SENSE OF WELL-BEING IN PATIENTS WITH FIBROMYALGIA. AEROBIC EXERCISE PROGRAM IN A MATURE FOREST: A PILOT STUDY

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ABSTRACT

Background and objective: Most patients with fibromyalgia benefit from different forms of physical exercise. The aim of this study was to analyze the benefits of moderate aerobic exercise when walking in two types of forests, young and mature, and to assess anxiety, sleep, pain and well-being in patients with fibromyalgia.

Patients and method: An experimental study involving walking through two types of forests was performed. A total of 30 patients were randomly assigned to two groups: experimental (mature forest) and control (young forest). The participants were administered the following tests: The *Spanish version of the Revised Fibromyalgia Impact Questionnaire* (FIQR) at baseline and the end-point of the study, the *State-Trait Anxiety Inventory* (STAI) after each walk, and a series of questions regarding symptomatic evolution. Several physiological parameters were registered.

Results: FIQR baseline and end-point scores indicated a significant decrease in the symptomatic subscales (SD=21.7; z=-2.4; p=0.041). The intra-group analysis revealed that differences were significant with respect to days of intense pain, insomnia and days of well-being only in the group assigned to the mature forest, not in the group assigned to the young forest. No differences were found with respect to anxiety.

Conclusions: An aerobic exercise program consisting of walking through a mature forest provides the subjective perception of fewer days of pain and insomnia accompanied by more days of perceived well-being in patients with fibromyalgia.

Key Words

Fibromyalgia, pain, anxiety, nonpharmacological therapy, therapeutic forest, well-being.

INTRODUCTION

In recent years, in Japan, the practice of recreational and relaxation activities conducted in forested environments and extensive green spaces for therapeutic purposes has increased considerably. This approach is called forest-therapy or "shinrin-yoku" (forest-air bathing and forest-landscape watching/walking) and represents a popular form of natural therapy for the many people looking to reduce stress [1]. Preventive medicine and complementary and alternative medicine have investigated the therapeutic effects of said therapy [2]. Some physiological studies partially support the hypothesis that walking in the woods has positive effects on the central nervous system, autonomic nervous system and endocrine system [3,4,5,6], increasing the immune response [7,8], affecting hypertension [9] and positively influencing non-insulin-dependent diabetic patients [10,11]. Physical activity in forests can have a positive effect on the cardiovascular response of young people [12]. In clinical practice, there already exists some evidence, although heterogeneous, of the positive impact of natural scenery on human health. Similarly, psychological studies indicate that there is a positive emotional response to forest environments because these environments effectively reduce stress and attentional fatigue, help relieve depression, and improve psychological relaxation [13]. Recent studies have indicated that walking through a forest can improve the perception of health conditions and tends to decrease stress in healthy people [14,15]. Additionally, cognitive and affective improvements have been observed in people with major depressive disorder who performed therapeutic walks in the forest [16]. However, existing evidence on the effects of forest therapy on people's health are controversial. A recent systematic revision of randomized clinical studies on the healing and health-improving effects of forest therapy [17] did not find sufficient evidence of such effects due to the poor methodological quality of the trials and the heterogeneous and

incomparable protocols employed. Nonetheless, the authors propose a series of strategies and methodological improvements that would make studies of forest therapy viable and would consolidate the limited existing evidence. Following the recommendations proposed by the aforementioned study [17], the overall objective of this research is to assess the short-term effects of walking through the woods in two natural conditions (primary forest vs. secondary forest) on fibromyalgia symptoms and to provide scientific evidence of the results on the health of patients with FM after walking through these woods.

Fibromyalgia (FM) is a rheumatic syndrome of unknown etiology characterized by chronic, diffuse musculoskeletal pain, fatigue, sleep disorders, morning stiffness, and psychological disorders, mainly anxiety and depression. This condition also exhibits hypersensitivity along with verifiable pain in specific anatomical points [18] and affects 2% to 8% of the population, mostly women [19]. Currently, there is no effective treatment to control FM symptoms, although there is growing evidence of the symptomatic benefit of certain pharmacological treatments (tricyclic antidepressants, inhibitors of serotonin, norepinephrine and gabapentinoid reuptake modulators) and of certain non-pharmacological therapies (physical exercise, cognitive behavioral therapy, health education) [19].

