

Aleksandra Ciochoń¹, Jolanta Jaworek²

¹ Orto Reha Sport, Kraków

² Department of Medical Physiology, Institute of Physiotherapy, Faculty of Health Sciences, Jagiellonian University Collegium Medicum, Kraków

Comparison of the classic massage effects and water exercises upon functioning state and subjective pain ailment of lumbar spine among pregnant women

Porównanie wpływu masażu klasycznego i ćwiczeń w wodzie na stan funkcjonalny i subiektywne dolegliwości bólowe dolnego odcinka kręgosłupa u kobiet w ciąży

ABSTRACT

Aim: Comparing the effects of classic massage and water exercises upon the functioning state of pregnant women with pain of the lumbar spine.

Material and methodology: The research involved 40 women with lumbar spine pain, being in the second and third trimesters of pregnancy. Respondents were divided into 2 groups. The first group was subjected to classical massage procedures, and the second group underwent water exercises. Lumbar spine mobility, pain levels and functional status of pregnant women were evaluated. The following diagnostic methods were used: goniometric measurement of lumbar spine mobility in the sagittal plane, visual analogue scale (VAS) of pain, and an original questionnaire prepared by the author.

Results: Following both treatments, the pain of the lumbar spine was reduced in responders of both groups, and the spine mobility was increased in the sagittal plane. A better analgesic effect was obtained in a group of women who took part in water exercises. Both the classical massage and exercise in water improved the functional status of women to the comparable degree.

Address for correspondence: aleksandra.ciochon95@gmail.com

ORCID: Aleksandra Ciochoń – 0000-0002-3093-052X; Jolanta Jaworek – 0000-0001-5897-7330

No sources of funding

Conclusions: Classical massage and exercise in water appear as safe and effective therapies recommended for pregnant women with lower spine pain.

Keywords: pregnancy, pain of the lumbar spine, treatment, classical massage, water exercise

STRESZCZENIE

Cel: Porównanie działania masażu klasycznego i ćwiczeń w wodzie na stan funkcjonalny ciężarnych z dolegliwościami bólowymi dolnego odcinka kręgosłupa.

Materiał i metodyka: Grupę badaną stanowiło 40 kobiet w II i III trymestrze ciąży z bólami kręgosłupa lędźwiowego. Respondentki podzielono na 2 grupy; pierwsza – korzystała z masażu klasycznego, a druga – brała udział w ćwiczeniach w wodzie. Ocenie poddano ruchomość kręgosłupa lędźwiowego, stopień dolegliwości bólowych oraz stan funkcjonalny badanych. Wykorzystano: pomiar goniometryczny ruchomości kręgosłupa lędźwiowego w płaszczyźnie strzałkowej, skalę bólu wizualno-analogową (VAS) oraz autorski kwestionariusz ankietowy.

Wyniki: Po zakończeniu zabiegów w obu grupach zaobserwowano zmniejszenie dolegliwości bólowych kręgosłupa oraz zwiększenie jego ruchomości. Lepszy efekt przeciwbólowy uzyskano w grupie kobiet, które brały udział w ćwiczeniach w wodzie. Zarówno masaż klasyczny, jak i ćwiczenia w wodzie poprawiły sprawność funkcjonalną badanych kobiet w porównywalnym stopniu.

Wnioski: Masaż klasyczny i ćwiczenia w wodzie są bezpiecznymi terapiami polecanymi kobietom w ciąży, które odczuwają dolegliwości bólowe dolnego odcinka kręgosłupa.

Słowa kluczowe: ciąża, dolegliwości bólowe dolnego odcinka kręgosłupa, leczenie, masaż klasyczny, ćwiczenia w wodzie

Introduction

Pregnancy is a special period of a woman's life. During the nine months, her body undergoes several changes related to intrauterine development of fetus and adaptation to future motherhood. The above natural adaptive processes are initiated by signals coming from the placenta and from the child, influencing the endocrine, circulatory, respiratory, urinary and muscular-skeletal systems. As a result of these changes pregnant women often suffer from dyspnea, metabolic and digestive disorders, increased blood pressure, lumbar pains (Jaworek, 2018; Skorupińska, 2017).

