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THE INFLUENCE OF THERMAL WATER ON THE BODY PARAMETERS OF PERSONS WITH DISEASES OF THE LOCOMOTOR SYSTEM

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Abstract. *The natural healing influences of the nature that surrounds us have a positive effect on preserving health, improving health and quality of life. They are also used in the treatment and rehabilitation of patients, and can be climatic, marine and thermal (balneological). Thermomineral waters have a temperature higher than the average annual temperature of a certain place and up to over 100°C. The beneficial effect of thermal mineral water on the human body can be attributed to the physical properties of water and the healing properties of minerals that reduce muscle stiffness and pain, stimulate circulation, have an anti-inflammatory and relaxing effect on the body, and thus have a direct effect on body parameters. The main goal of the research was to determine whether thermomineral water therapy has an impact on improving the vital functions of the human body. Other objectives were: to determine the age and gender of the subjects and the influence of these two parameters on the outcome of thermomineral water therapy, and to determine how thermomineral water therapy affected changes in pulse values, blood pressure and body temperature. The research was conducted as a cross-sectional study using a questionnaire aimed at monitoring the basic diagnosis of the subject, age, sex, body temperature, pulse and blood pressure. Through the research, two measurements of vital parameters were made in 60 subjects. The first measurement was carried out before the application of thermomineral waters, and then after the therapeutic application in order to monitor possible changes in the values of vital parameters. The research was conducted at SRC "Aquaterm" in Olovo. The obtained data were analyzed using statistical methods and will be tabulated and graphically presented in the paper. The results showed that the majority of respondents belonged to the age group of 41 to 60 years with a participation of 41.7%. The majority of respondents had discushernia as their primary diagnosis in 32.4% of cases, while in 24.3% of cases the primary diagnosis was lumbosacral syndrome. The values of systolic blood pressure after therapy with thermomineral water were lower than the initial values in 54.4% of subjects, while the values of diastolic blood pressure were lower than the initial values in 43.9% of cases. A slower heart rate after thermomineral water therapy was recorded in 66.7% of cases.*

Key words: *hydrotherapy, thermal water, health, vital parameters*

Introduction: thermomeneral waters

Thermal mineral waters are determined by the increased temperature and the increased content of mineral substances in them. Spas are also called warm waters suitable for bathing or those waters whose temperature is identical to the temperature

of the human body. Currently, there are 15 registered health resorts in Bosnia and Herzegovina that provide health tourism services. One of these is the "Aquaterm" spa recreation center, which is located in the very center of the town of Olovo, next to the place where the two (mountain) rivers Stupčanica and Bioštica meet and form the Krivaja river [1]. The chemical composition of the thermal water in the Spa and Recreation Center Aquaterm Olovo indicates that the thermal water used in addition to other physical modalities belongs to a temperature isotherm of 34°C. According to the chemical composition, it contains 323.3 mg/l of noble gases N (nitrogen-nitrogen 86.5%), and of microelements it contains: Strontium 0.34 mg/l, Bromine0 0.06 mg/l, Zinc 0.05 mg/ l. /l, Radium 0.01 mg/l, Iodine 0.02 mg7l and Uranium 0.7 g/l. The joint action of elevated water temperature and mineral ingredients creates a biological reaction of the organism. The activity of cells and their recovery is accelerated, there is also improved circulation through blood and lymphatic vessels and the immune system is strengthened [2].

Application of thermomeneral waters

The indication area for the use of thermal mineral waters is wide. It is determined by medical doctrine, individually for each patient, respecting generally accepted, absolute and relative contraindications. These are the following conditions and diseases: degenerative changes in the joints and spine, some inflammatory rheumatic diseases, extra-articular and degenerative rheumatic diseases, various post-traumatic conditions, conditions after certain surgical interventions, certain neurological diseases, some skin diseases and chronic inflammations [3]. The basis of therapy in Aquaterm is the well-known oligomineral medicinal water, which is used in therapeutic procedures in three ways: baths, inhalations and drinking. Types of therapies used in treatment are: hydrotherapy, electrotherapy, sonotherapy, magnetic therapy, thermotherapy, massages and kinesitherapy [4].

