Contribution of Individual Spa Therapies in the Treatment of Chronic Pain

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Abstract:

Objectives: The aim of the present study was to evaluate the contribution of individual spa therapies administered during a period of 3 weeks on measures of well being and pain in a sample of patients with chronic back pain.

Design: One hundred fifty-three patients with chronic back pain undergoing inpatient spa therapy in Bad Tatzmannsdorf, Austria, participated in the study. According to the prescription of their spa physician, patients underwent two or more of the following treatments: mud packs, carbon dioxide baths, massages, exercise therapies, spinal traction, and electrotherapy. The outcome measures were general pain, back pain, negative mood, and health satisfaction. Regression analyses were conducted to predict the 4 outcome measures at the end of spa therapy and at 6 weeks’ follow-up for all therapies applied. The pretreatment outcome measure, age, and sex were controlled for by entering them into the analysis.

Results: Patients showed significant improvements in all 4 outcome measures. The prediction of improvement was generally small: only 1% to 11% of the change of the outcome measures could be explained by the type and number of therapies received. On a short-term basis, mud packs and exercise were found to be associated with a greater improvement in mood, whereas a greater frequency of massage therapy and carbon dioxide baths was associated with a smaller improvement in health satisfaction. On a long-term basis, exercise therapy and spinal traction were associated with a greater reduction in back pain.

Conclusions: The results indicate that, in addition to the individual therapies, other factors relating to spa therapy as a whole must contribute to overall treatment outcome. In addition, the results support the efficacy of exercise therapy for chronic back pain.

Key Words: Back pain—Balneotherapy—Physical therapy—Quality of life—Spa therapy.

Balneotherapy, the use of baths and other natural remedies, is one of the most ancient therapeutic methods still being applied today. Natural hot and cold springs as well as mud have been used for the treatment of a variety of ailments, among them rheumatism. Claudius Galenus, for example, the well-known Roman doctor of the second century, recommended hot mud for persistent pains, swellings, and diseases of the joints, bones, and muscles. Although a large corpus of empirical knowledge has accumulated over the centuries, the systematic study of the physiological effects of individual therapies and the efficacy of spa therapy as a whole began relatively late. In Germany and Austria, for example, two countries with a long spa tradition, a flourish of scientific research on spa therapy started in the 1960s, although
results were published predominantly in German journals and therefore were not widely read in other countries.

In recent years, several internationally published studies have documented the effect of spa therapies on chronic pain disorders such as low back pain and rheumatoid arthritis. Generally, the effects of spa therapy are impressive and enduring. In a recent randomized, controlled study of patients with chronic low back pain, spa therapy was found to reduce pain and improve functional ability as well as improve several measures of mental health such as depression, anxiety, and well-being. Previous studies have demonstrated that these effects last up to 1 year. It remains unclear, however, which aspects of spa therapy contribute to these positive effects. This issue is of great importance, especially with regard to cost efficiency, because costs could be reduced by omitting ineffective therapeutic measures.

Several aspects of spa therapy can be distinguished as potentially being therapeutically effective. These are (1) natural remedies such as mud and thermal water, (2) additional therapies such as massages and electrotherapy, (3) living in a resort environment, and (4) having a respite from work. Some preliminary data suggest that living in a resort environment without receiving balneotherapy, or even a simple respite from work, may be beneficial to mental health. The emphasis of spa therapy, however, is the application of physical therapeutics and especially balneotherapies. It is traditionally acknowledged that these therapies should be applied in an inpatient setting, because it is believed that the effect of balneotherapy depends on provoking physiological reactions, the magnitude of which depends on the extent of stress-free intervals between therapies. In other words, an ambulant application of balneotherapy is considered to be less effective than resort-based balneotherapy (spa therapy), although studies with an outpatient design also have shown positive results.

There is a fairly large body of work on the physiological and pharmacological effects of some treatments used in combination with spa therapy, such as mud applications, thermal, mineral, and carbon dioxide (CO2) water baths, exercise therapy, and spinal traction, and electrotherapy (see also next section). Furthermore, several physiological effects of spa therapy have been noted that are not assigned to individual treatments but rather to spa therapy as a whole. Among these are a reduction of systolic and diastolic blood pressure and an increase in aerobic fitness. One of the mechanisms possibly contributing to these effects is the increase in stroke volume and cardiac output associated with headout water immersion. Repeated application of hydro-
weeks after the end of spa therapy (time 3). A medical examination was conducted at times 1 and 2.