Pain of the lumbar spine affects about 62% of pregnant women between 12 and 18 weeks of pregnancy, but the highest intensity of pain symptoms is usually observed during the third trimester of pregnancy (between 24

and 36 weeks). About 60% of pregnant women suffering from low back pain are unable to work and their functional state is bad. There are many risk factors responsible for pain of lumbar spine, such as: occurrence of lumbar-pelvic pain during previous pregnancies, heavy physical work, a low personal physical activity, but lumbar pain could occur independently of the above mentioned risk factors. Once low back pain appears during pregnancy it sometimes persists for several years after delivery, leading to limitation of physical activity and reduction in a woman's quality of life (Chaitow, 2015; Gross, 2017; Majchrzycki, 2015; Szpala, 2017).

The etiopathogenesis of lower spine pain during pregnancy is complex and not completely explained despite of many clinical studies. Modulation of hormones secretion and biomechanical changes of the spine and pelvic

girdle, often resulted in overloads within these structures, which contribute to the occurrence of lower spine pain, negatively affecting daily life, professional activity and sleep of pregnant women. One should not forget about psychosocial factors that may affect the degree of pain. Therefore, it may be difficult to explain the factors directly responsible for this ailment and to find the appropriate treatment of lumbar pain in pregnant women (Starzec, 2017).

It should be emphasized that application of special therapeutic methods, selected individually according to the condition of the patient, successfully releases the pain and improves the quality of life among pregnant women. Pharmacological treatment, although effective, is not common in this group of patients. Fortunately, physiotherapy offers many therapeutic methods for treatment of lumbar pain, which are effective and safe for mother and child. These methods include: classical massage, trigger point therapy, acupuncture, hydrotherapy and kinesiotherapy. Thanks to the application of appropriate methods of treatment, the functioning and well-being of the pregnant woman is improved, which positively influences the quality of life of the future mother.

Besides physiotherapy treatment of pregnant women, the education of them is important to explain that the low back pain could not be stated as a natural consequence of pregnancy, and that avoiding physical activity during normal pregnancy often leads to the intensification of pain symptoms. It should be emphasized that among all women who decided to seek help from a doctor or physiotherapist, as much as 70% of them reported the release of pain and an improvement of functional status, which persisted even for the rest of the pregnancy period (Chaitow, 2015; Miksza, 2017; Starzec, 2017).

Aim of the study

The aim of the study was to compare the influence of classical massage and water exercises on the functioning and the affliction of the

lumbar spine among pregnant women. Lower spine pains are very common among pregnant women, and determining which of the therapeutic methods will have a better therapeutic effect will help to plan the process of the lumbar spine pain treatment among pregnant women more effectively in the future and encourage them to do so.

Description of the research group and research methods used

The study was conducted at the pool of the AGH University of Science and Technology, at 4 Jana Buszka St. in Kraków, at Com-Com Zone Prokocim, at 29 Kurczaba St. in Kraków and other locations convenient for pregnant women, during a four month period (from January to April) in 2019. Pregnant women suffering from pain of the lumbar spine, being in the second and third trimester of pregnancy participated in the study. The inclusion criteria were as follows: normal course of pregnancy, approval of the doctor taking care of the pregnant women, and written conscious consent of the participants. The prevalence of pain resulting from a reason other than pregnancy, the use of analgesics or other measures of fighting pain during the examination, e.g. acupuncture, kinesiotaping, as well as failure to meet any of the above criteria for inclusion, was associated with the inability to participate in the examination or its interruption.

