pain of FM patients after eight weeks.

These study results are useful for future investigations to evaluate the benefits of physical fitness exercise for people with FM, thus contributing to their treatment.

Study limitations

This study has some limitations: the number of individuals involved in the ST sessions was low, and the 24 sessions are also considered low for possible positive effects. Nonetheless, these limitations do not prejudice our findings on the feasibility of ST program for patients with FM.

CONCLUSION

To conclude, ST is a feasible treatment for patients with FM. We found that the eight-week ST significantly improved pain intensity and daytime sleep disorders, indicating that ST improves the quality of life of patients with FM. We also observed a tendency towards reduction of other sleep variables after eight weeks of ST. We recommended more studies on the effects of ST on pain and sleep quality in patients with FM, involving an increase in the intervention period, number of sessions, etc., to verify if new relationships between ST and the study variables are found.

ACKNOWLEDGEMENTS

The authors thank National Council for Scientific and Technological Development (CNPq), Foundation for research and innovation support of the State of Santa Catarina (FAPESC) - Grant number 2019031000035 and call number Nº 027/2020 and Coordination for the Improvement of Higher Level Personnel (CAPES).

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this article. AA, RAKS, FG, CML, RB, DRC, and GGB all worked on the conception, acquisition, analysis, interpretation, writing of the article, and final approval of the version of the manuscript to be published.

REFERENCES

1. Wolfe F, Smythe HA, Yunus MB, Benett RM, Bombardier C, Goldenberg DL, et al. The American College of Rheumatology 1990 Criteria for the Classification of Fibromyalgia. Report of the Multicenter Criteria Committee. Arthritis Rheumatol. 1990;33(2):160-72.
2. Goldenberg DL, Burckhardt C, Crofford L. Management of fibromyalgia syndrome. JAMA. 2004;292(19):2388-95.
3. Hauser W, Bernardy K, Üçeyler N, Sommer S. Treatment of Fibromyalgia Syndrome With Antidepressants. JAMA. 2009;301(2):198-209.
4. Giacomelli C, Sernissi F, Sarzi-Puttini P, Di Franco M, Atzeni F, Bazzichi L. Fibromyalgia: a critical digest of the recent literature. Clin Exp Rheumatol. 2013;31(6):153-7.
5. Ferro CV, Ide MR, Streit MV. Correlação dos distúrbios do sono e parâmetros subjetivos em indivíduos com fibromialgia. Fisioter Mov. 2008;21(1):33-8.
6. Piedra CD, Di Stasi LL, Baldwin CM, Casal GB, Catena A. Sleep disturbances of adult women suffering from fibromyalgia: a systematic review of observational studies. Sleep med rev. 2015;21:86-99.
7. Olsen MN, Sherry DD, Boyne K, McCue R, Gallagher PR, Brooks LJ. Relationship between sleep and pain in adolescents with juvenile primary fibromyalgia syndrome. Sleep. 2013;36(4):509–16.
8. Ohayon M. Chronic pain and sleep. Int J Sleep Dis. 2006;1:16–21.
9. Andrade A, Vilarino GT, Sieczkowska SM, Coimbra DR, Bevilacqua GG, Steffens RAK. The relationship between sleep quality and fibromyalgia symptoms. J Health Psychol. 2018. Epub Ahead of print.
10. Marques AP, Santos AMB, Assumpção A, Matsutani LA, Lage LV, Pereira CAB. Validação da versão brasileira do Fibromyalgia Impact Questionnaire (FIQ). Rev Bras Reumatol. 2006;46(1):24-31.
11. Driver HS, Taylor SR. Exercise and sleep. Sleep Med Rev. 2000;4(4):387-402.
12. Lira FS, Pimentel GD, Santos RVT, Oyama LM, Damaso AR, Nascimento CMO, et al. Exercise training improves sleep pattern and metabolic profile in eldery people in a time-dependent manner. Lipids Health Dis. 2011;10(113):1-6.
13. Häkkinen A, Häkkinen K, Hannonen P, Alen M. Strength training induced adaptations in neuromuscular function of premenopausal women with fibromyalgia: comparison with healthy women. Ann Rheum Dis. 2001;60(1):21–6.
14. Valkeinen H, Alen M, Hannonen P, Häkkinen A, Airaksinen O, Häkkinen K. Changes in knee extension and flexion force, EMG and functional capacity during strength training in older females with fibromyalgia and healthy controls. Rheumatology. 2004;43(2):225-8.
15. Bircan Ç, Karasel SA, Akgün B, El O, Alper S. Effects of muscle strengthening versus aerobic exercise program in fibromyalgia. Rheumatol Int. 2008;28(6):527-32.
16. Hooten WM, Qu W, Townsend CO, Judd JW. Effects of strength vs aerobic exercise on pain severity in adults with fibromyalgia: A randomized equivalence trial. Pain. 2012;153(4):915-23.
17. Gavi MB, Vassalo DV, Amaral FT, Macedo DC, Gava PL, Dantas EM, et al. Strengthening exercises improve symptoms and quality of life but do not chence autonomic modulation in fibromyalgia: A randomized clinical trial. Plos one. 2014;9(3):e90767.
18. Andrade A, Sieczkowska SM, Vilarino GT. Resistance training improves quality of life and associated factors in patients with fibromyalgia syndrome. PM&R. 2018;11(7):703-9.
19. Andrade A, Vilarino GT, Bevilacqua GG. What Is the Effect of Strength Training on Pain and Sleep in Patients With Fibromyalgia? Am J Phys Med Rehabil. 2017;96(12):889–93.
20. Araujo PAB, Sties SW, Wittkopf PG, Netto AS, Gonzáles AI, Lima DP, et al. Pittsburgh sleep quality index for use in cardiopulmonary and metabolic rehabilitation. Rev Bras Med Esporte. 2015;21(6):472-5.
21. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28(2):193-213.
22. Burckhardt CS, Clark SR, Bennett RM. The fibromyalgia impact questionnaire: development and validation. J Rheumatol. 1991;18:728–33.
23. Bressan LR, Matsunani LA, Assumpção A, Marques AP, Cabral CMN. Efeitos do alongamento muscular e condicionamento físico no tratamento fisioterápico de pacientes com fibromialgia. Rev Bras Fisioter. 2008;12(2):88-93.
24. Steffens RAK, Viana MS, Liz CM, Brandt R, Bevilacqua GG, Andrade A. Efeito da prática conjunta da caminhada e yoga no sono, depressão e qualidade de vida em pacientes com síndrome da fibromialgia. ConS Saúde. 2013;12(3):371-8.
25. Steffens RAK, Liz CM, Viana MS, Brandt R, Oliveira LGM, Andrade A. Praticar caminhada melhora a qualidade do sono e os estados de humor em mulheres com síndrome da fibromialgia. Rev Dor. 2011;12(4):327-31.
26. Richards SCM, Scott DL. Prescribed exercise in people with fibromyalgia parallel group randomized controlled trial. BMJ. 2002;325(7357):1-4.
27. Pasqua LD, Steffens RAK, Viana MS, Brandt R, Vilarino GT, Andrade A. Efeito da caminhada no sono de pacientes portadores de sindrome da fibromialgia. Cons Saúde. 2012;11(4):580-6.
28. Sañudo B, Carrasco L, Hoyo M, McVeigh JG. Effects of Exercise Training and Detraining in Patients with Fibromyalgia Syndrome: A 3-Yr Longitudinal Study. Am J Phys Med Rehabil. 2012;91(7):561-9.