The main objective of the study was to assess the short-term effects of walking through the woods in natural conditions on fibromyalgia symptoms and to demonstrate that people with FM performing moderate exercise in therapeutic forests exhibit a significant improvement in their clinical symptoms when compared with the same type of exercise in younger forests. Secondary objectives included assessing whether there are significant differences in temperature, sound and moisture between mature and young therapeutic forests; whether people who exercise in therapeutic forests

significantly improve emotional control, have a sense of improved health and observed a reduction in pain; and whether the therapeutic forest provides patients with greater physical and mental relaxation.

PATIENTS AND METHODS

Design and participants

A randomized single-blind clinical trial of two groups, with individuals 20 to 70 years old who were diagnosed with FM, was designed. People with FM, belonging mostly to the Garrotxa Association of Chronic Fatigue and Fibromyalgia, were invited to participate. All of the patients met the diagnostic criteria of the American College of Rheumatology [20,21,18]. A sample size of 15 participants per group (young and mature forest) was selected to provide, with a power of 78.2%, a difference equal to or greater than 30 points in the FIQR scale between both groups, assuming a standard deviation of 30 points and a confidence level of 95%. The study was approved by the Institutional Review Board of the Institut d'Assistència Sanitaria in Girona. All participants signed informed consent.

Procedure

Participants were assigned to each group using a list of random numbers. Each group took six 1.25-kilometer walks in the evenings between 5 and 6 pm. During the walks, participants were accompanied by two nurses trained in interviewing. These nurses were blinded to the type of forest and ensured that the walks were performed in a homogeneous manner. Additionally, the nurses were responsible for managing the data collection notebooks.

Variables and instruments

Each participant's information regarding age and approximate date of fibromyalgia diagnosis was gathered and self-referential co-morbidity was recorded

before beginning the study using a standardized questionnaire. Participants' weights and heights were measured on the first and last day of intervention. Blood pressure, heart rate, oxygen saturation and temperature of the participants were determined at the beginning and end of each walk. In conjunction with the S*panish version of the Revised Fibromyalgia Impact Questionnaire* (FIQR) [22] and the S*panish version of State-Trait Anxiety Inventory* (STAI) [23] that were administered on the first and last day of intervention, participants completed an ad hoc questionnaire on the symptomatic progression of fibromyalgia during the last 15 days of the trial, specifying the days of generalized discomfort, the degree of intense pain, the presence of insomnia and the number of days during which they experienced well-being. Measures relating to environmental conditions of the forests, such as temperature (in degrees Celsius), luminosity (in lux), noise (in decibels) and atmospheric pressure (in hectopascals) were recorded thirty minutes prior to each session.

Description of the independent variable

The two forests are located in the Garrotxa Volcanic Zone Natural Park, specifically between Olot and the beech forest in Jordà (Northeast of Girona, Spain) The topography of this area is characterized by rolling hills and small mountains, corresponding to volcanoes of reduced dimensions that emerged approximately 17,000 years ago from lava flow. The forests are mainly composed of wet oak groves of sessile oak *(Quercus robur*), typical of the valley bottoms and quaternary plains that were successively filled by volcanic materials and lacustrine deposits. These forests grow in a middle-European sub-Atlantic climate, in the biogeographic mountain region, specifically the sub-montane area, and are very rare in the south of the Pyrenees. The walks were performed through flat areas in these woods.

The "Can Serra" mature forest (experimental group) has irregular trees with many centenarian feet. The dominant species is sessile oak, with a harmoniously irregular high mountain structure and a considerable density of old trees with sizable treetops. This area presents rare and very penetrable undergrowth, with sufficient space to accommodate a group of people on a therapeutic walk through the existing trails.

The young forest "Les Llongaines" (control group) consists of a more regular and dense woodland with an age range of 5-35 years, without any tree exceeding 50 years. The dominant species is sessile oak, although there is a small sector with beech trees. This is a large open area inhabited by species such as bramble *(Rubus ulmifolius)*, hawthorn (*Crataegus monogyna*) or broom (*Cytisus scoparius*). The vegetation is homogeneous, compact, closed and less penetrable.