The research involved 40 women ($n=40$), divided into two 20-person groups. The participants of the first group were subjected to a classical massage treatment of the low (lumbar) back, whereas the second group of women underwent water exercises. Allocation of participants to the therapeutic group depended on their health condition, previous experiences and willingness to participate in a given form of therapy. Pregnant women who took part in the swimming pool classes before becoming pregnant and those who were interested in water exercises were allocated to the second group (with water

Table 1. Characteristics of the whole group of pregnant women participating in the research (own source)

Feature	All participating pregnant women						
	Min. value	Median	Max. value	Mean	SD	Q1	Q3
Age [years]	21	25.5	35	–	–	23.5	32.5
Pregnancy week [weeks]	14	28	33	–	–	24.5	32
Number of pregnancies	1	1	4	–	–	1	2
Weight before pregnancy [kg]	48	–	90	67.68	10.71	–	–
Current weight [kg]	59	–	99	76.85	10.99	–	–
Height [cm]	156	–	187	169.38	6.38	–	–
BMI before pregnancy	17.85	–	30.82	23.56	3.34	–	–
Current BMI	21.20	–	34.42	26.78	3.46	–	–

therapy treatment). The remaining participants were benefited with massage therapy (group 1). There were no significant differences between both groups in terms of reported lumbar pain intensity, age, trimester of pregnancy, body weight or height and BMI (Table 1).

As many as 30 patients from all pregnant women participating in the study, declared professional and sporting activities (studies, office work, physical work, aerobics, swimming) before becoming pregnant, however, during pregnancy some of them gave up their duties and activities, largely due to lumbar spine pain (8 of them were on sick leave). However, some of office workers continued their sports activities during pregnancy up to the 6th month, despite the pain they felt.

The classic massage was performed by the researcher at the place of residence of the patients, 2–4 times a week. The patient was lying on her side, mainly on the left one. This position is more beneficial for the patients and was much more often chosen by the examined pregnant women. Worth noting is that the body's position on the left side prevents pressure of the inferior vena cava by the fetus and the enlarged uterus without causing the heart and breath to accelerate.

A shallow breathing and increased heart rate may cause anxiety and apprehension of the pregnant woman prior to the procedure, making it impossible or even discouraging her from performing subsequent procedures (Lewandowski, 2012). Some ladies changed the side they were lying on during the procedure. The treatment lasted from 15 to 25 minutes, depending on the patient's mood, feelings and tolerance of lying on the left or right side. Each pregnant woman participated in 10 massage procedures of the lower back region, including the gluteal muscles, where stroking, rubbing and rolling techniques were applied. The methodology of treatment is presented in Table 2 and Fig. 1.

The patient qualified to the second group (20 women) attended Aqua Yoga classes for pregnant women or Aqua Aerobique classes in locations convenient for them. The frequency of water exercises was 1 to 2 times a week. The methodology of treatment is presented in Table 3.

The swimming pool training consisted of 3 parts: a short warm-up lasting several minutes, the main part and the final part, which aimed at stretching, relaxing and oxygenating the body. Equipment, such as balls, boards and pool noodle, were used.

Table 2. Methodology of performing classical massage during pregnancy (Lewandowski, 2012)

Classic massage characteristics	
Patient's position	on the side, mainly on the left
Treatment duration	15–25 min
Frequency of treatments	2 to 4 treatments per week
Number of treatments	10
Location	lumbar-sacral section, gluteal muscles
Techniques used	stroking, rubbing, rolling

Before and after the application of a series of treatments of a given therapy (10 massages or 10 water exercises), each pregnant woman participating in the study underwent the following examinations to assess her current state of health:

- The active mobility of the lumbar spine in the sagittal plane was measured twice using a goniometer and the better result in a given sample was taken into account.
- Determination of pain in the lumbar spine using the VAS scale.
- Before and after the therapy, the respondents completed a questionnaire assessing

lumbar spine pain and its influence on everyday functioning.

The examination of the active range of lumbar motion in the sagittal plane was carried out by means of a goniometer whose axis was positioned on the iliac plate at the height of the spinous process of the L5 vertebrae, the movable arm ran along the torso and the immobile arm was positioned in parallel with the ground. The patient was leaning forward and backward (Hueter-Becker, 2018; Skolimowski, 2012).