Research methodology

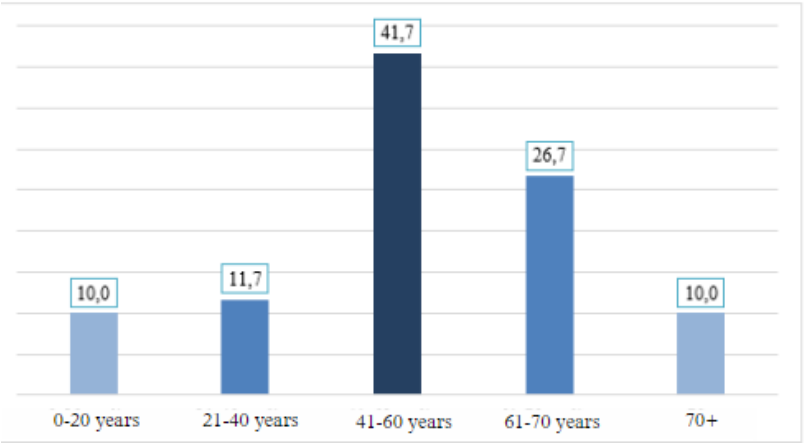
The research was carried out in the Aquaterm Olovo Health and Recreation Center as a cross-sectional study with the help of a questionnaire that aimed to monitor the basic diagnosis of the subjects, age, gender, body temperature, pulse and blood pressure. During the research, two measurements of vital parameters were carried out in 60 subjects. The first measurement was performed before the application of thermomineral waters, and then after the therapeutic application in order to monitor any changes in the values of vital parameters. The data obtained were further processed using statistical methods and will be presented tabularly and graphically in the paper.

The primary goal of the research is to determine whether therapy with thermal mineral waters affects the improvement of the vital functions of the human body. Other goals are: (1) to determine the age and gender of the subjects and the influence of these two parameters on the outcome of thermomineral water therapy and (2) to determine how thermomineral water therapy affected changes in pulse values, blood pressure and body temperature, in which graphically and tabularly presented data

obtained with the help of questionnaires in the Spa and Recreation Center Aquaterm Olovo.

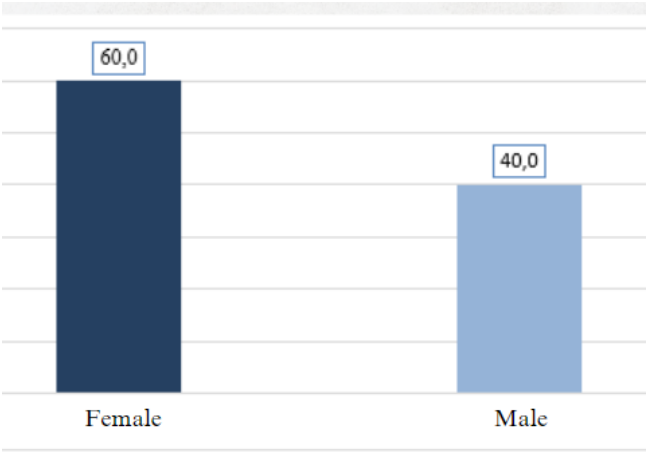
Research results

The number of respondents who participated in the observation of the effect of thermal water on body parameters in SRC "Aquaterm" Olovo was 60. The largest share of respondents was in the age group of 41 to 60 years.



