

## Effects of Balneotherapy and Physical Therapy on Sleep Quality in Patients with Osteoarthritis Aged 50 to 85 Years

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### ABSTRACT

**Objectives:** This study aims to investigate the effect of balneotherapy (BT) and physical therapy (PT) on sleep quality in patients with knee osteoarthritis (OA) aged 50 to 85 years.

**Patients and methods:** A total of 199 patients (76 males, 123 females; mean age 67.8±7.3 years; range 50 to 85 years) suffering from knee OA (Kellgren-Lawrence grade 2-3) for more than six months were enrolled. Sleep and functional status were assessed at baseline and after 19 sessions of BT and 15 sessions of PT by using Pittsburgh Sleep Quality Index and Western Ontario and McMaster Universities Osteoarthritis Index, respectively.

**Results:** A high prevalence of abnormal sleep quality in patients with knee OA was observed. The most common abnormality was sleep fragmentation (71%), with an increased sleep disturbance score. Patients reported significantly improved sleep, pain, stiffness, and functional status after BT and PT.

**Conclusion:** Balneotherapy and PT improved self-reported sleep and functional status in patients with OA aged 50 to 85 years. We may conclude that BT and PT, which are used in the treatment of OA, not only reduce nocturnal pain, but also improve sleep quality.

**Keywords:** Balneotherapy; knee osteoarthritis; sleep disturbance; sleep quality.

Osteoarthritis (OA), the most common chronic condition and leading cause of disability worldwide, is a degenerative joint disease characterized by pain and dysfunction due to progressive and irreversible loss of joint cartilage.<sup>1</sup> It can be defined by radiological abnormalities with or without clinical findings. Osteophytes and joint space narrowing usually affect interphalangeal joints of the hands, knees, and hips.<sup>2</sup>

Pain, depression, and sleep disturbance (SLD) are common complaints associated with OA. Patients with OA report problems with sleep onset (31%), sleep maintenance (81%), and early morning awakenings (51%).<sup>3</sup> The prevalence of nocturnal knee pain and sleep problems increase with the severity of OA.<sup>4</sup>

There is no specific treatment to repair damaged cartilage in OA. The goal of treatment in OA is to reduce joint pain and inflammation while improving and maintaining joint function. Some patients may benefit from conservative treatments such as rest, exercise, physical therapy (PT), and balneotherapy (BT). BT involves treating health problems by bathing, usually in hot springs. It can help treating a number of health conditions including arthritis, respiratory disorders, and high blood pressure.<sup>5</sup> But the literature is poor regarding the effects of BT and PT on the sleep quality. Thus, in this study, we aimed to investigate the effects of BT and PT on sleep quality in patients with OA aged 50 to 85 years. It is hypothesized that BT and PT result in improved sleep quality by means of relieving nocturnal knee pain.

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## PATIENTS AND METHODS

This study included 199 patients (76 males, 123 females; mean age  $67.8 \pm 7.3$  years; range 50 to 85 years) suffering from knee OA for more than six months who attended to the Physical Medicine and Rehabilitation Department of Bursa Military Hospital between December 2011 and June 2012. All patients' informed consents were obtained. The study was approved by our local research ethics board. Patients were evaluated according to the results of clinical examination, plain X-ray findings, and routine laboratory parameters. OA of the knee was defined as the presence of radiographic changes (joint space narrowing with osteophyte, with or without cyst formation, sclerosis) together with pain. Kellgren-Lawrence grading system was used to assess radiographic severity of knee OA.<sup>6</sup> Knee OA was recorded as present if Kellgren-Lawrence grade was 2 or higher. Pain was evaluated on a 100 mm visual analog scale. All patients had pain during most painful knee movement between 50-70 mm on visual analog scale. Histories of underlying inflammatory arthropathy, psychiatric/hematological/neurological disorder, hyperuricemia and/or intra-articular corticosteroid injection within the last three months were the exclusion criteria. Each patient completed a questionnaire, providing details regarding demographics, medical history, and sleep characteristics. All patients were treated with one cure (19 days) of BT and 15 sessions PT (ultrasound, hot pack, transcutaneous electrical nerve stimulation, and mud pack). BT was applied in thermo-mineral water pools for 20 minutes with a temperature of 39 °C. The water had a low mineral density with a concentration of 623 mg/L, and none of the minerals were above the accepted threshold levels. Sleep and functional status were assessed at baseline and after treatments of BT and PT by using Pittsburgh Sleep Quality Index (PSQI) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Functional disability was assessed using WOMAC which produces scores for three subscales: pain, stiffness, and physical function.<sup>7</sup> Sleep quality and patterns were assessed by using PSQI. PSQI is an effective instrument used to measure the quality and patterns of sleep in older patients. It differentiates "poor" from "good" sleep by measuring seven domains: subjective sleep

quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the last month. Scoring of the answers is based on a 0 to 3 scale. A global sum of  $\geq 5$  indicates poor sleeper.<sup>8</sup>

### Statistical analysis

Statistical analysis was conducted using SPSS for Windows, version 15.0 software program (SPSS Inc., Chicago, IL, USA). The baseline characteristics were shown as the mean  $\pm$  standard deviation for continuous data (e.g., age and duration of disease) and n (%) for categorical data (e.g. sex). The mean differences from baseline values to the end of treatment were examined using a paired t test. The level of significance was  $p < 0.05$ .

## RESULTS

There was no significant difference between the patients who continued and those who dropped out regarding any of the demographic variables (all  $p > 0.05$ ), or in sleep, pain stiffness and physical functioning (all  $p > 0.05$ ).

