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The efficacy of balneotherapy and physical modalities on the pulmonary system of patients with fibromyalgia

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Abstract. Effects of balneotherapy on Primary Fibromyalgia Syndrome (FMS) have been studied well, except for its effect on the respiratory symptoms of FMS. In this study we allocated 56 patients with FMS into three groups who matched according to age, gender and duration of illness. All three groups received the same three physical therapy modalities (PTM): transcutaneous electrical nerve stimulation (TENS), ultrasound (US) and infrared (IR). The first group received PTM plus balneotherapy (PTM+BT), the second group received PTM alone (PTM), whilst the third group received PTM plus hydrotherapy (PTM+HT). All groups were treated for three weeks and in the same season. All patients were assessed at four time points: (a) at baseline, (b) on the 7th day of therapy, (c) at the end of therapy (after 3 weeks) and (d) at 6 months after the end of therapy. The effectiveness of treatments in all groups were evaluated in three main categories (pain, depressive and respiratory symptoms). Tender point count, total algometric measurements and pain with visual analog scale for pain; Beck Depression Inventory (BDI) and Hamilton Depression Rating Scale (HDRS) for depression; dyspnea scale, and spirometric measurements for respiratory symptoms; plus quality of life with visual analog scale as a general measurement of effectiveness were taken at all four assessment time points.
Both at the end of therapy and at the 6 months follow up significant improvements in dyspnea scale, and spirometric measurements, as well as in other measured parameters were observed in group PTM+BT. All groups achieved significant improvements in BDI and HDRS but scores of PTM and PTM+HT groups had overturned at 6 months follow up. Except second group which receieved PTM alone, pain evaluation assessments were improved at 6 month follow up in PTM+HT and PTM+BT groups. But PTM+BT group had more significant improvements at the end of therapy. PTM group had no significant change for dyspnea scale and spirometric measurements. PTM combined BT and HT groups achieved significant improvements at the end of therapies for dyspnea scale and spirometric measurements, but only PTM +BT group had significant improvements for dyspnea scale and spirometric measurements at six month follow up. The group of PTM+BT was significantly better than other groups.
Our results suggest that supplementation of PTM with balneotherapy is effective on the respiratory and other symptoms of FMS and these effects were better than other protocols at 6 month follow up.

Keywords: Fibromyalgia, spirometry, balneotherapy, hydrotherapy, physical therapy modalities

1. Introduction

Primary fibromyalgia syndrome (FMS) is a common chronic disabling condition, that affects predominately women and is characterized by generalized musculoskeletal pain and diffuse tenderness at specified

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anatomic locations, termed as tender points (TP) [1]. Patients with FMS may also have headache, irritable bowel, dysmenorrhea, depression, and respiratory symptoms [2–4]. Respiratory symptoms like dyspnea may be related to poor sleep, fatigue, low physical performance, respiratory muscle weakness and central nervous dysfunction [5]. Authors reported that maximum expiratory and inspiratory pressures were found to be lower in these patients and concluded that this might be due to diaphragmatic dysfunction [6,7].

The etiopathogenesis remains still unknown and so that there is no standard treatment regime either; it is usually symptomatic. Several treatment modalities ranging from analgesics or antidepressant therapy to biofeedback, exercises, yoga, pilates, chiropractic interventions and electro acupuncture have been suggested for this entity [8–13]. Many authors recently studied the effectiveness of balneotherapy in patients with FMS [14–18]. Balneotherapy was shown to provide significant and longer-lasting improvement compared to control groups in the symptoms of pain, fatigue, and sleep disturbance [17–19]. However, the effects of balneotherapy on some symptoms like respiratory problems were not determined well.

The aim of this study was to assess the effects of balneotherapy + PTM on respiratory systems of patients with FMS with an prospective controlled design.

2. Methods

2.1. Patients and programmes

A total of fifty-six female patients aged between 38 and 56 were recruited from Bursa Military and Istanbul Physical Medicine and Rehabilitation Education Hospitals.