An analogue visual scale (VAS) was used to assess the incidence and intensity of pain. This

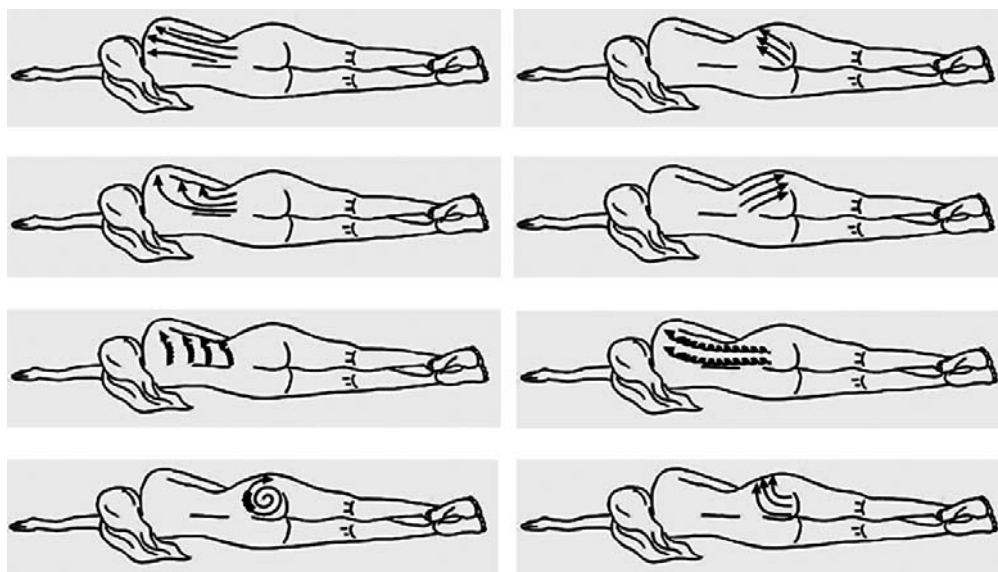


Fig. 1. Massage of pregnant women in the spine and gluteal muscles (Lewandowski, 2012)

Table 3. Methodology of exercise in water depending on the trimester of pregnancy (Redl-Pieprzycza, 2010)

Exercise characteristics	Pregnancy trimester	
	II	III
Duration	Approx. 45/50 min	Approx. 30/35 min
Rest	Small number, short	Frequent, longer
Frequency of exercises	1 or 2 times a week, depending on the patient's mood, between classes, minimum a break day	
Number of treatments	10	
Type of exercises performed	<ul style="list-style-type: none"> ■ Breathing, mainly diaphragmatic breathing, learning different ways of breathing used during the birth phases ■ Coordination preparing for childbirth ■ Strengthening and stretching the abdominal muscles and the back in the lumbar region ■ Stretching the perineal muscles ■ Improving circulation and muscle pump ■ Increasing mobility of the spine and peripheral joints ■ Evening out the excessive lumbar lordosis ■ Relaxing spinal muscles ■ Swimming in backstroke style 	
Number of repetitions	Approx. 20 repetitions	Approx. 10 repetitions
Exercise pace	Average	Slow
Performance method	Rhythmically, smoothly	Easy, smoothly

diagnostic method consists in marking a point on a 10 cm section, corresponding to the patient's current pain; the beginning of the section means no pain and the end of the section refers to the strongest pain that can be imagined (Chaitow, 2015; Skolimowski, 2012).

The last method of verifying the condition of a pregnant woman was a questionnaire, prepared by the researcher. The questionnaire, filled in by the surveyed women, consisted of a certificate as well as single- and multiple-choice questions to be completed on the basis of the current state of health and the existing ailments. The questionnaire included the previously mentioned VAS scale.

Statistical analysis

The results were analyzed using Microsoft Office Excel 2003 and Statistica 13 spreadsheets. Statistical methods were used: W. Shapiro-Wilk's test, t-student test for dependent

groups or Wilcoxon's pairs test, depending on whether the distribution of the researched variables presented normal distribution. The significance level was determined as $p < 0.05$.

Results

The influence of the applied therapies on subjective pain sensation

After the completion of each treatment's cycle of treatments (massage or exercises in water), both groups of women reported a reduction in pain in the lower spine.

Before the treatment 70% of the women subjected to massage treatment and 60% of participants of water exercises declared pain of the lumbar spine occurring every day. In the remaining responders this pain occurred from 2 to 3 times a week or occasionally.

