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The Effect of Geothermal Water on Skin Condition and Body Fat

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Original Research Article

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ABSTRACT

Balneotherapy for therapeutic purposes has been used since ancient times, and was based on empirical experience carried forward from generation to generation. There is scientific evidence about the positive effects of the thermal water on the skin and on body weight, but studies with the mineral water from a borehole are missing.
Objective: To investigate the effect of high mineralization geothermal water on the skin and body fat.
Methods: The study included 50 women who received geothermal water baths for 15-20 min (34°C, 27,6 g/l mineralization and a pH of 7,24). The participants' subjective and objective skin state and body fat were assessed after the procedure, as well as 1 and 4 months after the procedure. The statistical software package SPSS 20 was used for the analysis.
Results: There were reductions in the overall number of skin complaints (p=0,001), usage of skincare products (p=0,001), limb volume (p<0,05), skin ridge thickness (p<0,001), and BMI (p=0,015); whereas there was an increase in the moisture content of the skin (p=0,047) after a 15-minute balneotherapy treatment. After 1 month following the treatment, there remained a reduction in the skin ridge (p<0,05), limb volume (p<0,05), itching, networks of veins, cellulite (p=0,046), and usage of skincare products (p=0,001). After 4 months following the treatment, there remained fewer skin complaints (p=0.01), itching and cellulitis (p=0,046); and furthermore, a positive impact on the volume of the limbs was observed (p<0,05), and the skin ridge was significantly lower

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than before the treatment (p<0,01). After 20 minutes of balneotherapy treatment, there were fewer skin complaints (p=0,003), a decreased BMI (p<0,001) and a lower body fat percentage (p=0,017); as well as greater skin moisture (p<0,05) and skin elasticity (p=0,016).
Conclusions: High mineralization geothermal baths of a duration of 15-20 minutes improve the skin condition and reduce the amount of fat in the body; the effect lasts up to 4 months after the treatment. As a result, geothermal water treatments should be integrated into the treatment programs for skin diseases and should take a significant place among beauty procedures.

Keywords: Balneotherapy; body fat; geothermal water; skin.

1. INTRODUCTION

The healing effect of thermal water has been mentioned from the times of the Roman Empire [1]. In recent decades, several fields of medicine have undergone a great transformation because of the evidence of the effects of natural scientific factors. The result of the effects of neuroreflexive and humoral mechanisms is a complex series of reactions involving the adaptations of the human body, caused by the stimulation of mechano-, thermo-, baro- and chemo-receptors. It is difficult to attribute the measured effects to specific parameters. The scientific reports suggesting that the chemical and thermal properties of spa water have an impact on skin cell physiology [2], trigger physiological changes in the renal and cardiovascular systems with potentially beneficial effects on skin diseases. Whereas the benefits of the external use of several minerals (zinc, magnesium and iron) are known well, and have been confirmed by the FDA; the benefits of other minerals to the skin are still under investigation [3]. The efficacy of spa therapy for inflammatory skin diseases and the mechanisms are only partly understood, and incorporate chemical, thermal, mechanical and immunomodulatory effects. Minerals in spring water (sulfur, magnesium, calcium, selenium) induce anti-inflammatory, keratolytic, antibacterial or antifungal effects [4]. For anti-inflammatory effects, the inhibition of Th1, Th2, Th17 differentiation, inhibition of keratinocytes cytokine (IL-6, IL-8, IL-1α, TNFα and GM-CSF) production, and modulatory effects on epidermal Langerhans cells have been reported [4]. Also studies with animal models showed bicarbonate-calcium-magnesium mineral water improve in skin regeneration, not only by increasing keratinocyte proliferation and migration but also favorably modulating the regenerated collagen and elastic fibers in the dermis [5]. Experimental in vitro studies on cell cultures and human keratinocyte cell lines showed that thermal springs reduce parameters associated with inflammation [6]. Scientific works by various authors have revealed that direct contact with thermal water has a beneficial therapeutic effect in the treatment of skin diseases (psoriasis, dermatitis, eczema, various infections and injuries) [7-17].

In addition to the diverse positive effects on the body, obesity is a specific target of balneotherapy, where treatments have also shown a positive result [18-20]. Overweightness and obesity are the main risk factors in coronary heart disease, strokes, type II diabetes, osteoarthritis, and certain types of cancer (uterus, breast, intestine) [21], and thereby worsen the quality of life, increase mortality and add to health-related costs. The mechanisms for this effect is under investigation. Water immersion is believed to induce cardiac, blood flow, and temperature changes to the body. The displacement of body fluid to the central cavity causes an increase in interstitial fluid transfer into the vascular space reducing exercise-induced swelling and increasing cardiac output and blood flow, which accelerates the removal of metabolites and waste products, reduction of muscle oedema and fatigue, and enhances delivery of oxygen [22,23]. Hot water temperatures are associated with an increase in peripheral vasodilatation, which also results in increased blood flow thus decreasing blood pressure, regulating autonomic nervous system [24]. Impact on the plasma level of the adipocytokines leptin and adiponectin [25] as antioxidant and metabolic activities matters [19]. Different studies data show that the effectiveness of balneotherapy on weight loss is similar to the results obtained by drug treatment, commercial weight management programs, and comprehensive lifestyle modification programs. Some scientific human studies showed reduced excessive body mass, correction of blood lipid spectrum, normalization of metabolic processes in the liver [26,27,18]. The healing effects of thermal spring water are well known, but further studies of its biological properties and its therapeutic benefits are necessary [28].