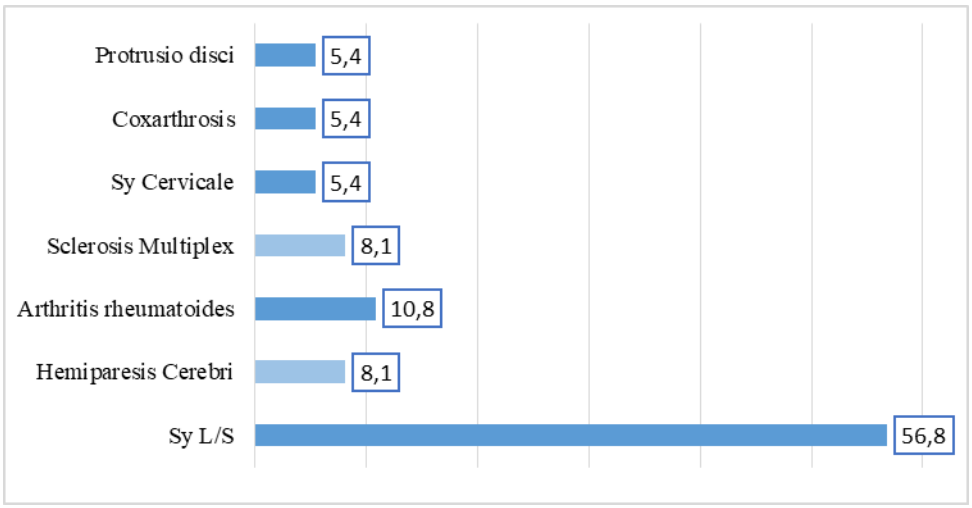
Graph no. 1: Age groups of respondents

The youngest age group was up to 20 years old, and the share of respondents in this group was 10%, as well as in the 70+ group.



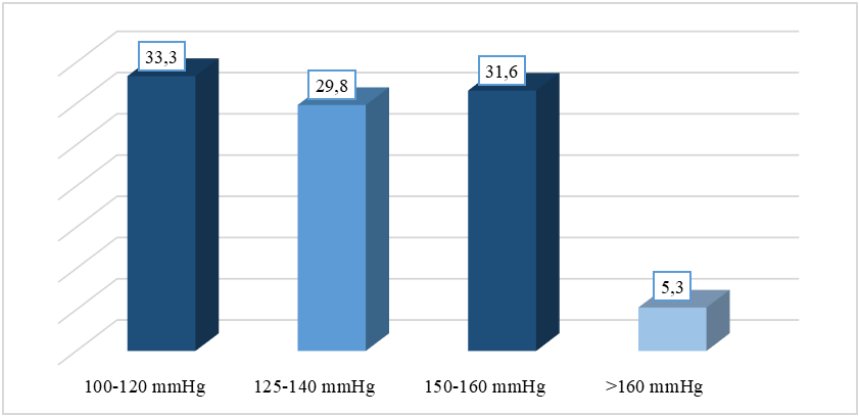
Graph no. 2: Gender of respondents

Looking at the gender of the respondents, women participated more with 60% compared to 40% of men. The basic diagnoses of the observed patients, i.e. the indications for treatment with thermo-mineral waters, were different. Among the leading diagnoses were: lumbosacral syndrome (56.8%) and rheumatoid arthritis (10.8%).



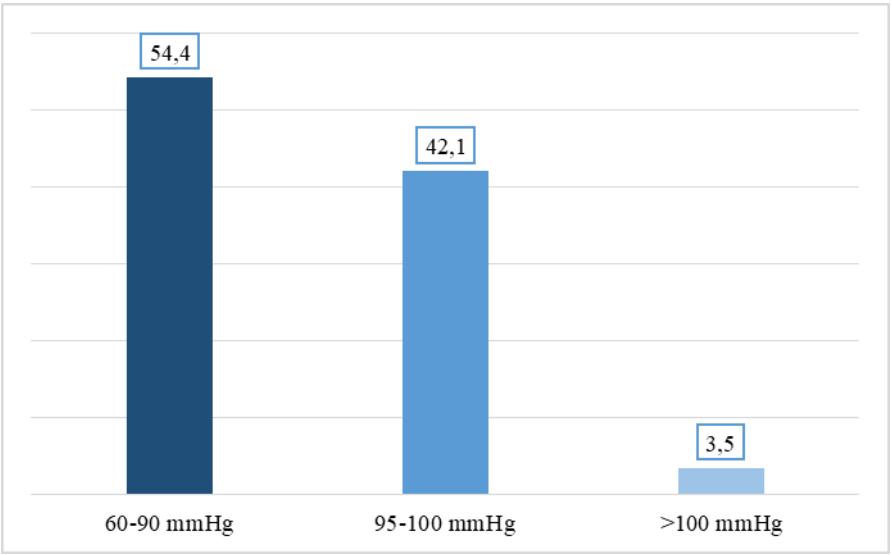
Graph no. 3: Basic diagnoses of the respondents