At the end of the massage therapy, the percent of pregnant women experiencing daily pain decreased to 15%. The rest of women

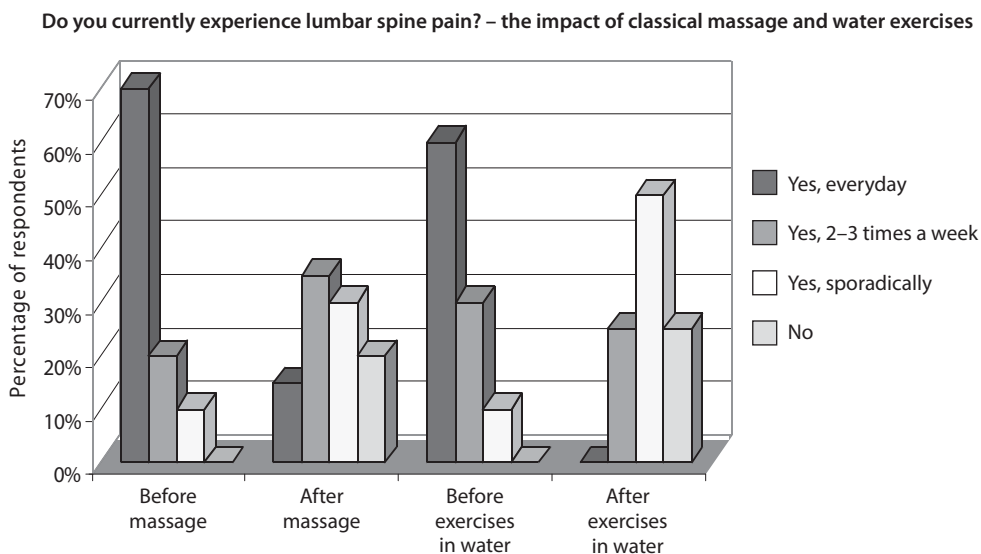


Fig. 2. The influence of classical massage and water exercises on the occurrence of pain in pregnant women ($p < 0,05$) (own source)

taking part in the massage therapy reported lumbar pain occurring 2 to 3 times a week or less frequently.

After completion of the water exercises (10 series), none of the respondents complained about everyday spinal pain, which appeared sporadically ($p < 0,05$) (Fig. 2).

Classical massage and exercises in water also influenced the night pain of lumbar spine. In the group of pregnant women subjected to massage 20% declared a night pain before the treatment, whereas after series of massage the percent of women reporting, the night-time pain of the spine was 5%.

In the group using water exercises, only 5% complained about the night-time pain of the spine and this value did not change after the therapy.

Before the treatment the experience of 24-hour spinal pain, occurring every day was reported by 55% of participants of water exercises and by 20% of women from the massage group. At the end of activities the participants of water therapy less frequently complained about 24-hour spinal pain (decrease from 55% to 20%); however, massage did not reduce the

number of women experiencing 24-hour spinal pain ($p < 0,05$) (Fig. 3).

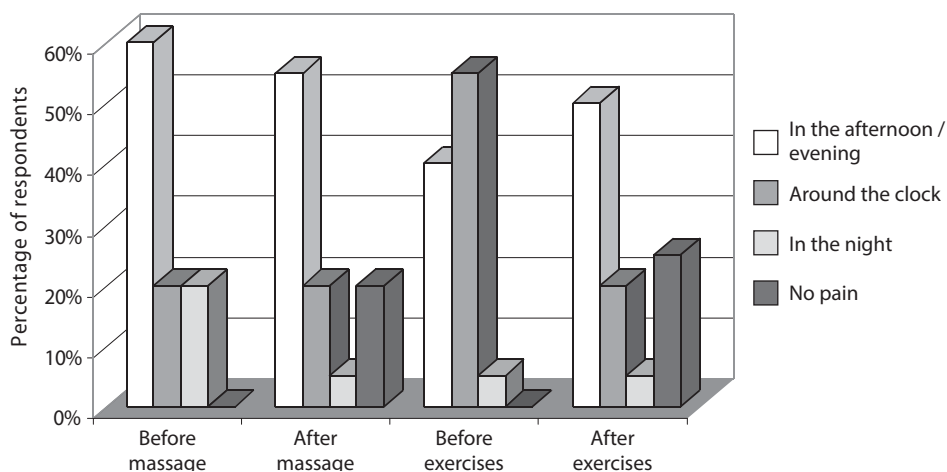
The initial intensity of pain assessed on the VAS scale in both groups was similar and averaged 6 points on the VAS scale in the group with massage and 6.5 points in the group exercising in water. After the therapy, this value dropped to 3.5 and 3 points, respectively, in the group with massage and in the group participating in water exercises, which may prove the effectiveness of both treatments ($p < 0,05$) (Table 4).