Although there is a proven positive effect of the Dead Sea and other natural mineral water sources on the skin and on body weight, there is a lack of studies on the effect of water extracted from boreholes. The objective of our study is to explore the effect of geothermal water of a high degree of mineralization on the skin and on body fat.

2. MATHERIALS AND METHODS

The study, involving 50 women (average age 35), was carried out in Klaipeda, at the spa centre in February-June 2015. All subjects were informed about the purpose, conditions, and course of the study prior to the inclusion, and signed a participant's agreement. This open-label trial was implemented in observance of the rules of good clinical practice; protocol was approved by the Ethics Committee of Vilnius University. The voluntary participants randomly were divided into 2 groups (25 in both), which received geothermal water treatments of a different duration of procedure (Group I-15 and Group II-20 min). Randomization into two different treatment groups was performed by an individual who was not involved in the implementation of the study using a random-number table. A professional performing the statistical analysis was aware of the randomization.

The inclusion criteria were: women 18-55 years of age, had not received any rehabilitation procedures during the last 3 months, and who wished to participate in the study. Exclusion criteria: current acute skin or infectious disease, active tuberculosis, severe asthma, malignant tumours, severe nervous system disorders (psychosis, neurosis, epilepsy), liver failure, kidney failure, severe heart deficiency, severe hypertension, angina at rest, non- corrected serious endocrinological diseases (thyroid, pancreas), heart rhythm disorders, bleeding, severe allergic reactions, severe obesity in the absence of pregnancy. All of the participants were examined by a general practitioner.

Geothermal water of an indifferent temperature (34°C), with a high mineralization of 27,6 g/l (supplied by borehole from Klaipeda region) was used for the study. The chemical composition of the water is presented in Table 1. The geothermal water was slightly alkaline, pH was 7.24, specific electric conductivity was 42800 µS/cm at 25°C, total water hardness 173, carbonate 1.35, and with a cation/anion balance +5998 mg-eq/l.

Table 1. Composition of the geothermal water

Element	Concentration, mg/l
Cl^-	16,060
Na^+	7040
Ca^{2+}	2310
Mg^{2+}	703
SO_4^{2-}	1164
K^+	187
HCO_3^-	82.6
Fe total	0.58
F^-	0.16
Mn^{2+}	0.2
The amount of dissolved mineral substances	27,556

The subjects received 15 balneoprocedures in geothermal water baths daily five times a week for 3 weeks. The participants were immersed to below the armpits in warm water of 34°C. The exposure time for balneoprocedure for Group I was 15 minutes; and for Group II was 20 minutes. It was recommended that the subjects slightly moved around while in the bath. In case of unpleasant sensations, weakness or heart problems, they could seek medical attention, and their behavior and changes in appearance were monitored and observed during the treatment. The enrolled patients completed the balneotherapy treatment as outpatients, with no change in their daily routine or work attendance.

According to the methodology a questionnaire about the health and about the skin condition of the women were used; the skin moisture and elasticity was measured with a Soft 55 Catellani 1930 measurer; the BMI and skin fat were measured with an Omron body fat measurer and with scales; the skin ridge was measured with a caliper; and the other sizes were measured with a tape-measure. The participants were examined before the procedures and immediately after the treatment; while the remnant effect of the 15-min treatment was evaluated 1 and 4 months after the treatment.

For the statistical evaluation, 21 questionnaires from Group I women (84% of the participants) and 23 questionnaires from the Group II women (92% of the participants) were submitted. The participants in both groups were similar in terms

of height (168,5 cm in Group I and 166,6 cm in Group II), the status of general health (both 7,7, VAS), wellbeing (7,9 and 7,7, VAS), pain (3,3 and 3,5, VAS), stress (4 and 4,6, VAS), fatigue (4,8 and 4,7, VAS), alcohol (14 and 19%) and medication usage (25 and 29%). The Group I participants were younger (30 and 39 years), less in weight (64 and 67 kg), had more complaints (2 and 1,2), smoked every day (40 and 14%), their incidence of morbidity was higher (48 and 24 %).

In describing the data, we calculated the average of the readings, as well as the standard deviations (SD). To determine the accuracy and reliability of the statistical evaluation, we calculated the confidence intervals at a confidence level (CI) 0,95. The data in the graphs are given using the average of 95% CI. During the verification of the hypotheses about the normality of the distribution of the parameters, the Kolmogorov-Smirnov test was used. Student criteria was used for the comparison of the data averages of the two independent groups when some signs satisfied the conditions of normality; and the nonparametric Mann-Whitney criterion was used when the distributions in the studied population did not satisfy the conditions of normality. For the comparison of the two dependent quantitative signs, we used a pairwise Student's *t*-test; and used a nonparametric Wilcoxon, Sign and McNemar's test when the distributions did not satisfy the conditions of normality. The pairwise comparisons of the averages of the dependent variable estimates were performed using the Sidak criterion. The significance level during the verification of the statistical hypotheses was 0.05. For the accumulation of the study readings, MS Excel tables were used. The calculations were performed using the statistical software package SPSS 20.

3. RESULTS

3.1 The Effect of Geothermal Bath on the Skin

The effect of the geothermal water treatment on the general skin condition was studied, such as its moisture, elasticity, individual characteristics of the skin and the use of skin products.