The major inclusion criteria were the American College of Rheumatology criteria for FMS according to the American College of Rheumatism (ACR) [1]. Exclusion criteria were the presence of some medical disorders, which required treatment (for example, fractures, infectious diseases, malignant tumors), prevented physical activity and patients compliance (for example, unstable hypertension, severe cardiovascular problems, major hepatic and renal insufficiencies, hemorhagic diseases, serious anemia, pregnancy, psychiatric disorder) or participation in pool sessions and application of physical modalities (for example, heat intolerance, water phobia, skin diseases, allergy to chlorine, skin insensitivity). The patients had not participated in balneotherapy, hydrotherapy, or any kind of regular exercise in the last two years. All patients were instructed to discontinue their medication throughout the study period; only paracetemol was permitted to use at follow up. Laboratory tests used for patients' evaluation included complete blood count, erythrocyte sedimentation rate, C reactive protein level, blood glucose level, hepatic and renal function tests, thyroid stimulant hormone level and X-rays.

The study was approved by the local ethics committee. The patients were fully informed about the nature and purpose of the study, and informed consent was obtained from each of them.

All patients ($n = 16$) who had inclusion criteria were selected for PTM+BT, among 200 patients at Military Hospital's ward. Among 95 patients who were diagnosed as FMS according to inclusion criteria by physicians in Physical Medicine and Rehabilitation Education Hospital's outpatient unit, 40 patients who were matched with demographic and clinical characteristics (such as age, gender, duration of disease) of PTM+BT were randomized (1:1) and assigned to either of two groups, each consisting of 20 people. These two groups called for staying hospital. So all groups were inpatient. All three groups were submitted to a therapy simultaneously.

3. Assessments

All patients were assessed before, in the first week and at the end of the therapy protocols (3rd week), and at the 6th month after the therapies. The same investigator performed all assessments.

3.1. Measurements

Demographics and clinical characteristics (Table 1) and measurements (Table 2) were performed for all three groups of patients.

Pain is the main symptom of FMS, and pain relief is expected as a result of spa therapy [20]. So, tender points count (TP), a 10-cm visual analogue scale (VAS) (0 indicates no pain whereas 10 is the worst), total pressure pain thresholds with a dolorimeter[1] on TP according ACR were selected for evaluation pain.

The patients were also required to complete the Beck Depression Inventory (BDI) [21,22] and Hamilton De-

[1] Pain Diagnostics and Thermography Inc., 233 East Shore Road, Suite 108, Great Neck, NY 11023, USA.

Table 1
Demographic and clinical characteristics

	PTM + BT	PTM	PTM + HT	p
Age (years)	46.87 ± 9.2	44.65 ± 8.79	42.95 ± 8.34	$p > 0.05$
Duration of symptoms (years)	7.47 ±	6.22	5.97	$p > 0.05$
Education (years)	6.4 ± 2.3	6.5 ± 2.9	6.3 ± 2.9	$p > 0.05$
	PTM + BT	PTM	PTM + HT	p
Married %	75	75	80	$p > 0.2$
Non smokers %	80	70	80	$p > 0.2$
BMI % (>24.9)	56	55	50	$p > 0.2$
Dispnea %	44	50	55	$p > 0.2$
No restorative sleep %	75	75	80	$p > 0,2$
Headache %	68.7	70	70	$p > 0.2$
Dysmenorrheal symptoms %	44	50	45	$p > 0,2$
Pollacuria %	44	35	50	$p > 0.2$
Depression %	37.5	40	35	$p > 0.2$
Iritabl colon symptoms %	25	25	30	$p > 0.2$