Statistical analysis

A descriptive analysis of all study variables was performed using quantitative (measures of central tendency and dispersion) and qualitative (measures of absolute and relative frequencies) data analysis, both globally and stratified by forest type. To determine the effect of forest type on the clinical symptoms of the participants, a inter-group comparison of the means for independent groups with the nonparametric Mann-Whitney U test of the difference in the FIQR scores was conducted between both groups of participants at the beginning and end of the study. Additionally, the Wilcoxon test was used for paired data when comparing the intra-subject difference. The Mann-Whitney U test was used to achieve the secondary objectives for quantitative variables, and the χ^2 test was used for ordinal and nominal qualitative variables.

RESULTS

Initially, 34 participants who were randomized in two groups enrolled in the study. Nonetheless, only 30 of them took part in the research because four dropped out

by choice, alleging time incompatibility before the start of the study. All participants were women, and 14 and 16 participants were assigned to the mature forest and to the young forest, respectively. The average age of all participants was 62.3 years (SD=7.7) with an average weight of 70.7 kg (SD=14.1), height of 158.3 cm (SD=28.2), systolic blood pressure of 131.4 mm Hg (SD=20.4), diastolic blood pressure of 77.2 mm Hg (SD=9.1), heart rate of 74.4 bpm (SD=9.2), oxygen saturation of 96.2% (SD=2.1) and body temperature of 35.4ºC (SD=0.4). Table 1 presents the baseline characteristics of the participants stratified by group. The comparison of baseline characteristics between the two groups revealed significant differences in systolic blood pressure, which was higher in the participants assigned to the young forest, and oxygen saturation, which was higher in participants assigned to the mature forest. With respect to the environmental features during the study, no significant differences were observed between the two forests.

Table 1. Characteristics of the participants [mean (SD)]

	Young forest (n=16)	**Mature forest** (n=14)
Age	60.6 (8.4)	64.4 (6.5)
Weight	73.3 (18.1)	67.8 (6.9)
Height	159.1 (6.6)	157.3 (3.1)
BMI	28.9 (6.9)	27.4 (3.1)
SBP	140.4 (19.0)	121.3 (17.6)
DBP	79.8 (8.6)	77.1 (9.3)

HR	74.7 (10.2)	75.7 (10.2)
SaO2*	95.3 (2.2)	97.4 (1.6)
BT	35.7 (0.5)	35.9 (0.4)

BMI: body mass index; SBP, systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; SaO2: Oxygen saturation; BT: body temperature; * p <0.05

At baseline, the mean score of all participants in the FIQR scale was 58.7 points (SD=20.5). The breakdown of the FIQR score on its three subscales was 16.6 points (SD=6.7) for the functional disability subscale, 10.1 points (SD=6.6) for the overall impact of the disease subscale and 32.0 (10.7) points for the subscale of clinical symptoms, without exhibiting statistically significant differences between participants assigned to either group.

In the total sample, the intra-group analysis (pre-post) revealed a difference score of 3.8 points (SD=22.9) for the total FIQR, 1.3 points (SD=8.0) for the subscale of functional disability, -0.9 points (SD=7.9) for general impact subscale and -4.2 points (SD=11.0) for the clinical symptoms subscale, which was statistically significant. Table 2 presents the scores for individual clinical symptoms, where a significant decrease in the severity of symptoms, such as anxiety and tenderness, was observed.

Table 2. Differences in the FIQR symptom score for all participants between baseline and at end-point: Intra-group (pre-post) analysis

	Baseline	**End-point**	**Difference**
FIQR pain	6.5 (2.3)	5.6 (2.6)	-0.9 (2.3)
FIQR energy	6.7 (3.2)	5.8 (3.1)	-0.9 (4.1)

FIQR stiffness	6.2 (2.9)	5.0 (3.3)	-1.2 (3.1)
FIQR sleep quality	7.7 (2.6)	6.3 (3.3)	-1.4 (3.6)
FIQR depression	5.1 (3.7)	4.7 (3.5)	-0.4 (4.2)
FIQR memory problems	6.1 (3.1)	6.1 (3.3)	0.03 (2.1)
FIQR anxiety	6.3 (3.5)	4.3 (3.6)	-1.9 (3.7)*
FIQR tenderness	7.2 (2.8)	5.8 (3.2)	-1.4 (3.0)*
FIQR balance problems	5.3 (3.2)	5.2 (3.1)	-0.03 (2.8)
FIQR sensitivity to noise, light, odors, and cold	6.9 (3.3)	6.5 (3.6)	-0.5 (3.7)