The Group I participants evaluated their skin condition in a 10-point scale (VAS) immediately after the 3 weeks of geothermal water treatment, as well as after 1 and 4 months. Positive results of the 15-minute geothermal water bath on the skin elasticity, moisture content, cellulite and general skin condition were recorded, although these results were not statistically significant (p=0,062–0,766) (Fig. 1). The evaluation of the total amount of skin condition complaints showed a statistically significant positive variation (average before the treatment was 3 (SD 1,8) and after the treatment was 1,9 (SD 1,3), p=0,001). After 4 months, the skin condition was

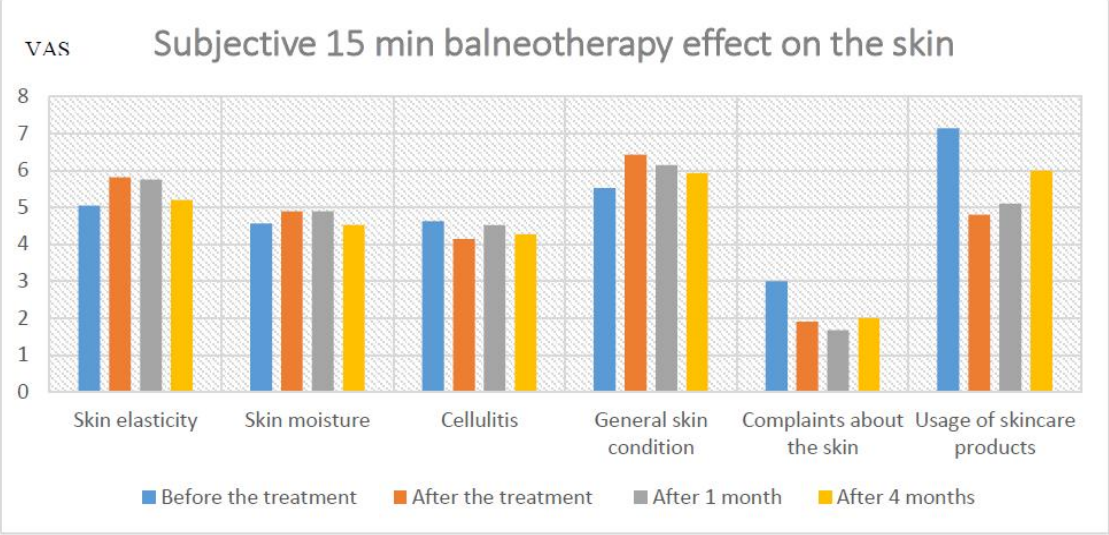

Fig. 1. Effect of the 15-minute treatment on the subjective condition of the skin

significantly better than the initial condition (by an average of 0,41 point, p=0,010). Although the result was statistically unreliably, the skin elasticity remained increased in comparison with the initial condition (0,2 point), and there were fewer signs of cellulitis (0,4 point) (Fig. 1).

The evaluation of the effect of the 20-minute geothermal water treatment (II Group) on the subjective skin condition and its improvement, as well as the frequency of the products used before and after the treatment, showed a positive result for almost all signs (except for cellulite) (p=0,156–0,741), and statistically, the total amount of skin complaints decreased significantly (by an average of 0,8, 95% CI from 0,327 to 1,357, p=0,003) (Fig. 2).

The study of the 15-minute geothermal water treatment on the objective body skin moisture content and elasticity showed a statistically significant increase in the skin moisture content (average increase of 7,5, 95% CI from -14,85 to -0,1; p=0,047), and this result still lasted after 1 month of treatment. However, an objectively relevant change in the body skin elasticity was not observed (Fig. 3). After 4 months of treatment, the body skin moisture content remained at a negligibly increased level (p=0,073).