Individual diagnoses also included post-stroke conditions and chronic diseases such as diabetes and hypertension.



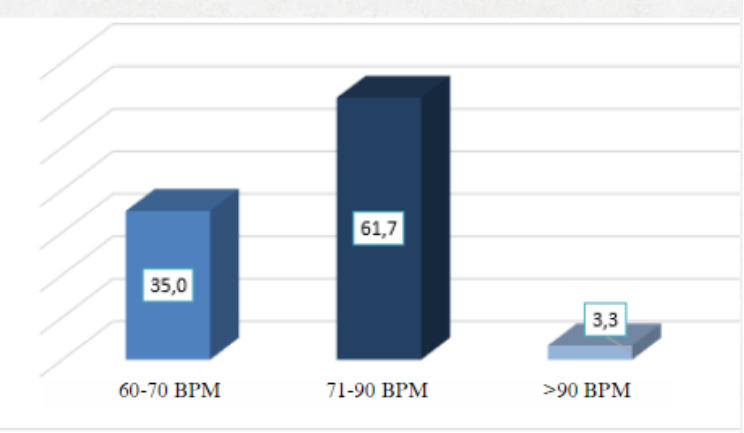
Graph no. 4: Systolic blood pressure values before thermomineral water therapy

Initial values of systolic blood pressure were in the physiological range of 100-120 mmHg in 33.3% of subjects. In 31.6% of cases, the respondents had hypertension, while 5.3% of the respondents had markedly elevated systolic blood pressure. Diastolic blood pressure values before therapy with thermomineral water were in the range 60-90 mmHg in 54.4%. 42.1% of respondents had slightly elevated diastolic pressure, while in 3.5% of cases diastolic pressure was in the range of hypertension.



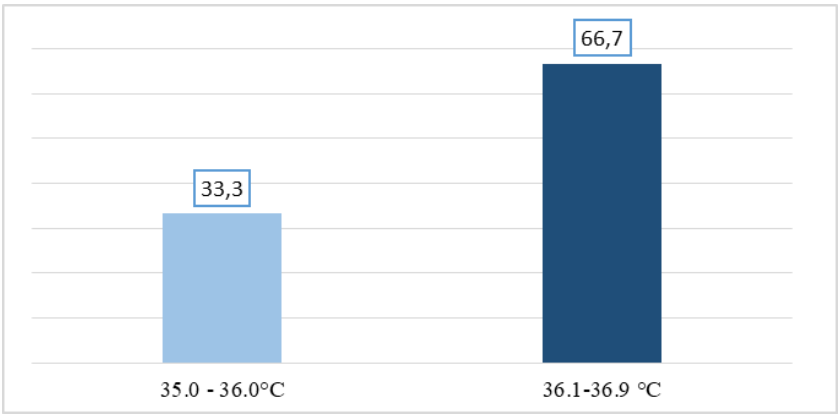
Graph no. 5: Diastolic blood pressure values before thermomineral water therapy

As part of the vital parameters, the subjects' heart rate was also observed, which in 61.7% of cases was in the range of 71 to 90 beats per minute.