Table 2
All initial measurements between groups

	PTM + BT ($n = 16$) Mean ± SD	PTM ($n = 20$) Mean ± SD	PTM + HT ($n = 20$) Mean ± SD	p ANOVA
Total algometric	60645 ± 6350	59782 ± 7873.38	61080 ± 6298.59	$p > 0.05$
Tender point count	17.10 ± 1.8	16.35 ± 1.46	17.35 ± 1.09	$p > 0.05$
VAS pain	7.20 ± 0.51	6.78 ± 1.03	7.07 ± 0.69	$p > 0.05$
Beck Depression I.	16.4 ± 9.2	16.05 ± 7.87	15.3 ± 6.74	$p > 0.05$
Hamilton DT	17.2 ± 5.75	17.65 ± 5.26	16.9 ± 5.38	$p > 0.05$
Dyspnea	2.14 ± 2.02	2.03 ± 0.73	2.05 ± 0.83	$p > 0.05$
FVC	2.4 ± 0.76	2.45 ± 0.657	2.3 ± 0.8	$p > 0.05$
FEV1.0	1.5400 ± 0.572	1.52 ± 0.5	1.53 ± 0.2	$p > 0.05$
FEV1.0/FVC	65.98 ± 19.3	67.53 ± 18.06	64.9 ± 15.4	$p > 0.05$
FEV1.0/VC	62.16 ± 17.9	59.78 ± 16.8	61.3 ± 16.9	$p > 0.05$
FEV 1%	64.2 ± 19.1	64.2 ± 17.24	64.5 ± 11.8	$p > 0.05$
PEF	1.82 ± 0.84	1.83 ± 0.73	1,78 ± 1,1	$p > 0.05$
Expiration time	3,22 ± 1,06	3,20 ± 0,95	3.02 ± 0.8	$p > 0.05$
VC	2.57 ± 0.6	2.63 ± 0.61	2.61 ± 0.9	$p > 0.05$
VAS quality of life	7.32 ± 0.57	7.4 ± 0.62	7.29 ± 0.71	$p > 0.05$

pression Rank Scale (HDRS) were filled by same doctor [23]. These tests were evaluated by a certified specialist.

Pulmonary functions were determined with dyspnea scale [24] and a digital portable spirometer.[2] The following parameters were measured: (1) forced vital capacity (FVC); (2) forced expiratory volume in 1 s (FEV 1); (3) maximum mid expiratory flow (MMEF 25–75%); (4) the ratio of FEV 1 to FVC% (FEV 1 / FVC%), and (5) peak expiratory flow (PEF)

For the pulmonary function tests, the patient was seated comfortably. He/she was instructed to take a full breath in, then to close the lips around the mouth piece and blow out as hard and fast as possible. Inspiration should be full and unhurried, and expiration tested should be continued without pause. A minimum exhalation of 6 s was necessary to obtain maximal FVC. The technique was demonstrated to every subject and the result was expressed in liters (body temperature, barometric pressure and saturated; BTPS). At least three pulmonary function measurements were obtained. FVC and FEV 1 of the best were computed. The percent of predicted spirometric values were used for comparison [25].

The patients were asked to mark the level of the effect of their disease on daily life on a 10-cm scale ranging from 0 (no disturbance) to 10 (severely disturbing) [26].

3.1.1. Interventions

All groups received 15 sessions of Physical Therapy Modalities (PTM) with the same protocol: Conventional TENS for 15 minutes to cervico-dorso-lumbar paravertebral regions with 6 electrodes were applied bilaterally, ultrasound were applied to cervico-dorsal

[2] Minato, Osaka, Japan.

Table 3
Thermal water analysis in Bursa Military Hospital

T(°C)	38
pH	6.75
CO_2 mg/L	114.4
Anions	mg/L
Cl^-	7.37
HCO_3^-	280.6
$SO4^{-2}$	85
F^-	0.92
Total anions	374.16
Cations	mg/L
Ca^{++}	67.85
Mg^{++}	20.34
Na^+	28.73
K^+	4.69
Total cations	121.89
TOTAL mineral	536.26

paravertebral muscles 1.5 watt/cm^2 for 6 minutes bilaterally, one 250-watt infrared heat lamp was covered to 50 cm far from to cervico-dorso lumbar region for 15 minutes.

The patients in PTM+BT group ($n = 16$) were admitted to wards of Military Hospital SPA for 3 weeks. Spa therapy consisted of 19 session thermal pool baths (at 37–38°C for 20 min) each day of a week except Sundays. The thermal water used in balneotherapy was acratothermal water (Table 3).