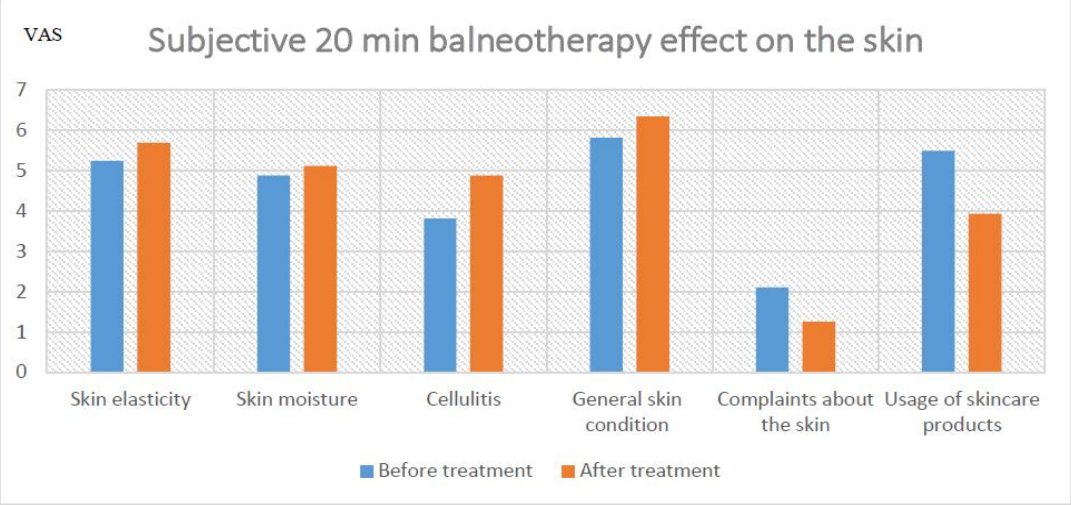

Fig. 2. The effect of the 20-minute treatment baths on the participants' skin

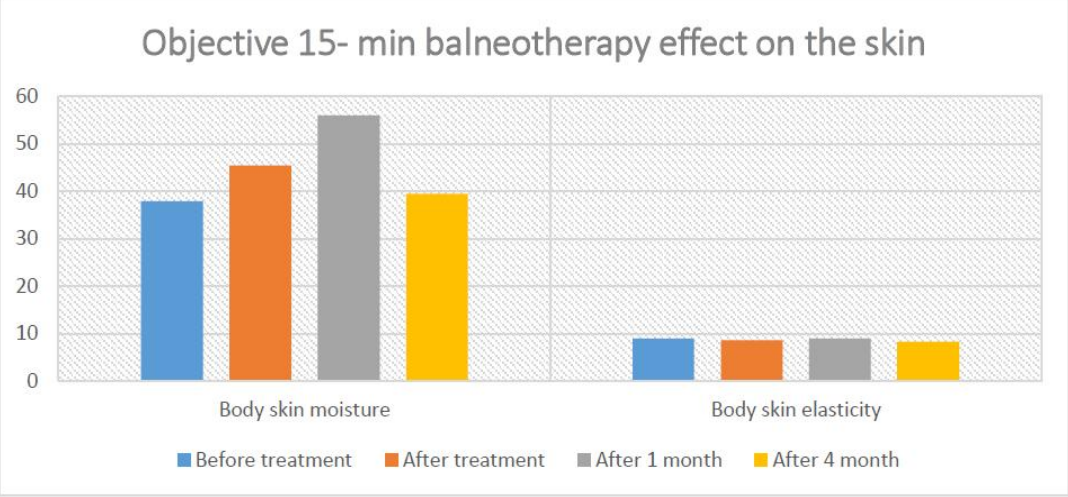

Fig. 3. The effect of the 15-minute treatment on the objective skin condition (scale units)

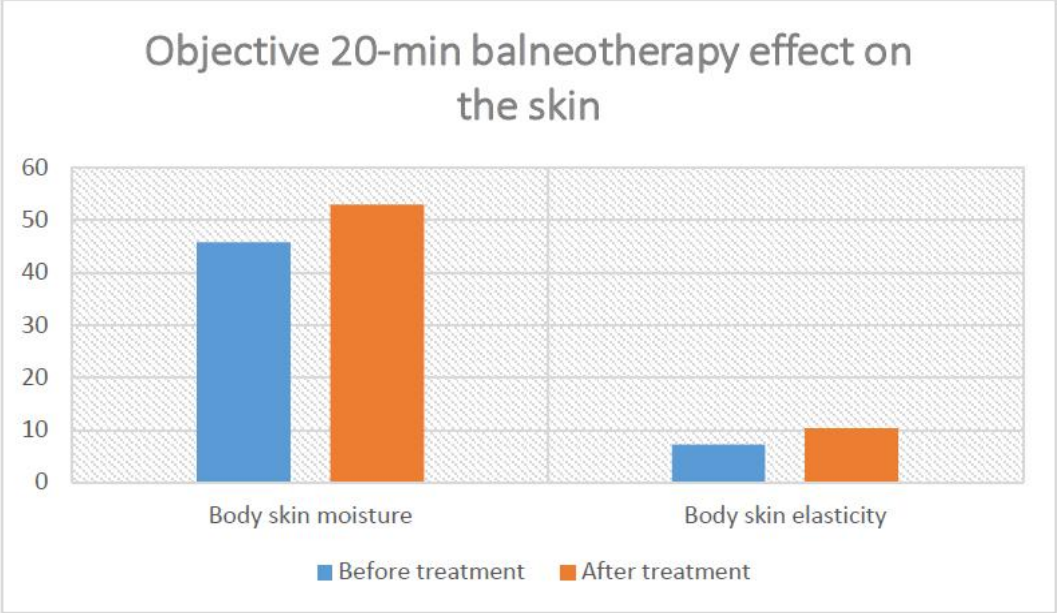

Fig. 4. The effect of the 20-minute treatment on the objective skin condition (scale units)

The study of the objective change in the body skin condition after the 20-minute treatment revealed a reliable improvement in the skin moisture content and elasticity (Fig. 4 above). The skin moisture content improved by 7 (p=0,05) and the elasticity by 3 units (p=0,016).

To evaluate the effect of the geothermal water treatment on the skin condition, different questions were asked that allowed us to describe the current situation of the skin. The evaluation of the changes after the 15-minute treatment using the McNemar test found that 16 of the participants had complained of dry skin before the treatment, and for 5 of them (31%) the skin was no longer dry; 4 participants had itchy skin, and the itching disappeared for 3 of them (75%); allergic skin disappeared in 1 out of 1 participant (100%); skin redness disappeared in 3 out of 4 participants (75%); vascular networks decreased in 2 out of 7 participants (29%); 2 out of 4 participants had slack skin that disappeared (50%); 3 out of 3 participants had skin soreness and acne that disappeared; and 5 out of 12 participants had a reduction in skin cellulitis (42%). However, these results did not reach the limits of confidence in the statistical test. In the evaluation of their reliability using the Wilcoxon test, a significantly positive change was received with respect to itchy skin and cellulite (both p=0,046). However, no significant changes in the reduction of eruption elements were found (p=0,317–1). The evaluation of the residual positive effect on the skin revealed even better results where after 1 month of treatment, a significantly positive effect was found related to: skin itching (where it disappeared in 4 out of 4 affected participants, p=0,046); vascular networks in the skin (disappeared in 4 out of 7 participants, p=0,046) and a decrease in cellulitis (decreased in 8 out of 12 participants, p=0,046). Other signs of skin conditions (dryness, fatness, flaking, sensitiveness, redness, ptosis and acne) remained negligibly improved (according to the McNemar test). 1 month after the treatment, these had disappeared in 2 out of 3 participants (67%) who had complained of such eruptions (McNemar). After 4 months, the amount of skin complaints remained reduced (before the treatment -3,4 and after the treatment -2, p<0,001), while the following positive (unreliable) changes remained the same: skin dryness, slackness and rashes disappeared (for those who had them) in 25% of the women; spots had reduced in 33%; vascular networks, cellulite appearances and fat content had reduced in 50%; itching had reduced in 67%; redness had reduced in 75%; flaking had reduced in 83%; and lower levels of acne, rents, allergies, pustules, scratching, scales and nail changes were found in 100%.