**Spa therapies**

Table 1 gives an overview of the treatments applied during spa therapy in this study. Mud applications were administered as mud baths, in which patients were immersed in 42°C watered mud, or as mud packs, in which mud heated to 46°C was applied to pain areas and patients were wrapped in blankets. The duration of both therapies was 15 to 20 minutes. Mud (peloid) applications are used to treat inflammatory and degenerative pain disorders. The primary therapeutic aim is to induce local and general hyperthermia. The advantage of mud over water is that because of the greater viscosity of mud, heat is transmitted solely through conduction (direct heat transport through substance) rather than through convection (heat transport by movement of fluids or gases). This permits the use of higher temperatures without overheating the skin, thereby conveying greater amounts of warmth to the tissue. The immediate therapeutic effects include spasmolysis, an increase in local perfusion, and an increase in local metabolism.11 It has been shown that repeated exposure to mud baths leads, for example, to an increase in plasma cortisol, presumably due to heat stress.33 Subjectively, mud baths and mud packs are highly favored by spa patients34 and are considered to be effective but tiring treatments.35

Carbon dioxide was applied either in tub baths with 32°C to 34°C naturally carbonated water or by direct immersion of patients in CO₂ gas in chambers covering the body from the neck downward. Carbon dioxide baths are used predominantly in the treatment of cardiac and vascular disorders, although they are also used in such disorders as fibromyalgia.11 The dissolved CO₂ diffuses into the skin, leading to a marked increase in peripheral perfusion and oxygen utilization (Bohr effect).17 In addition, we have observed small increases in intracranial perfusion (unpublished data, 2000). Carbon dioxide affects skin receptors, reducing, for example, the sensitivity of cold receptors and nociceptors and increasing the sensitivity of heat receptors.36 Subjectively, patients consider CO₂ therapy to be relaxing but energizing.35

Massages (dry) were performed on the whole body or only the back. Massages were also performed with a hose in tubs filled with thermal water (jet massage). The duration of massage therapies was 10 to 20 minutes. Massage as a hands-on therapy has a general and muscle-relaxing effect and has been found to increase local blood flow and the pain threshold.20,37 A recent controlled study has shown that comprehensive massage therapy diminishes subacute low back pain.38 Patients prefer massages to all other spa therapies34 and consider them to be effective, relaxing, and refreshing.35

Exercise therapy in groups was conducted by a physical therapist on mats or in a pool filled with thermal
water (exercise therapy under water) for a duration of 30 minutes. Exercise therapy has well-known positive effects on the muscular and cardiovascular system, such as increasing muscular strength and coordination as well as aerobic capacity. Furthermore, exercise therapy is known to be a powerful instrument in the treatment of musculoskeletal chronic pain. Patients prefer exercise therapy in water to exercise therapy on mats. Even though exercise has immediate positive effects on mood, spa patients generally prefer passive therapies such as massages or baths.

A spinal traction treatment was conducted in a pool filled with thermal water. During this therapy, patients hung from a cushioned collar fixed around their neck, with a lead belt (5 kg) placed around their waist, for 9 to 15 minutes. After spinal traction, patients received a brief back massage. The aim of spinal traction is to increase the intervertebral interspaces, thereby possibly reducing intradiscal pressure and disc prolapses. In addition, thermal water reduces muscular tension and joint strain because of the buoyancy and warmth and thereby possibly facilitates the effects of spinal traction.

Different forms of electrotherapy, such as interventional therapy and ultrasound and short-wave diathermy, were applied. One of the aims of these therapies is the direct warming of deeper tissue layers such as muscles and joints. In addition, electrotherapies are thought to stimulate muscle and nerve cells and possibly raise the pain threshold, although these effects are controversial. At this point it is also unclear whether electrotherapies are more effective than placebo manipulations in reducing pain.