The patients in PTM group and PTM+HT group stayed in the ward of hospital. Fifteen hydrotherapy (tap water) sessions and PTM were applied to PTM+HT group (at 37°C for 20 min).

3.1.2. Statistical analysis

Statistical analysis was performed using SPSS for Windows version 6.1.[3] Results were considered to be statistically significant for P-values less than 0.05. Due to the distribution characteristics, a part of data collections were evaluated using non-parametric statistical methods. ANOVA, Mann–Whitney U test and Wilcoxon matched paired tests were applied, inter- and intragroup analysis as appropiate, to compare results.

4. Results

All patients completed therapies, but 28 of them participated in 6 months follow up. Dropouts were 7 (43%), 13 (65%), and 8 (40%) patients in groups PTM+BT, PTM, and PTM+HT respectively. Reasons for dropping out included a change in the willingness of participants to accept their group assignment because of increased pain, stiffness, or fatigue (most of them were in group PTM) and communicational problems at the 6 months follow up (in group PTM+BT and PTM+HT). No complication occurred during therapies.

There were no differences between the initial values of any of the variables for individuals that were presented in Tables 1 and 2 ($p > 0.05$ ANOVA).

Our study data indicated that all therapies are beneficial in patients with FMS in several aspects, such as improving BDI score, HDRS, pulmonary spirometric functions, dyspnea scale, relieving pain with VAS, total pain pressure thresholds and decreasing tender point count at the end of therapy sessions (Table 4). These beneficial effects persisted up to 6 months especially in some variables of group I (Table 5).

4.1. Psychological well-being

The group PTM+BT showed improvements over time in both BDI and HDRS scores for depression at the end of therapy ($p < 0.01$), and at 6 months follow up ($p < 0.05$). There were significant improvements in both BDI and HDRS scores ($p < 0.002$, $p < 0.0001$ respectively) for group PTM at the end of therapy, but they had no significant improvements at the 6 months follow up for's BDI and HDRS scores ($p > 0.5$). Group PTM+HT's scores for depression had significantly improved at the end of therapy ($p < 0.0001$), but scores had overturned at 6 months follow up. When three groups were compared with each other, the group of physical therapy modality, which combined with balneotherapy, was the most successful therapy and the effects were statistically significant ($p < 0.001$) (Tables 4–5).

4.2. Pain relief

A statistically significant difference in VAS, total pressure pain thresholds, and tender point count at the end of therapy and 6 months follow up, was observed in group-PTM+BT (for all variables, $p < 0.0001$). Group PTMI significantly improved for all three pain measurements at the end of therapy ($p < 0.0001$), but their improvements were not shown in the 6 months follow up, no differences were found in comparison to pretest. For group PTM+HT, all variables for pain achieved significant improvements at the end of therapy and 6 months follow up ($p < 0.001$). A statistically significant difference was found in total pressure pain thresholds be-

[3] Version 6.1, SPSS Inc., Chicago, IL Software-package.

Table 4
Comparison of differences at the beginning and end of the therapies

	PTM + BT ($n = 16$) Mean ± SD	PTM ($n = 20$) Mean ± SD	PTM + HT ($n = 20$) Mean ± SD	p ANOVA
Total algometric	19065 ± 1563	1063 ± 142.05§	14565 ± 1256.41*	P< 0.05
Tender point count	10.45 ± 0.3	2.95 ± 0.05§	9.5 ± 0.85	P< 0.05
VAS pain	6.1 ± 0.81	1.88 ± 0.72§	5.47 ± 0.01	P< 0.05
Beck Depression I.	8.4 ± 4.8	2.4 ± 1.7**	5.1 ± 1.65	P< 0.01
Hamilton DT	8.2 ± 1.35	4.55 ± 2.03**	6.25 ± 0.92	P< 0.01
Dyspnea	1.54 ± 0.82	0.18 ± 0.24¥	1.1 ± 0.32	P< 0.05
FVC	0.13 ± 0.07	0.0 ± 0.06*	0.3 ± 0.25	P< 0.05
FEV1.0	0.73 ± 0.11	0.02 ± 0.11¥	0.47 ± 0.02	P< 0.05
FEV1.0/FVC	13.67 ± 10.7	0.22 ± 9.66§	8.3 ± 2.9**	P< 0.05
FEV1.0/VC	5 ± 3.3	1.38 ± 5.6¥	4 ± 0.4	P< 0.05
FEV 1%	0.1 ± 4.1	0.9 ± 1.34	0.6 ± 0.3	P< 0.01
PEF	0.36 ± 0.31	0.02 ± 0.26¥	0.14 ± 0.3	P< 0.05
Expiration time	0.84 ± 0.32	0.2 ± 0.13*	0.82 ± 0.22	P< 0.05
VC	0.2 ± 0.18	0.01 ± 0.07*	0.06 ± 0.08	P< 0.01
VAS quality of life	5.1 ± 0.61	2.01 ± 0.51**	4.3 ± 0.4	P< 0.05