Graph no. 6: Heart rate of the subjects before the therapy with thermomineral water

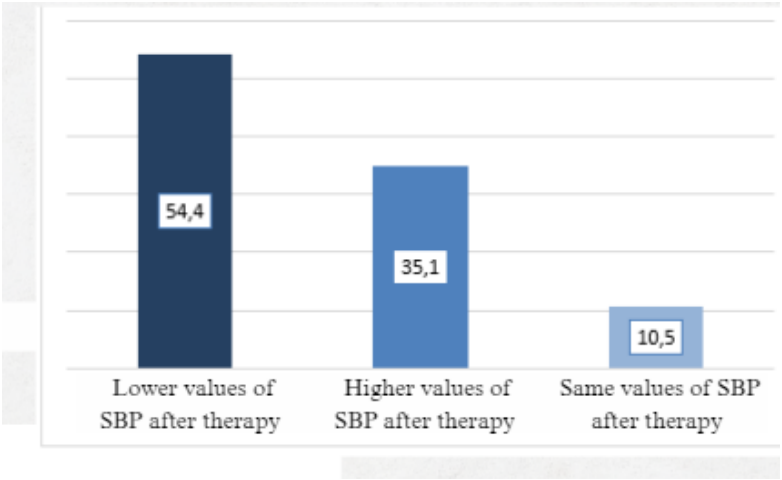
In 35% of the respondents, the heart rate was between 60 and 70 beats per minute, and in 3.3% of the respondents, a slightly faster heart rate was recorded, and in this group of respondents it was faster than 90 beats per minute.



Graph no. 7: Body temperature values of subjects before the application of thermomineral water

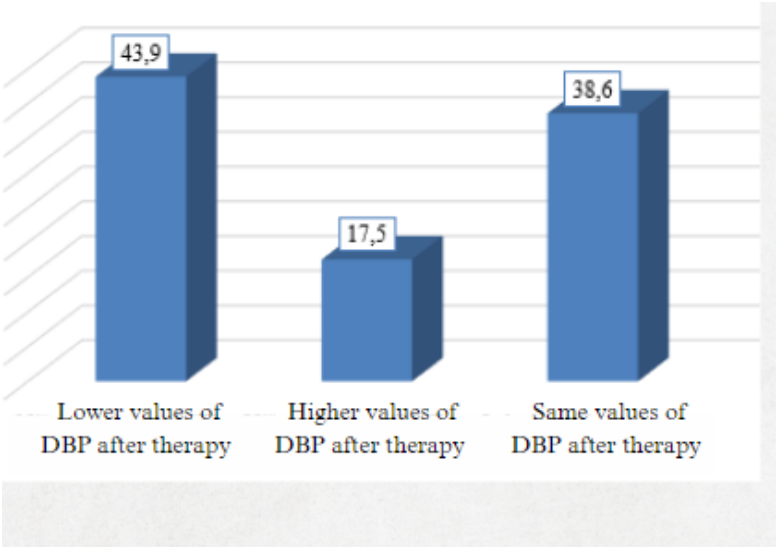
All the measured values of body temperature in the subjects before using the thermomineral water were within physiological limits. It is important to note here that both mercury and digital thermometers were used to measure body temperature, which showed slightly lower body temperature values, which in this case are considered physiological. For easier observation, the measured values of body temperature were divided into two groups: 33.3% of the subjects had a body temperature in the range of 35.0°C to 36.0°C, while 66.7% of the subjects had a measured body temperature. ranging from 36.1°C to 36.9°C.

All the mentioned parameters were measured after the application of thermomineral water therapy in order to confirm the health effectiveness of this type of therapy. Given that the initial values of body parameters were in the majority of cases within physiological limits without major deviations, the results of thermomineral water therapy will be observed in a general sense through the reduction or increase of individual values of body parameters.