### Variables

The dependent variables were measured with several standardized German questionnaires sensitive to change. General pain was assessed with the scale for physical complaints (Giessener Beschwerdebogen), incorporating 6 items assessing complaints associated with pain at different locations. Negative mood was assessed with the quality-of-life questionnaire (Profil der Lebensqualität chronisch Kranker), incorporating 8 items probing anxiety, anger, and depression. Health satisfaction was measured with a 7-item scale from the questionnaire for satisfaction with life (Fragebogen zur Lebenszufriedenheit), incorporating 8 items probing satisfaction of life. Pain intensity was measured on the basis of patients’ response to the statement “The pain is: very intense, intense, moderate, slight, no pain.” The independent variables were the number of every therapy a patient received.

### Statistics

To analyze the effect of therapies on treatment outcome, linear regression analysis were conducted for the 4 outcome variables at time 2 (at the end of spa therapy) and time 3 (5 weeks after spa therapy). Regression analysis is a method used to identify the total contribution of a list of independent variables and the individual contribution of each independent variable on one dependent variable. Thus, covariations between the dependent variables are controlled statistically. Variables were entered in three blocks: first, the dependent variable at time 1 to control for baseline effects; second, age and sex, to control for their effects; and third, the therapies. The results are described by the squared partial regression coefficient ($r^2_{\text{change}}$), illustrating the overall contribution the frequency of therapies introduced at step 3 had in treatment-related improvements (explained variance), and by $\beta$ values, which illustrate with limitations the effect of one dependent variable (e.g., one therapy) on treatment outcome while all other variables are controlled. Figure 1 is based on the adjusted means calculated by multivariate analyses of covariance, with the reduction of pain as independent variable and the therapies as dependent variables.

### RESULTS

Table 2 gives descriptive details of the spa therapies applied in the present study. The therapies are listed according to frequency of prescription. Massages, CO2 applications, and mud applications were the most frequently used treatments, received by approximately 90% of the patients but in varying frequency. The other therapies such as exercise, electrotherapy, and spinal traction were received by 30% to 50% of the patients. Older patients were less likely to undergo spinal traction, exercise therapy, or mud treatment, but were more likely to have electrotherapy and CO2 administered. The prescription of therapies was practically independent of sex and relative body weight, although overweight patients tended to receive more electrotherapy. Subjects with higher levels of general pain underwent more spinal traction and had less underwater exercise, and patients with more severe back pain underwent more electrotherapy. Otherwise, the frequency and type of prescribed therapies were unrelated to a patient’s pain or affective situation.

To confirm the effect of spa therapy on the 4 outcome measures, two multivariate analyses of variance for repeated measures were conducted for times 1 and 2 (beginning and end of spa therapy) as well as times 1 and 3 (beginning of spa therapy and at 5 weeks’ follow-up). An improvement in health status was noted for all 4 variables at the end of spa treatment (multivariate $F = 75.2$; $p < 0.0001$) and at the 5-week follow-up (multivariate $F = 30.5$; $p < 0.0001$).

To determine the individual and the total contribution of spa therapies on the outcome of spa therapy, 8 regres-
sion analyses were conducted (Table 3). As is reflected by $r^2$ change, the differences in type and number of prescribed therapies did not affect the outcome of treatment to any large degree. The extent to which therapies did explain the observed improvement (explained variance $/H11505r^2$/change $\times 100$) varied between 1% and 11%. Negative mood and health satisfaction at the end of therapy and back pain at follow-up were predicted significantly on the basis of the individual spa therapies received. No association was found between the frequency of therapies and general pain, indicating that the improvement of general pain was not affected by the type and number of treatments used in this sample. With regard to the effect of individual therapies on the outcome of spa treatment, we found that long-term improvement in back pain was positively associated with exercise both on mats ($/H9252/0.24; /H11505p/0.01$) and in thermal water ($/H9252/0.22; /H11505p/0.02$), as well as spinal traction ($/H9252/0.23; /H11505p/0.03$). The short-term improvement in mood was positively associated with mud therapy ($/H9252/0.24; /H11505p/0.004$) and exercise ($/H9252/0.18; /H11505p/0.05$). In contrast, the short-term improvement in health satisfaction was negatively related to the frequency of CO2 baths ($/H9252/0.14; /H11505p/0.05$) and massages ($/H9252/0.17; /H11505p/0.02$).