Effects of the applied therapies on lumbar spine mobility in the sagittal plane

Before the therapy, reduced mobility of the lumbar spine in the sagittal plane in both directions was found in all pregnant women, as compared to the normal mobility range, that was 85° (100%) at the forward flexion and 30° (100%) at the extension (Skolimowski, 2012).

The mean range of lumbar spine flexion before classical massage was 51° that was 60% of the normal value, and after the massage this flexion increases to 54.9° that was 64.7% of normal value (increase by 4.7%). The mean range

When do you most often experience lumbar spine pain? – the impact of classical massage and water exercises

Fig. 3. Pain sensation during the day – before and after treatments ($p < 0,05$) (own source)Table 4. Classical massage and exercises in water and the VAS scale – mean and standard deviation ($p < 0,05$) (own source)

Pain intensity [VAS]	Classical massage [%]		Exercise in water [%]	
	Before the therapy	After the therapy	Before the therapy	After the therapy
Mean	6	3,5	6,5	3
Standard deviation	1.58	2.45	1.29	2.16

of extension in this group was 15.9° before and 18° after therapy (53.3% and 60% of the normal value, respectively, increase by 6.7%) (Fig. 4).

In pregnant women attending water exercises the mean range of lumbar spine flexion before exercises was 52° that was (61.2% of normal range) and after the therapy this flexion increases to 57.9° that was 68.2% of normal value (increase by 7%). The mean range of extension in this group was 13.9° before and almost 17° after series of water training (from 46.6% to 56.6% of the norm, increase by 10%) ($p < 0,05$) (Fig. 4).

Effects of the applied therapies on the functional state

When assessing the functional condition of pregnant women, the influence of pain and mobility of the spine on basic life activities

such as: care (e.g. washing and dressing), moving, sitting, standing and sleeping, was taken into account. Both classical massage and exercises in water have improved these parameters. The results obtained are presented in Table 5 ($p < 0,05$). Patients who applied classical massage were found to move and hold a standing position more easily. In turn, the applied exercises in water, in the opinion of the patients, worked out better with regard to care procedures, sitting and sleeping. Due to the different results, it is not clear which treatment is more effective in improving the physical condition of pregnant women.

Discussion

Pain ailment of the lumbar spine in pregnant women is defined as repeated or continuous