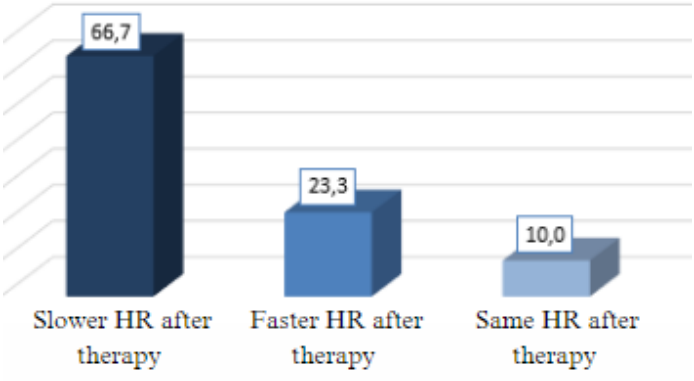
Graph no. 8: Systolic blood pressure values after application of thermomineral water therapy

Observing the systolic blood pressure after the application of the therapy, it can be concluded that in 54.4% of cases the thermomineral water lowered the blood pressure, while in 35.1% of the observed subjects there was an increase in the systolic blood pressure compared to the values measured before the thermomineral water for the therapy. In 10.5% of respondents, no changes in systolic blood pressure values were recorded. The results of measuring diastolic blood pressure after the use of thermomineral water therapy show similar results to those of systolic blood pressure.



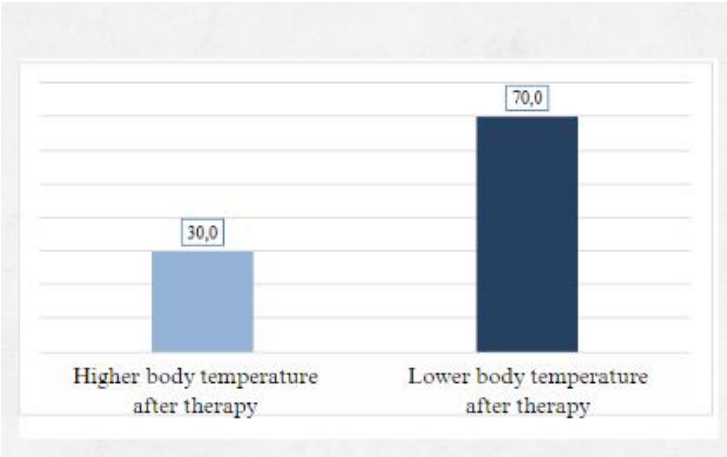
Graph no. 9: Values of diastolic blood pressure after application of thermomineral water therapy

Thus, a drop in diastolic blood pressure was found in 43.9% of respondents after the use of therapy. In 17.5% of subjects, there was an increase in the value of diastolic blood pressure, and in 38.6% of the observed cases, there was no change in the value of this observed physical parameter.



Graph no. 10: Heart rate after application of thermomineral water therapy

Therapy with thermomineral water also had a favorable effect on lowering the heart rate, so in 66.7% of the subjects after the therapy, a slowing of the heart's work was recorded compared to the initial values. A faster heart rate after therapy was recorded in 23.3% of the subjects, and in 10% of the observed cases there was no change in the pulse compared to the initially measured values.



Graph no. 11: Body temperature values after application of thermomineral water therapy

A decrease in body temperature after therapy, in relation to the initially measured values, is recorded in the majority of observed cases and has a participation of 70%. In 30% of the subjects, the body temperature increased after the

thermomineral water therapy. Body temperature values before and after therapy did not remain the same in any of the observed subjects.

Table no. 1: Differences in the average values of the measured parameters during the therapy in the bathtub and the swimming pool

	Bath	Pool
Average value of systolic blood pressure	134 mmHg	129.7 mmHg
Average value of diastolic blood pressure	87.2 mmHg	78.8 mmHg
The average value of the frequency of heart pressure	74.5 o/s	73.3 o/s
Average value of body temperature	36°C	35.9°C

In 50% of the subjects, the therapy with thermomineral water was carried out in the bathtub, while in the other half the therapy was applied in the pool. The table above lists the average values of the observed physical parameters after the application of thermomineral therapy in the pool and bathtub in order to determine whether there is a significant difference in the outcome of the therapy.