Western Ontario and McMaster Universities Osteoarthritis Index showed significant reduction in pain at one-month compared with baseline ( $p < 0.05$ ). Patients scored higher on the PSQI at baseline than at one-month. Table 1 shows WOMAC and PSQI scores of the participants before and after BT and PT. In general, participants reported improvement for each of the component scores; i.e., scored lower at one-month than baseline, with significant less severe sleep problems at one-month on all domains (all  $p < 0.05$ ), except for daytime dysfunction and use of sleep medication.

## DISCUSSION

This study indicates that BT and PT are effective on knee OA in terms of pain alleviation and improved sleep quality. To our knowledge, this study is one of the largest and most rigorous trials of the efficacy of BT and PT on sleep.

With its various kinds of interventions, balneology or medical hydrology has been an

**Table 1.** Western Ontario and McMaster Universities Osteoarthritis Index and Pittsburgh Sleep Quality Index scores and other sleep habits of participants before and after therapy (balneotherapy and physical therapy)

	Before therapy (n=199)	After therapy (n=199)	<i>p</i>
	Mean±SD	Mean±SD	
WOMAC (Pain)	13.3±2.3	10.0±3.1	<0.001
WOMAC (Stiffness)	3.9±1.7	3.3±2.0	<0.001
WOMAC (Function)	35.5±13.3	28.9±14.1	<0.001
PSQI	7.5±3.8	6.4±3.2	<0.001
Sleep duration	0.7±0.9	0.6±0.7	0.055
Sleep disturbance	1.7±0.7	1.6±0.7	0.666
Sleep latency	1.4±0.8	1.4±0.8	0.359
Daytime dysfunction	0.9±0.8	0.7±0.8	0.016
Habitual sleep efficiency	0.9±1.0	0.6±0.8	0.002
Subjective sleep quality	1.2±0.7	1.0±0.6	<0.001
Use of sleep medication	0.5±0.9	0.4±0.8	0.082

SD: Standard deviation; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; PSQI: Pittsburgh Sleep Quality Index.

important modality in the field of medicine, which includes prevention, treatment, and rehabilitation of a large number of health conditions. The main indication for BT in Turkey is rheumatic disorders (degenerative joint diseases, soft tissue disorders, and rarely inflammatory rheumatic diseases).

Pain is the most important feature of OA. However, the mechanisms causing nocturnal knee pain remain unclear, even though many people with knee OA experience it. It is documented that knee OA patients have synovitis even in the early stages of the disease and its prevalence and number of regions increase with the severity of OA.<sup>9</sup> More regions with synovitis may be related to an increasing prevalence of nocturnal pain.<sup>4</sup> Previous studies have shown that BT is effective on pain in OA.<sup>10-12</sup> Wigler et al.<sup>10</sup> reported that the index of disease severity score was better in patients with OA having daily thermal mineral water baths. Moreover, the well-being status remained for 16 weeks. The beneficial effects or mechanism of action of BT has not been fully understood yet. It can be claimed that these benefits result from the combination of chemical and thermal effects.<sup>11,12</sup> Although there is little evidence, considering the chemical effect, one might expect that organic substances or minerals are absorbed through the skin during BT.<sup>13</sup> Extensibility of collagen-rich tissues may increase with thermal stimulation. Because of the increased extensibility of collagen-rich tissues, the range of motion of joints improves, pain diminishes, and muscle spasm relieves. The analgesic effect of heat may be

due to increased beta-endorphin concentration.<sup>14</sup> It has been postulated that human skin can release significant amounts of opioid peptides, modifying the threshold of pain under different stimuli, such as heat or ultraviolet radiation. Furthermore, heat may increase secretion of cortisol and catecholamines by thermal stress, thus having an anti-inflammatory effect.<sup>15</sup> To sum, without ignoring the possible contribution of the chemical substances, we suggest that the observed improvements in the clinical variables in this study were mainly due to the thermal effect.

Sleep quality is a major concern regarding patients with OA; as a matter of fact, 60% of people with OA reports pain during the night.<sup>16</sup> In fact, pain secondary to OA is the most common factor predicting SLD in patients. It is well established that pain hinders sleep and disturbed sleep lowers pain threshold.<sup>17-19</sup> Whether SLD precedes or follows pain onset is unclear, but reciprocal effects are likely.<sup>17</sup> Even after treatment with anti-inflammatory medications, patients with OA show significantly greater objective SLD, as compared with age-matched control subjects. Vitiello et al.<sup>20</sup> reported that BT improved both immediate and long-term self-reported sleep quality in a sample of older patients with OA and comorbid insomnia. The other major finding of their study is that BT without specifically addressing pain management appeared to reduce both immediate and long-term reported pain.<sup>21-23</sup> Nevertheless, given the likely reciprocal effects between pain and SLD, distinguishing unique

causal pathways is difficult. Chronic pain initiates and exacerbates SLD; disturbed sleep in turn maintains and exacerbates chronic pain and related dysfunction.<sup>18,19,24</sup> The question is whether an intervention that improves sleep in individuals with disturbed sleep and comorbid pain state, such as OA, might reduce pain as well.

This study has some potential limitations. Firstly, participants were recruited primarily through government hospital health reports for BT from all around the country and they might not be representative of all patients with OA of the knee. The other criticism is the impossibility of exclusion of the effects of the BT environment from the study setting. It is often stated that staying at a resort hotel provides a positive placebo effect. And maybe the most important limitation of the study is the lack of a control group.

Balneotherapy and PT were not tested before in a well-controlled study of individuals with sleep disorder and comorbid chronic illnesses such as OA. BT and PT improved immediate self-reported sleep quality in this sample of older patients with OA. These results are unique in demonstrating the effects of BT and PT on sleep disorders. The current study suggests that, in addition to decreasing pain in older patients with OA, and even without directly addressing sleep disorder management, BT and PT appear to improve sleep quality too.

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