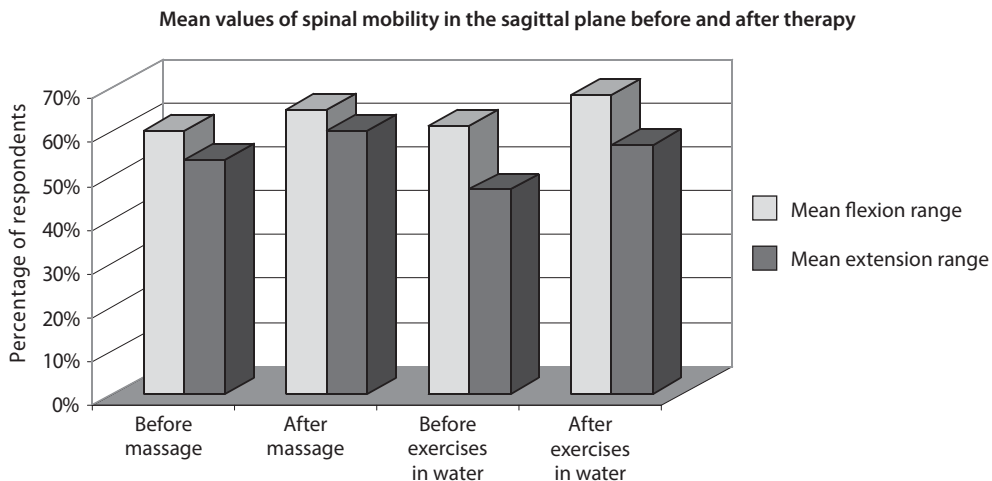


Fig. 4. Goniometric measurement of lumbar spine mobility in pregnant women before and after therapy ($p < 0,05$) (own source)

pain in the lumbar-sacral region of the spine and pelvis lasting for at least a week. Although this ailment is very common, the etiopathogenesis of pain ailment of the lumbar spine in pregnant women is not fully explained. Predisposing factors for pain include: change of spinal curvature in the thoracic and lumbar segments, shift of the center of gravity, ligament relaxation and fluid retention in adjacent tissues (ElDeeb, 2016; Field, 2008). With the development of a pregnancy, the painful conditions that occur are more severe and even appear in hitherto painless areas of the body, has a negative impact of the functional capacity and quality of life of pregnant women.

This research examined the effect of classical massage and water exercises on pain and functional condition of women in the second and third trimester of pregnancy. Before the treatments, all participants reported the reduce of functional condition caused by lumbar pain that was expressed as difficulties in sitting, walking and standing. Similar results were obtained in previously published papers, showing that the intensity of pain symptoms was observed during standing, sitting, flexing the trunk forward (lifting objects) and during movement (Fast, 1987; Gilleard, 2002).

It has also been proven that in the pregnant women change of body position from sitting to standing strongly increased pressure on hip and knee joints and could make this movement difficult especially at the end of pregnancy. Another activity that could be difficult for pregnant women and required more effort is rising the arms up (Gilleard, 2002).

Recently published studies have shown that the reduction of spinal mobility in pregnant women has hindered basic life functions (Przewłocka-Gągała, 2016). Taking into account the results of our own research and analyzing publications over the last few decades, we can conclude that lower spine pain during pregnancy is still a current and very complex problem, worsening the already reduced functional capacity of pregnant women due to pregnancy development.

Physical activity reduces the intensity of pain, improves the motor skills of pregnant women, increases glucose tolerance and prevents the occurrence of overweight in pregnant women. During pregnancy, it is recommended to practice physical exercise (walking, cycling) for about 30 minutes, 3 times a week, with an intensity of 60–90% of the maximum heart rate and stretching once or twice a week

Table 5. Effect of classical massage and water exercises on the functioning of pregnant women (own source)

Life functions to be evaluated	Classical massage [%]		Difference [%]	Exercise in water [%]		Difference [%]
	Before the therapy	After the therapy		Before the therapy	After the therapy	
Care activities						
Because of the pain, I cannot wash or dress without the help of another person.	5	0	-5	0	0	0
Usually washing and dressing causes slight pain.	65	50	-15	60	35	-25
I don't feel any pain in my lumbar spine while washing and dressing.	30	50	+20	40	65	+25
Walking						
Because of the pain, I can't walk on my own, I need help from another person.	5	0	-5	0	0	0
Because of the pain, I can walk on my own for 5–10 minutes.	40	20	-20	50	35	-15
I don't feel any pain in my lumbar spine while walking.	55	80	+25	50	65	+15
Sitting						
Because of the pain, I can't sit for more than 5–10 minutes.	10	0	-10	0	0	0
Pain allows me to sit no longer than 30 minutes.	70	65	-15	85	60	-25
I don't feel any pain in my lumbar spine in a sitting position.	20	35	+25	15	40	+25
Standing						
I can't stand more than 10–15 minutes as the pain increases.	60	35	-25	35	20	-15
I feel a slight pain while standing, but it doesn't increase.	30	30	0	50	60	+10
I don't feel any pain when I stand, I can stand as long as I want.	10	35	+25	15	20	+5
Sleep						
Because of the pain, I have trouble falling asleep and/or often wake up at night.	45	35	-10	65	50	-15
While lying in bed, I feel a slight pain, but it does not affect the quality or length of sleep.	15	10	-5	15	15	0
I don't feel any pain lying in bed, I have no trouble sleeping.	40	55	+15	20	35	+15