Discussion

Many studies have confirmed that balneotherapy is a safe and proven treatment, and scientists believe that treatment methods with mineral water compared to similar treatments with non-mineral water have a better and longer-lasting effect of improvement in terms of pain, function, quality of life and various clinical parameters [5]. Research from 2013 entitled "Effects of balneotherapy on blood pressure and heart rate in patients with osteoarthritis and hypertension" aimed to determine the impact of balneotherapy on changes in the mentioned physical parameters. The results of the study showed that before treatment the mean peripheral arterial pulse in all participants was 78.38 ± 4.06 beats per minute (median = 78.25 beats/min; range = 63.00-106.00 beats/min). Before treatment, the mean systolic and diastolic blood pressures of all participants were 118.50 ± 9.88 mmHg (median = 120.00 mmHg; range = 80.00-160.00 mmHg) and 74.09 ± 6.46 mmHg. (median = 70.00 mmHg; range = 50.00-110.00 mmHg). After 15 balneotherapy sessions, the mean heart rate of all participants was 78.27 ± 3.58 beats per minute (median = 78.00 beats per minute; range = 56.00-90.00 beats/min); mean systolic blood pressure was 116.09 ± 10.06 mmHg (median = 120.0 mmHg; range = 80.00-150.00 mmHg); and mean diastolic blood pressure was 72.48 ± 6.04 mmHg (median = 70 mmHg; range = 50.00-110.00 mmHg). The study revealed a significant reduction in observed parameters after balneotherapy treatment [6]. Research carried out in Austria examined the impact of balneotherapy through the measurement of 24-hour blood pressure with the help of a holter. The results showed that 24-hour blood pressure and nocturnal blood pressure and daytime blood pressure at medium and high initial values decrease significantly ($P < 0.05$) after the 3rd week of balneotherapy, while patients with low blood pressure showed almost no change. The pattern of 24-hour blood pressure variation of patients with mean values remained almost unchanged during balneotherapy [7]. Many conducted studies aimed at investigating the

effectiveness of balneotherapy have methodological flaws, which reduces their reliability. The potential beneficial effects of the use of thermomineral waters on health registered in practice are still not sufficiently documented, while respecting the principles of evidence-based medicine.However, numerous studies prove that treatments in thermomineral water contribute to the prevention of diseases of modern man prone to a sedentary lifestyle (osteoporosis, vertebral pain syndromes, osteoarthritis, stress, hypertension, obesity, hyperlipidemia, diabetes, depression) [8]. Research carried out in Austria examined the impact of balneotherapy through the measurement of 24-hour blood pressure with the help of a holter. The results showed that the 24-hour blood pressure and the nocturnal blood pressure and daytime blood pressure of patients with medium and high initial values decreased significantly ($P < 0.05$) after the 3rd week of balneotherapy, while patients with low blood pressure showed almost no change. The pattern of 24-hour blood pressure variation of patients with mean values remained almost unchanged during balneotherapy [7]. Many conducted studies aimed at investigating the effectiveness of balneotherapy have methodological flaws, which reduces their reliability. The potential beneficial effects of the use of thermomineral waters on health registered in practice are still not sufficiently documented, while respecting the principles of evidence-based medicine. However, numerous studies prove that treatments in thermomineral water contribute to the prevention of diseases of modern man prone to a sedentary lifestyle (osteoporosis, vertebral pain syndromes, osteoarthritis, stress, hypertension, obesity, hyperlipidemia, diabetes, depression) [8].