A graphic representation of the association between received spa therapies and the reduction of back pain is given in Figure 1. The average number of therapies, corrected for age, sex, and the pre-spa level of pain, are displayed for spa patients showing no, medium, and large improvements in back pain at follow-up. Although they are based on a different statistical approach, the results correspond to the findings of the regression analysis in that the differences in the frequency of therapies are moderate, but the conditions of patients receiving more therapy with mud, exercise, and spinal traction improved the most.

**DISCUSSION**

The aim of the present study was to summarize and evaluate the effects of individual therapies administered

**TABLE 2. Description of spa therapies: frequency, average (SD), and correlations with sample characteristics**

<table>
<thead>
<tr>
<th>Patients receiving therapy (%)</th>
<th>Average no. of therapies</th>
<th>Relative weight (BMI)</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>Sex</td>
</tr>
<tr>
<td>Massage</td>
<td>93.4</td>
<td>8.8 (3.4)</td>
<td>0.09</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>86.8</td>
<td>7.1 (3.4)</td>
<td>0.18*</td>
</tr>
<tr>
<td>Mud</td>
<td>86.1</td>
<td>7.5 (3.6)</td>
<td>-0.22†</td>
</tr>
<tr>
<td>Jet massage</td>
<td>45.7</td>
<td>3.1 (3.5)</td>
<td>-0.08</td>
</tr>
<tr>
<td>Exercise therapy</td>
<td>45.0</td>
<td>2.9 (3.7)</td>
<td>-0.23†</td>
</tr>
<tr>
<td>Electrotherapy</td>
<td>39.7</td>
<td>3.7 (5.4)</td>
<td>0.23†</td>
</tr>
<tr>
<td>Spinal traction</td>
<td>33.1</td>
<td>2.1 (3.0)</td>
<td>-0.30†</td>
</tr>
<tr>
<td>Exercise (hydro)</td>
<td>29.8</td>
<td>2.0 (3.4)</td>
<td>-0.04</td>
</tr>
</tbody>
</table>

BMI, body mass index.

*p <0.05; †p <0.01.
negative mood 0.11
general pain 0.02 NS
back pain 0.07 NS

Another factor is the placebo effect, which has a substantial impact on pain relief and psychological effects. Nevertheless, it was found that the bulk of improvement could not be explained by the number of treatments used compared to other research on the effect of individual therapies. For example, Konrad et al.5 compared the effect of three different treatments for nonspecific lumbar pain—passive thermal baths, underwater traction baths, and underwater jet massages—on back pain in an ambulatory setting. Subjects underwent 3 therapies a week for 4 weeks. No differences between the three treatments were found with regard to the decrease in pain intensity or pain medication, although all three treatments were successful. A recent review article on the efficacy of physical therapies for the control of musculoskeletal pain also supports the notion of small specific-therapy effects. Specific effects of individual therapies were not found, but patients receiving more treatment generally did better than patients receiving less treatment.47

In studies investigating other disorders such as rheumatoid arthritis6 and essential hypertension,32 clear differences between treatments also could not be found, even though spa therapy as a whole was successful. This apparently limited specific effect of individual treatments may be due to several factors. One is the placebo effect, which has a substantial impact on pain relief and presumably is enhanced by variables such as professional attention and patient involvement, both of which presumably are larger in balneotherapy than in standard pharmacotherapy.48,49 Another factor is the structure of spa therapy, where phases of rest and phases of physiological stimulation are alternated in a stress-free environment. This is thought to bring about the physiological and psychological changes traditionally observed in spa therapy, although more research is necessary to clarify this point.12 Third, traditional balneotherapies generally are based on water immersion and/or hyperthermia and therefore may have more similarities than differences.