In the evaluation of skin lesions after the 20-minute treatment, a positive trend was observed for some signs, but these changes were not

statistically significant by the Wilcoxon, Sign and McNemar tests. The following positive changes were observed: 36% of the participants stopped using moisturising creams; 50% had reduced itchy skin; 67% had reduced skin sensitivity; 71% had reduced nail changes; 72% had reduced skin dryness; 75% had reduced cellulitis; and 100% had lower levels of skin fatness, scaling, redness, soreness, vascular networks, rashes, spots, pustules, acne, and the use of fatty creams and serums.

Additionally, the effect of the 15-minute treatment on the use of skincare products, as a measure for the skin condition improvement, was studied. It was found that both immediately after the treatment and 1 month after the treatment, a statistically significant reduction in the frequency of skincare product usage was seen (average, VAS, before the treatment 7,14 (SD 2,78) and after the treatment 4,81 (3,11), p=0,001). Immediately after the treatment, the participants did not find it necessary to use so many other personal care products (p=0,083 to 0,666), and after 1 month, the total consumption of skin improvement products remained significantly lower (average, VAS, 5,1 (SD 3,42), p=0,001). After 4 months, 50% used fewer fatty creams, 40% used fewer nourishing creams and serums, and 8% used less moisturizers (McNemar's test, p=0,5–1). Throughout the study, the frequency of the use of creams remained at a decreased level by 1 point (p=0,213). After the 20 minutes treatment, the frequency of the use of creams also decreased by an average of 1,6 points (p=0,156); whereas 100% of the participants did not use fatty creams and serums, and 36% used less moisturizers (Figs. 1-2).

3.2 The Effect of the Geothermal Bath on Body Fat

In order to determine the effect of the geothermal water treatment on body fat, the size of the limbs, the thickness of the hypodermic ridge, the BMI and the body fat content were measured.

It was found that, after 15 minutes of a geothermal bath treatment, the volume of the limbs, BMI and fat content all decreased. Furthermore, after the treatment, a statistically significant (p<0,05) decrease in all of the limb volumes (at 8 measuring points) was seen. After 1 month following the treatment, the limb volume increase was statistically significant, but the evaluation of the volume after 4 months showed a positive impact on all volumes of the limbs (p<0,05) (Fig. 5). The analysis of the effect of the water treatment on the hypodermic fat layer found that, after the treatment, the skin ridge of both the upper and lower limbs (at 16 measuring points) decreased in a statistically significant manner (p≤ 0.001). After 1 month following the treatment, the fat layer in the area of the biceps (left) and the forearm (right) of the upper limbs and the calf (right) area of a lower limb were significantly lower (p<0,05). The ridges of the remaining skin areas also remained decreased in comparison to the initial measurement, but only negligibly. After 4 months following the treatment, the hypodermic fat layer (for all measurements) of the limbs was significantly lower than before the treatment (p≤0,01) (Fig. 5).

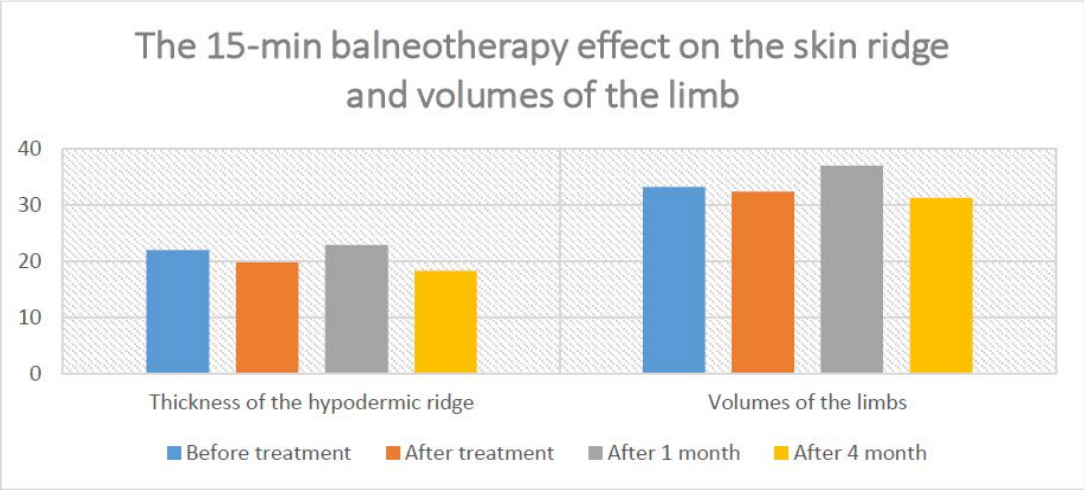

Fig. 5. Change in the limb skin ridge (mm) and the volume of the limbs (cm) after the 15-minute treatment

It was found that the limb volume of the Group II participants did not change significantly after the treatment. The analysis of the effect of the geothermal water treatment on the hypodermic fat layer found that there was a decrease in all dimensions, but a statistical significance of the decrease was only reached in the ridge of the right forearm (p=0,016) and the right thigh (p=0,038). The total changes in the limb skin ridges and volumes are given in Fig. 6.