* $p < .0.05$

The inter-group analysis comparing total and subscale scores revealed no statistically significant differences between groups. The group assigned to the mature forest had a score difference in the total FIQR of -6.1 points (SD=21.3), 0.5 points (SD=9.0) in the subscale of functional disability, -2.6 points (SD=6.7) in global impact and -4.1 points (SD=11.8) in the clinical symptoms. In the group assigned to the young forest, the difference in the total FIQR was -1.7 points (SD=24.6), 2.2 points (SD=7.2) for the subscale of functional disability, 0.6 (SD=8.6) points for overall impact and -4.3 points (SD=11.8) for clinical symptoms. Table 3 presents the differences in individual symptoms between the two groups.

Table 3. Differences in the FIQR symptom score for all participants between baseline and end-point: Inter-group analysis.

	Young forest (n=16)	**Mature forest** (n=14)
FIQR pain	-1.0 (2.6)	-0.7 (2.0)
FIQR energy	-0.7 (3.3)	-1.0 (4.9)
FIQR stiffness	-1.5 (3.4)	-0.9 (2.7)
FIQR sleep quality	-0.9 (3.19)	-1.8 (4.1)
FIQR depression	-0.3 (3.6)	-0.4 (4.9)
FIQR memory problems	-0.1 (2.1)	0.1 (2.0)
FIQR anxiety	-1.0 (3.7)	-2.9 (3.4)
FIQR tenderness	-1.1 (3.0)	-1.6 (3.0)
FIQR balance problems	-0.1 (2.1)	0.1 (3.4)
FIQR sensitivity to noise, light, odors, and cold	-1.6 (2.9)	0.9 (4.0)

With respect to anxiety, the mean score on the subscale of the STAI trait was 4.9 points (SD=8.3) and 34.9 points status (SD=9.5). At baseline, no significant differences were observed in any of the scales or subscales among the participants in both groups. State-anxiety exhibited no differences between the groups either with respect to the different days on which the study was performed or with respect to evolution. Similarly,

no differences were found in any of the recorded physiological parameters (blood pressure, heart rate, and body temperature and oxygen saturation) between the start and end of the study.

With respect to subjective assessments on the number of days of perceived wellness/discomfort between baseline and end-point, a decrease in symptoms was observed, yet it was not statistically significant either globally or inter-group. The intra-group analysis revealed that only the mature forest group and not the young forest group exhibited significant differences in the days of intense pain, insomnia and sense of well-being (Table 4).

Table 4. Days of perceived well-being/malaise at baseline and end-point and differences stratified by the type of forest: Intra-group (pre-post) analysis

Young forest	**Baseline**	**End-point**	**Difference**
Days of malaise	12.4 (3.0)	9.4 (5.4)	-3.3 (3.9)
Days of intense pain	8.9 (5.4)	6.1 (5.7)	-2.1 (7.0)
Days of insomnia	7.4 (6.5)	5.6 (6.7)	-1.9 (6.4)
Days with no anxiety	2.9 (5.0)	1.3 (2.1)	-2.1 (6.0)
Days of perceived well-being	1.4 (2.2)	2.9 (4.4)	1.5 (3.0)
Mature forest			
Days of malaise	8.6 (5.0)	4.8 (6.5)	-3.8 (7.4)
Days of intense pain	7.9 (5.9)	2.5 (4.1)	-5.9 (7.0)*
Days of insomnia	7.9 (6.6)	3.7 (5.3)	-4.7 (6.4)*
Days with no anxiety	6.1 (5.5)	6.8 (6.8)	1.0 (7.3)
Days of perceived well-being	2.2 (2.5)	7.0 (4.7)	5.0 (4.8)*

* $p < .0.05$

Table 5 presents the final scores of some parameters that exhibited improvements in the participants walking through the mature forest.

Table 5. Assessment at the end of the study (median (SD)).