§ $p < 0.0001$ comparison between group PTM + BT.
¥ $p < 0.001$ comp ± arison between group PTM + BT.
** $p < 0.01$ comparison between group PTM + BT.
*$p < 0.05$ comparison between group PTM + BT.

Table 5
Comparison of differences at the beginning and 6 months follow up

	PTM + BT ($n = 9$) Mean ± SD	PTM ($n = 7$) Mean ± SD	PTM + HT ($n = 12$) Mean ± SD	p ANOVA
Total algometric	13020 ± 1202	317 ± 285.38§	6780 ± 2677.5*	P< 0.05
Tender point count	7.8 ± 09	0.55 ± 0.001§	3.92 ± 1.7	P< 0.05
VAS pain	5.3 ± 0.69	0.09 ± 0.54§	2.99 ± 0.31	P< 0.05
Beck Depression I.	6.2 ± 5	1.02 ± 2.45*	1.2 ± 2.36**	P< 0.05
Hamilton DT	5.8 ± 0.55	2.1 ± 1.55*	1.5 ± 1.48*	P< 0.05
Dyspnea	0.9 ± 1.07	0.12 ± 0.04*	0.09 ± 0.09*	P< 0.05
FVC	0.09 ± 0.01	−0.025 ± 0.09§	0.06 ± 0.15	P< 0.05
FEV1.0	0.55 ± 0.06	−0.01 ± 0.09*	−0.8 ± 0.001*	P< 0.05
FEV1.0/FVC	6.42 ± 1.1	−2.1 ± 9.86§	2.1 ± 1.6*	P< 0.05
FEV1.0/VC	1.9 ± 1.16	−1.15 ± 0.5¥	0.6 ± 2.7	P< 0.05
FEV 1%	−0.18 ± 1.1	−3.4 ± 8.54¥	−0.15 ± 1.9	P< 0.05
PEF	0.98 ± 0.01	−0.03 ± 0.001**	−0.08 ± 0.5**	P< 0.05
Expiration time	0.03 ± 0.27	0.15 ± 0.01*	0.2 ± 0.04*	P< 0.05
VC	2.61 ± 0.09	−0.03 ± 0.13*	−0.01 ± 0.31*	P< 0.05
VAS quality of life	5.1 ± 0.61	2.01 ± 0.51**	3.6 ± 0.5	P< 0.05

§ $p < 0.0001$ comparison between group PTM + BT.
¥ $p < 0.001$ comparison between group PTM + BT.
** $p < 0.01$ comparison between group PTM + BT.
*$p < 0.05$ comparison between group PTM + BT.

tween group-PTM+BT and groupPTM+HT ($p < 0.05$) at the end of therapy. And this finding persisted for 6 months though by then the difference between the two groups was greater and favoured the balneotherapy combined group ($p < 0.05$). There were no differences in other measurements for pain between balneotherapy and hydrotherapy combined groups at the end of therapy and follow up (Tables 4–5).

4.3. Changes in pulmonary functions

Significant changes in the spirometric parameters were observed in-group PTM+BT such as dyspnea scale, FEV1, FEV1/FVC, FEV1%, VC ($p <$ 0,0001

for FEV1, $p < 0.05$ for others) at the end of the therapy (Table 4). Some of these changes, dyspnea scale, FEV1, VC scores, persisted for 6 months follow up ($p < 0.075, p < 0.05, p < 0.06$, respectively) (Table 5).