The study sought to determine whether the 15-minute treatment would affect the body mass index (BMI) and the variation in the body fat content. The results obtained showed that both of these signs decreased: the BMI was significantly reduced (on average 0,32, 95% CI from 0,07 to 0,57, p=0,015); and the body fat percentage decrease was not significant (on average 0,57; 95% CI from – 3,76 to 1,51, p=0,224) (Fig. 7). After 4 months, the BMI and fat content remained lower than the initial measurement (0,28, respectively (p=0,088) and 0,52).

At the end of the 20-minute geothermal water bath treatment, a significant reduction in the BMI and fat content was determined. The BMI decreased by 0,5 (p<0,001) and the body fat percentage decreased by 2 (0,017) (Fig. 8).

3.3 Comparison of the Treatment Effects in the Groups

The quantitative study results of the 15-minute and 20-minute treatment groups were also compared. In all cases, calculations were performed to determine whether the data satisfied the conditions of normality, and parametric or non-parametric methods were applied. The verification of the objective study data by the Kolmogorov-Smirnov and Shapiro-Wilk tests showed that part of the data fully satisfied the condition of normality (the skin moisture content); whereas another part of the data has some reservations. As a result, different methods were needed for the comparison of the groups.

In applying the *t*-test, a statistically significant difference of the skin elasticity between Groups I and II was obtained (p=0,039). According to the Mann-Whitney test results, it can be said that the following statistically significant results between the groups were found: differences in body fat content (p=0,008) and differences in skin elasticity (p=0,012). The body fat content significantly decreased and the skin elasticity increased more in Group II (20-minute treatment).

In comparing the subjective skin changes between the groups after the treatment, it was found, when comparing Group I with Group II, that no essential differences between the groups were found (p=0,072 to 0,905).

The analysis of the data concerning the limb volumes between the study groups found that they are not distributed according to a normal distribution, so we applied a nonparametric test to the result. We can conclude that all differences between the treatment groups (in 8 measuring points: both upper arms and forearms, both thighs and calfs) were significant, and were more in favour of the Group I (15-minute) treatment (p<0,001 to 0,014).

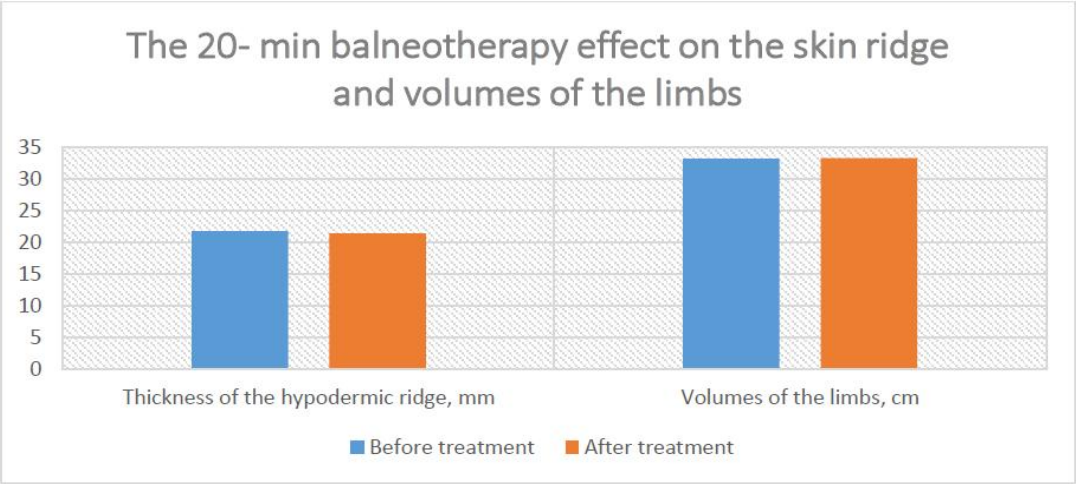

Fig. 6. Changes in the limb skin ridge and volume of the limbs after the 20-minute treatment