Conclusion

Natural healing influences are part of the nature that surrounds us, and they have a positive effect on improving health, preserving health and improving the quality of life, and are also used in the treatment and rehabilitation of patients, and can be climatic, marine and thermal (balneological). Thermomineral waters have a temperature higher than the average annual temperature of a certain place and up to over 100°C. The beneficial effect of thermal mineral water on the human body can be attributed to the physical properties of water and the healing properties of minerals that reduce muscle stiffness and pain, stimulate circulation, have an anti-inflammatory and relaxing effect on the body, and thus have a direct effect on body parameters. The main goal of the research was to determine whether therapy with thermal mineral waters affects the improvement of the vital functions of the human body. Other objectives were: to determine the age and gender of the subjects and the influence of these two parameters on the outcome of thermomineral water therapy, and to determine how thermomineral water therapy is reflected on changes in pulse values, blood pressure and body temperature. The conducted research is a type of cross-sectional study with the help of a questionnaire that aimed to monitor the basic diagnosis of the subject, age, sex, body temperature, pulse and blood pressure. During the research, two measurements of vital parameters were carried out in 60 subjects. The first measurement was performed before the application of thermomineral waters, and then after the therapeutic application in order to monitor any changes in the values of vital parameters. The research was carried out at SRC "Aquaterm" in

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UTICAJ TERMALNE VODE NA TJELESNE PARAMETRE KOD OSOBA SA OBOLJENJIMA LOKOMOTORNOG SISTEMA

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Sažetak. *Prirodni ljekoviti faktori dio su prirode koja nas okružuje i koji pozitivno utiču na očuvanje zdravlja, poboljšanja zdravlja i poboljšavanja kvaliteta života. Takođe se koriste u liječenju i rehabilitaciji bolesnika, a mogu biti klimatski, morski i termalni (balneološki). Termomineralne vode imaju temperaturu višu od prosječne godišnje temperature određenog mjesta i do preko 100°C. Blagotvorno dejstvo termomineralne vode na ljudski organizam može se zahvaliti fizikalnim svojstvima vode i ljekovitim svojstvima minerala koji smanjuju spazam i bolove mišića, podstiču cirkulaciju, smanjuju krvni pritisak, djeluju protivupalno regenerativno i opuštajuće na tijelo te na taj način imaju direktan uticaj na tjelesne-vitalne parametre. Glavni cilj istraživanja je bio utvrditi da li terapija termomineralnim vodama ima uticaj na poboljšanje vitalnih funkcija ljudskog organizma. Ostali ciljevi bili su: utvrditi dob i pol ispitanika kao i uticaj ova dva parametra na ishod terapije termomineralim vodama, te utvrditi kako se terapija termomineralnom vodom odrazila na promjene u vrijednostima pulsa, krvnog pritiska i tjelesne temperature. Istraživanje je provedeno presječenom studijom pomoću anketnog upitnika koji je imao za cilj praćenje osnovne dijagnoze ispitanika, dobi, pola, vrijednosti tjelesne temperature, pulsa i krvnog pritiska. Kroz istraživanje su rađena dva mjerenja vitalnih parametara kod 60 ispitanika. Prvo mjerenje je sprovedeno prije primjene termomineralnih voda, a potom nakon terapijske primjene kako bi se pratile eventualne promjene nastale u vrijednostima vitalnih parametara. Istraživanje je provedeno u SRC „Aquaterm“ u Olovu. Dobijeni podaci su analizirani statističkim metodama te će biti tabelarno i grafički prikazani u radu. Rezultati su pokazali da je većina ispitanika pripadala dobnoj skupini od 41 do 60 godina sa učešćem od 41,7%. Većina ispitanika je kao osnovnu dijagnozu imala diskusherniju i to u 32,4% slučajeva, dok je u 24,3% slučajeva osnovna dijagnoza bila lumbosakralni sindrom. Vrijednosti sistolnog krvnog pritiska su nakon terapije termomineralnom vodom bile niže od početnih kod 54,4% ispitanika, dok su vrijednosti dijastolnog krvnog pritiska bile niže od početnih u 43,9% slučajeva. Sporija frekvenca srčanog pulsa nakon terapije termomineralnom vodom bilježi se u 66,7% slučajeva.*

Ključne riječi: *hidroterapija, termalna voda, zdravlje, vitalni parametri*