There were no significant improvements in pulmonary functions both at the end of therapy and 6 months follow up for group PTM.

A statistically significant difference was found in Dyspnea scales, FEV1, FEV1% at the end of the therapy ($p < 0.0001$, $p < 0.0001$, $p < 0.001$, respectively) but there were no significants improvements in pulmonary functions at 6 months follow up for group PTM+HT (Tables 4–5).

4.4. Patient's assessment for quality of daily life

Pretest values of groups were not different from each other. In the balneotherapy combined group, they were found to be significantly better than the baseline values during the follow-up period, both intra and inter groups, ($p < 0.01$) (Tables 4–5).

5. Discussion

Because of the unknown etiology and the unclearly understood pathogenesis, there is no standard therapy regime for FMS. A variety of pharmacologic treatments and non pharmacologic treatments including exercise, cognitive behavioral strategies, education, acupuncture, biofeedback, hydrotherapy, balneotherapy, thalassotherapy, electrotherapy, tai chi, yoga have been used to treat FMS [8–20,27–35]. No guidelines exist for management of FMS. Balneotherapy has been used in several studies for FMS and reviewers reported that moderate evidence for efficacy were observed for balneotherapy and hydrotherapy, weak evidence for efficacy were reported for electrotherapy and ultrasound [8, 14–20,27,33].

Our data suggested that balneotherapy might be a useful therapeutic tool in FMS. The results of our study with regard to pain relieve are in agreement with other trials previously performed in spas, but it is important to underline that control matched trial on the respiratory system effects of balneotherapy have never been performed for the pulmonary symptoms of FMS. Half of the participants had dyspnea and obstructive respiratory patterns although only few patients were smokers (Table 1). Dyspnea in FMS were observed in some studies, [4,6]. Caidahl et al. reported a higher ratio for dyspnea in their study, FEV1 FEV1/FVC ratio were significantly lower than healthy controls [6].

The respiratory system is one of the multiple sites influenced by fibromyalgia. Authors reported that FEV1 values were significantly decreased compared to controls in their study, they suggested that it should be attributed to the accompanying physical inactivity [6, 36]. This finding supports our results, there was no association with any respiratory disorder secondary to fibromyalgia in our study, we concluded that it should be related to inactivity or other peripheral or central mechanism, which was reported in fibromyalgia as endocrinologic changes or respiratory muscle weakness [5,6].

Group PTM+BT and PTM+HT had some improvements in some variables of spirometric measurements, especially in FEV1, FEV1%, FEV1/FVC and VC. But only FEV1 value persisted in group PTM+BT at 6 months follow up. Spirometiric studies, which were designed for the measurement of the effects of balneotherapy on fibromyalgia, had not been seen in the literature. Few studies with acratothermal waters and thermomineral waters had led to statistically significant increases on FEV1 value of osteoartritic patients and patients with chronic obstructive lung disease [37,38]. Kurabayashi et al. suggested that the sub diaphragmatic peritoneal pressure elevated by hydraulic pressure could work as a load to diaphragm construction during inspiration resulting in diaphragm exercise and could help the diaphragm to elevate and evacuate air during expiration resulting in a decrease in dead space. Hydraulic pressure was reported to increase cardiac output, leading to an improvement in blood gas exchange in the pulmonary capillaries. Thermominerals might be caused by decreasing viscosity of sputum [38].

The PTM group had no significant improvement in spirometric variables. Authors reported that electrotherapy, ultrasound might relieve pain but they had no effect on other FMS symptoms because of their local effects in this systemic disease [39,40].

Our study data indicated that the addition of balneotherapy to commonly prescribed electrotherapy in rehabilitation medicine was beneficial in patients with FMS in pain relieving and decreasing tender point count. These beneficial effects may persist up to 6 months in most cases. Similar effects were observed in hydrotherapy-combined group, too. Findings of the balneotherapy group in present study are in agreement with previously published studies [14,15,17,41,42].