	Global	**Young forest**	**Mature forest**
I think this therapy was good for me.	8.2 (1.8)	7.8 (1.8)	8.5 (1.8)
During the walks, I have been more relaxed than usual.	8.0 (2.0)	7.1 (2.1)	9.0 (1.4)*
I would recommend this therapy to others.	8.9 (2.1)	8.0 (2.7)	9.7 (0.6)*
My sleep problems have improved.	5.3 (2.9)	5.6 (2.6)	5.0 (3.3)
I feel less tired.	4.6 (2.8)	4.2 (1.7)	5.1 (3.7)
I feel less pain.	4.7 (2.6)	3.9 (1.8)	5.6 (3.0)
I feel less anxious.	4.5 (3.6)	3.8 (2.0)	5.2 (3.3)
As days went by, I felt greater discomfort.	4.7 (3.6)	3.4 (3.0)	5.9 (3.9)
I would use this therapy again.	95.8%	92.3%	100%

* $p < .0.05$

DISCUSSION

The main aim of this research was not achieved, as the results revealed no differences between the groups in the two forest types. However, participants who walked in the mature forest, unlike those who did so in the young forest, reported significant differences between baseline and final scores with respect to the number of

days of intense pain, days of insomnia and days of well-being. Other controlled studies with FM patients that used different types of activity (moderate exercise, stretching and educational therapies) reported improvements with respect to pain, functional status and life quality as well [24,25]. Our results are very similar to those observed by Arcos et al., [26] through a combined program of aerobic exercises and progressive relaxation techniques, given that the benefits of this therapy consisted mainly of improvements in night's rest, pain and quality of life.

There is a benefit associated with the intervention because the scores in the FIQR subscale for symptoms revealed an overall decrease in intensity, specifically pointing to significant differences in anxiety and pain items. Other studies showed similar findings of patient improvement after conducting different types of physical exercises [27,28,29]. However, the progress observed in our study cannot be attributed to physical exercise in the forest, given that all participants performed the same activity. In our study, participants in the experimental group, unlike the control group, reported improvements in pain, insomnia and wellness compared with baseline.

Although anxiety is one symptom that typically improves in most studies on exercise and FM, no significant differences in anxiety were found between groups in our study. The lack of response could be attributed to the short duration of the study, which only lasted two weeks. Studies of longer duration, usually more than eight weeks, have obtained better results [30,31].

When comparing both groups (young/mature forest), the group that walked through the mature forest reported feeling more relaxed than usual, in a statistically significant manner, compared with those who performed the exercise in the young forest. This subjective perception may be related to the alleged benefits of walks through mature woodland. Walking in such an area involves contact with phytoncides

produced by trees, as well as fresh air, pleasant scenery and mild climate. These features are part of most standard programs in this type of therapy. Some hypotheses hold that the health benefits derived from activities undertaken in forests can be explained by the recovery of homeostasis after experiencing acute or chronic stress. The natural stimuli associated with walking in the woods promotes relaxation of the central and autonomic nervous systems by reducing the secretion of stress-related hormones (cortisol, epinephrine and norepinephrine) and facilitating recovery of the immune response [32]. These physiological responses to the environment might interact with each other, leading to positive health outcomes. These mechanisms could be explained with respect to the results observed in other epidemiological studies that have reported positive relationships between the environment and health parameters. At present, there is little evidence on the direct benefits of walking through the woods in reducing chronic pain and fatigue in patients with FM [3].

The study has several limitations. First, due to its exploratory nature, it was underpowered to detect minor differences in the primary efficacy variable, which is the FIQR score. An otter limitation, as previous stated, was the short duration of the study length. Similarly, the characteristics of forests, despite significant differences in vegetation and tree age, also limited the results, as some of these differences bordered on statistical significance. Perhaps greater differences could have been found if the forest had had therapeutic features closer to those of older forest with more evolved natural dynamics. However, such types of forest are very scarce and valuable and are generally located at a considerable distance from urban areas, which would have prevented the study. Another limitation is the small number of cases and walks in the forest.

Nonetheless, the results are encouraging and are consistent with those observed in studies of healthy individuals. As previously mentioned, walking in the woods among phytoncide emanations in a pure environment and surrounded by landscapes of scenic quality is part of most forest therapy programs. Further research with programs of longer duration, conducted in more mature forests, would clarify the potential benefit of forests in people with FM. Perhaps these exercises could be a complement to existing therapies.

Conflict of interest:

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