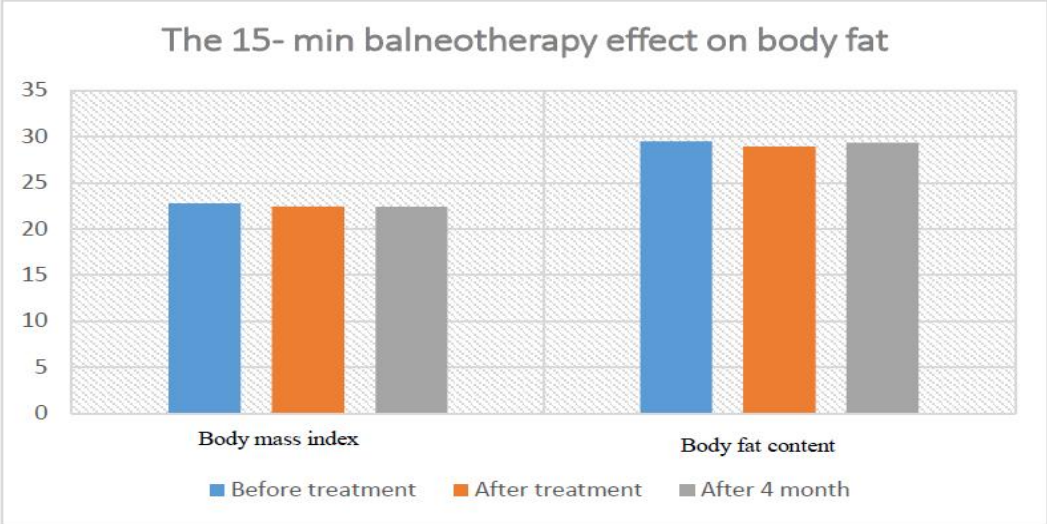

Fig. 7. Change in the BMI and fat content after the 15-minute treatment

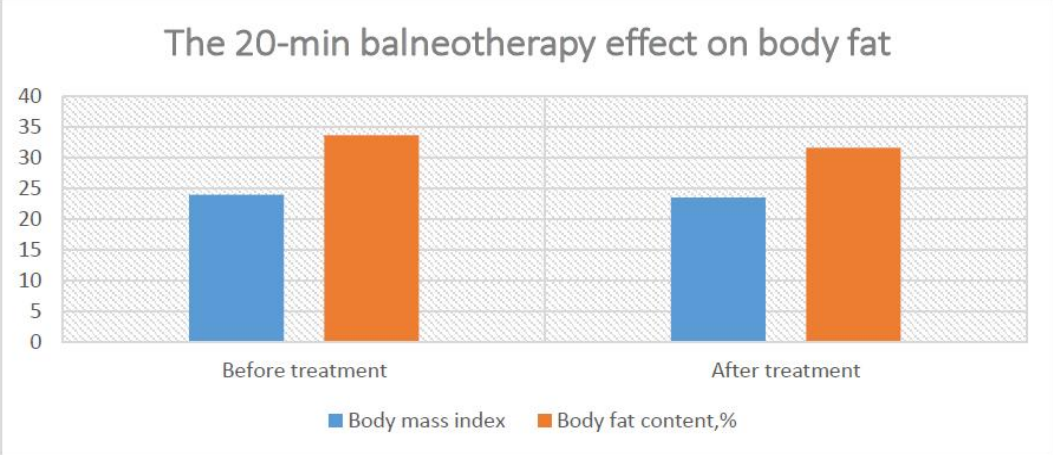

Fig. 8. Change in the BMI and fat content after the treatment

According to the Kolmogorov-Smirnov and Shapiro-Wilk tests, the results of the skin ridge results tend more to normality, with some reservations. In applying the *t*-test, significant differences were determined everywhere between Groups I and II, except on the lateral side of the right thigh and the right biceps (p=0,001 to 0,034). Since the data did not fully meet normality, we also applied another criterion – the Mann-Whitney test. Based on the data we received, significant differences were again found everywhere between Group I and Group II, with the exception of the right biceps (p<0,001 to 0,036). Results were more in favor of the Group I (15-minute) treatment.

The comparison of all changes in the study groups is shown in Table 2. From this, it can be summarized that the 15-minute treatment was more useful for the reduction of the body volumes; and the 20-minute treatment was more useful for weight and fat loss and for the increase in skin elasticity, as well as for the improvement in skin moisture content after the geothermal water treatment.

4. DISCUSSION

The study found that the geothermal water with a high mineralization (27,6 g/l) has a significant impact on the reduction of skin condition complaints, as well as increasing the skin moisture content and elasticity, and reducing hypodermic fat and the fat content in the body. A 15-minute treatment was more useful for the reduction of the body size; and a 20-minute

treatment was beneficial for weight loss and for fat reduction. After 1 month following the end of the treatment, significant changes in the reduction of the complaints remained the same (76%) for some indicators such as the skin ridge thickness, reduction of itching, and reduced vascular networks and skin cellulite. After 4 months following the treatment, the skin condition still remained significantly better than the initial measurement (on average, by 0,41 point), a positive effect on all of the limb volumes was observed ($p<0,05$), and the hypodermic limb fat layer (all measurements) was significantly lower than before the treatment ($p\leq0,01$).

Table 2. Comparison of changes in the study groups

Parameter	15-min treatment	20-min treatment
Change in volumes, cm	-0,8*	+0,1
Change in skin ridge, mm	-2,2*	-0,4
BMI change, kg/m2	-0,3*	-0,45*
Change in fat content, %	-0,57	-2*
Change in skin moisture content, unit	+7,5*	+7,1*
Change in skin elasticity, unit	-0,4	+3*

** Statistically significant change.*
No significant adverse effects of the treatment were observed

The Cl-Na-SO4-Ca water we analyzed produces effects that are specific to the main minerals. Of course, the chloride in the water improves the cellular metabolism, tissue regeneration, and blood and lymph circulation, as well as stimulating the organic and metabolic functions [29]. In 34-36°C water, the muscle tone decreases, contractures remises, peripheral arterial blood flow is stimulated, tissue trophic improves, and swelling and pain lessens; while in a 20-30 g/l of water mineralization the adrenal cortex function is stimulated and there are improvements in the oxidation and reduction processes in the tissues, the skin vascular tone is regulated, and there is a positive effect on the adaptive mechanisms. Additionally, the functional ratio of the cerebral cortex and the hypothalamus is changed, and the sympathetic nervous system tone increases; the ribonucleic acid content in the skin cells increases; the glycogen and ascorbic acid content decreases; and the tone of the peripheral veins increases as well [29].