Long-term follow up studies reported different results, Altan et al. [16] showed that addition of bal-

neotherapy to relaxation exercises aided pain relief during 6 months. Evcik et al. [14] showed decrease of pain intensity and number of tender points lasting 6 months after a cycle of balneotherapy in some studies [14,15].

Hot stimuli and hydrostatic pressure of the thermal pool may influence muscle tone and pain intensity, helping to reduce muscle spasm and to increase the pain threshold in the nerve endings [43]. Peripheral vasodilatation occurs through the effects of water temperature and chemical components. Vasodilatation may help to relieve pain by removing algesic metabolites from the environment [16]. Mineral water may also exert a beneficial influence on the oxidant–antioxidant system [44] and this effect could be beneficial, since oxidative stress disorders have been described in FMS [45]. Balneotherapy also provoke a neuroendocrine reaction in response to thermal stress, characterized by a significant increase in serum levels of pituitary hormones and opioid peptides such as endorphins. This effect leads to an intense, progressive improvement of muscular and articular pain [46]. Hydrotherapy with tap water had some improvements on pain of FMS patients; Busch [47] suggested that mechanic and thermal effects might influence central and peripheral inhibition.

Since FMS is characterized by generalized musculoskeletal pain it is obvious that the use of TENS is limited. Nevertheless, in some cases where a localized musculoskeletal pain problem is prominent, the use of TENS is certainly justified based on the available clinical data in other conditions [39]. Authors had observed effectiveness of electrotherapy and ultrasound in short-term studies, but they had not followed up the long-term effects [40].

The association between the described psychosocial factors and widespread musculoskeletal pain are well known. Following balneotherapy, psychologic well being has been observed for periods of up to 6 months following therapy [41]. However, Evcik et al. have reported improvements on psychological well being, but it did not persist for 6 months [14]. Depressive symptoms, in our study were observed in the same ratio as in the literature [48]. The parameters of BDI and HDRS in-group I persisted for 6 months follow up in the present study. It might be related to psychological stabilization and elimination of risk factors because of the changing environment.

Studies demonstrated that hypothalamic-pituitary axis is affected in FMS and balneotherapy has a normalization effect via cortisol directly on this system. Balneotherapy induces serotonin that may have achievements on psychological well being. Thermominerals are effective with mineral contents such as calcium and magnesium contents, too. Depression leads to immune deficiency, balneotherapy has an immune stimulant effect and may relieve depressive symptoms by this effect [49]. Hydrotherapy has well being effects on psychological aspects and water immersion may increase plasma catecholamine that is decreased in depression [50].

Self-assessments of patients' quality of life also improved in both balneotherapy or hydrotherapy combined groups. Buskila and Neuman observed that quality of life of FMS patients were improved at least 3 months after balneotherapy application in their studies [12,35]. Hydrotherapy was observed as having similar effects [27,51].

The long-term treatment of fibromyalgia remains problematic because the natural history of this condition appears to be one of continuous and unremitting pain. High dropout has been reported in several studies in FMS [34,35]. The dropout rate in the Richards et al. study was similar with ours [35]. We did not give any treatment or education program after therapy. In the study with low drop out, multidisciplinary therapies and interviews continue until the end of study [52]. It could effect on the results of study. So we have no communication with patients until 6 months after the end of therapies. Seventy seven percent drop out were reported in a study, after 6 months follow up. Authors concluded that adherence was poor when patients had to exercise on their own [53].

Antoher important limitation of the study is sample size. It was also signed in other studies and reviews [51,53–55]. Larger patient groups are warranted to determine the reproducibility of our results.

We consider that patients in balneotherapy combined with PTM group had more substantial and longer-lasting improvement in FMS symptoms than the therapy provided to other groups. The effects of balneotherapy on respiratory system and other variables of the spa environment may play a role in the achievement of clinical improvements in spirometric functions.

In conclusion, balneotherapy is found to be effective in FMS patients'spirometric measurements and other some symptoms. Beneficial effects are observed both at the end of therapy and six months follow up.

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