Nevertheless, some specific effects of individual therapies could be observed in this study. In regard to the immediate effects of spa therapy, the improvement of negative mood was positively related to the application of mud treatments and to exercise. Exercise is known to improve mood.50 A specific mood-enhancing effect of mud therapy has previously been documented only once, in a study on the effects of a combined antidepressant and mud-pack treatment.51 But even though the psychological effects of being wrapped in warm mud are considered. In contrast, the increase in health satisfaction was negatively related to the number of massages and, to a lesser extent, the number of CO2 baths. This is an unexpected finding because massage is usually found to have a positive effect on at least the affective aspect of well-being.38,52,53 Because almost all patients received massages, this finding suggests that patients undergoing massages more frequently expected a greater effect than actually was achieved and therefore reevaluated their health status as less favorable. This line of argument corresponds to the fact that patients consider massages to be superior to all other spa therapies.35

In the assessment of medium-term effects, exercise on mats and under water was found to be positively related to the reduction of back pain. This is in accordance with the results of other studies showing a positive and/or lasting effect of land-based and underwater exercise on back pain.54,55 The effect of spinal traction on back pain also was positive, although studies have yielded conflicting findings about the therapeutic efficacy of this intervention.56–58 The positive effects of spinal traction in this study may be due to the administration of traction in thermal water. In view of the differences between short- and medium-term effects, it is important to note that the effects of spa therapy generally are believed to continue to evolve for several days to weeks after the end of treatment, depending on both the status of the patient and the type of treatment used.12,26

One aim of our study was to provide evidence about the relative efficacy of the treatment measures constituting spa therapy and thus to enable improvements in cost-efficiency by omission of inert measures. The most prominent finding is that each therapeutic application accounts for only a small percentage of overall treatment outcome. Therefore, omitting an individual therapy should not effect outcome to any large extent. Nevertheless, exercise therapy should be part of a treatment regi-

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**TABLE 3. Results of the regression analysis of the 8 spa therapies on the 4 outcome measures at the end of treatment and at follow-up**

<table>
<thead>
<tr>
<th></th>
<th>End of spa therapy</th>
<th>6 Weeks’ follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r² change</td>
<td>p</td>
</tr>
<tr>
<td>back pain</td>
<td>0.07</td>
<td>NS</td>
</tr>
<tr>
<td>general pain</td>
<td>0.02</td>
<td>NS</td>
</tr>
<tr>
<td>negative mood</td>
<td>0.11+</td>
<td>0.008</td>
</tr>
<tr>
<td>health satisfaction</td>
<td>0.07</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Baseline, age, and sex were controlled for. r² change, the squared regression coefficient describing the total association of the 8 therapies with the outcome measure; NS, not significant.

* p < 0.05; † p < 0.01.
men for chronic back pain. Our study does not provide information about which of the contextual aspects of spa therapy, such as the structured daily regimen or the respite from work, may be superfluous.

The problem in the present study, common to most other multidisciplinary treatment regimens, was to pinpoint the contribution of individual therapies in a multimodal treatment regimen. The use of regression analysis can lend some insight about both the overall contribution of spa therapies and the contribution of individual therapies to treatment outcome, although there are severe contraindications to the use of this method for this particular set of data. The major limitation is that subjects were not assigned to therapies randomly but rather assigned by a physician on the basis of their health status, their disorder, and their inclination. Although, except for age, marked associations between prescribed treatments and descriptive variables were not found (therefore suggesting equal distribution of patients among therapies), this is a potential source of error. Furthermore, the effect of a great number of different therapies was studied in a sample size that might not allow enough variation to occur and thereby limits the possibility of finding significant associations. This latter limitation may also have reduced the small association between the outcome measures and the prescribed therapies, although the variability of the individual therapies on the basis of their standard deviations is sufficiently large. Notwithstanding these shortcomings, the majority of the results are in accordance with the available literature on treatment effects, supporting the validity of the approach used. It also should be considered that the results reflect relative effects of spa therapies on the overall treatment effect and not the absolute effect of the treatment.

CONCLUSIONS

The present study shows that the individual balneotherapies and physical therapies applied during spa therapy account for only a small part of the overall effects of spa therapy on pain and mental health. In comparisons of the effects of the individual therapies, the findings indicate that (1) active therapies such as exercise have a positive effect on well-being and pain on a short-term and medium-term basis, and (2) passive treatments such as mud applications and massage have only short-term effects, which are not consistently positive. An exception to this pattern is spinal traction in thermal water, which also had a positive medium-term effect on back pain. More research is needed to understand which factors in addition to the effects of the individual therapies account for the large documented effect of spa therapy in the treatment of chronic pain.

REFERENCES