There are more and more studies emerging that deal with the biochemical mechanisms of the positive effects of mineral water. Studies by Venier and Larese Filon show that some (not all) metal ions can easily pass through the skin, and in particular, are stimulated by sweat [30]. Additionally, trends to increase the minerals such as copper, zinc, calcium, magnesium and iron levels during the mineral baths, and to decrease in the levels of cadmium are found [3]. Icelanders found that the *Blue Lagoon* extracts could induce the expression of involucrin, loricrin, transglutaminase -1 and the filaggrin gene in human epidermal keratinocytes and could affect the dermal fibroblasts [7,11]. It is believed that magnesium and calcium play a key role in regulating the proliferation and differentiation of keratinocytes, and also in activating the migration of keratinocytes, inhibiting E-cadherin and stimulating the α1β2-integrin functions [31].

In Japan, balneotherapy is now being successfully applied in the treatment of atopic dermatitis, because the acidic medium and the active manganese and iodine ions cause a strong bactericidal effect and can successfully treat purulent skin lesions. Proksch et al. found that significant changes in the skin (a reduction in transepidermal water loss, roughness and redness, as well as an increased skin moisture content) occurred after daily 5% Dead Sea baths when compared with tap water [12]. Furthermore, a randomized, double-blind study by Portugal-Cohen et al. demonstrated that the treatment of atopic dermatitis with Dead Sea salt was more effective in the SCORAD scale (*SCORing Atopic Dermatitis*) for the reduction of transepidermal water loss, etc. [17]. According to a joint study project in 2013, by FEMTEC (*World Federation of Hydrotherapy and Climatotherapy*) and FoRST (*Foundation for Spa Scientific Research*), only a small part (9%) of hydrotherapy is currently applied to the dermatology. Commonly, sulphate and carbonate waters with a middle and high mineralization of Ca, Mg, Na salts are used [32]. Intensive studies of the use of Dead Sea minerals in the treatment of various dermatological conditions, especially of psoriasis, atopic dermatitis, vitiligo and other eczemas, are still ongoing. Also, N. Riyaz, having revised the Dead Sea water studies on dermatology and J. Schlessinger both stated that spa therapy is an interesting concept for the treatment and prevention of dermatological diseases [1,33].

There are not many studies related to the balneotherapy treatment of obesity. However, a study by Hahn et al. found a significant 1,91 kg/m (2) BMI decrease in a balneotherapy group that was compared with the use of a motivational

dietary interview (0,20 kg/m2) (P < 0,001). The one-year benefit, compared to matched interview patients, was 4,6 kg [18]. Some broad commercial weight loss programs for one year can reach 6,65 kg as standards only 3,16 kg [34]. It is also known that thermal therapy for obese people can reduce body weight and body fat without any change in plasma ghrelin concentrations [26]. It has been found that carbon dioxide arsenic mineral baths improve the microcirculation and fat metabolism, and thus have a beneficial effect on arterial hypertension, obesity and hyperlipidaemia [35]. Kang Ki Yeon study with obese children shows that hot spring bath could be an effective way of managing and treating obesity (BMI after 4 procedures lowered (from 25,99 to 25,06), as body fat mass (from 21,83 to 19,55) and percent body fat (from 38,24 to 34,20) [36]. Furthermore, an experimental study on rats showed that mineral water with arsenic could reduce excessive body weight, adjust the spectrum of blood lipids and normalize the metabolic processes of the liver [27]. Is balneotherapy more effective than hydrotherapy in our research field? The common things and differences of both therapies where discussed by MZ Karagulle in 2006 [37]. Lot of studies were made to compare both water therapies for the treatment of knee osteoarthritis, lower back pain, inflammatory and metabolic diseases [38] with magnitude of improvement in thermal water group (pain, tenderness, mobility, quality of life and etc) however no scientific balneotherapy studies involving tap water control group on skin and obesity were not found. Skin status changes because of thermal fresh water effects (stimulation of vasodilation, enhancing of blood circulation, some anti-inflammatory effect) definitely are [2,24,23] but major neuroreflexive, humoral mechanisms are involved during balneotherapy [1,3,12,19,29]. There is a need for further research for comparison of geothermal vs tap water treatment to clarify complex balneotherapy mechanism regarding thermal effect of hydrotherapy with tap water on the effect on skin and fat distribution.

Balneotherapy has a long history of applications and research, and the number of published studies that analyse the mechanisms of balneological substances and interventions is increasing. Judging from the available scientific data, balneotherapeutic treatments can improve the recipient's physical and psychological state, and can successfully treat the disorders of the skin and internal organs. If the safety and efficacy of geothermal water therapy is proven further, it could gain a more meaningful place in integrative medical treatments and in the promotion of health.

5. CONCLUSIONS

1. A 15-20 minute baths in geothermal water improves the skin condition and reduce the hypodermic fat content in the body.
2. The positive effect of the geothermal water remains for up to 4 months after the treatment.
3. Geothermal water treatments could be integrated into the programs for skin disease treatment and should take a significant place among beauty treatment procedures.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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