(Filhol, 2014; Maitre, 2013). The evidence of the positive effect of physical exercise was the reduction of spinal pain intensity and improvement of functional efficiency published by Boguszewski D. et al. (Boguszewski, 2014), who evaluated the effect of relaxation and stabilization exercises on the intensity of lower spine pain in women in advanced pregnancy.

In the pregnant women carried out after classical massage and water exercises, we observed a reduction in pain intensity and improvement of their physical condition. The positive effect of the massage on the functional condition of pregnant women has already been reported before, stating – after a series of these treatments – the reduction of pain in the lower extremities and back and decreasing the feeling of anxiety, fear and anger (Boguszewski, 2012; Field, 2008). Unfortunately, there are few publications on the analgesic and functional massage effects in pregnant women, as well as on the impact of exercise in water; much more often, there are works on their relaxing and antidepressing effects. Therefore, it is all the more important to continue the research in this group of patients, not only during pregnancy, but also during childbirth and later on, during the postpartum period.

Exercise in water, just like a massage, not only has a beneficial effect on functional efficiency, reducing muscle tension and improving the range of movement in the joints, but also has a soothing effect on the nervous system. It was observed that due to participation in aqua aerobics activities the pain of the lumbar spine and pelvic girdle decreased and the mood of pregnant women improved, making them more optimistic about the upcoming delivery date (Redl-Pieprzyca, 2010; Valim, 2011).

In conclusion, it can be stated that many factors are responsible for the appearance of spinal pain in pregnant women and there are many ways to treat the occurring lumbar pain. However, despite the easy access, pregnant women are unaware of their benefits. Classical massage as well as exercises in water, which

were used in this research, have proven to be effective in fighting pain and improving the functional condition of pregnant women. It is not possible to indicate unequivocally which of these treatments is more effective, so every pregnant woman in the choice of therapy should be guided by her previous experiences, her own interests and the recommendations of the gynecologist.

Conclusions

The use of classical massage and exercises in water has proven to be an effective and safe analgesic therapy recommended for pregnant women suffering from lower spine pain.

A small but statistically significant advantage of exercises in water over classical massage has been shown in the reduction of pain in the lumbar spine.

Both therapies have improved the physical condition of pregnant women, making everyday activities easier.

Pregnant women from both groups stated that the quality and length of their sleep has improved after the therapy.

Literature

- Boguszewski D., Sałata D., Adamczyk J.G., Białoszewski D. (2014). Ocena skuteczności ćwiczeń relaksacyjnych i stabilizacyjnych w minimalizacji bólu lędźwiowo-krzyżowego odcinka kręgosłupa u kobiet ciężarnych. *Prz Med Uniw Rzesz Inst Leków*, 2: 152–161.
- Boguszewski D., Sałata D., Adamczyk J. et al. (2012). Ocena skuteczności klasycznego masażu wykonywanego przez partnera w łagodzeniu zespołów bólowych dolnego odcinka kręgosłupa u kobiet ciężarnych. *Fizjoter Pol*, 4(12): 379–387.
- Chaitow L., Fritz S., Dziak A. (red.) (2015). *Masaż leczniczy. Bóle dolnego odcinka kręgosłupa i miednicy*. Elsevier Urban&Partner publishing house: 2–14, 25–32, 42, 98–103.
- ElDeeb M.A., Hamada A.H. et al. (2016). The relationship between trunk and pelvis kinematics during pregnancy trimesters. *Acta Bioen Biomech*, 18(4): 79–85.
- Fast A. et al. (1987). Low back pain in pregnancy. *Spine*, 12(4): 620–624.

- Field T., Figueriedo B. et al. (2008). Massage therapy reduces pain in pregnant women, alleviates prenatal depression in both parents and improves their relationships. *J Bodyw Mov Ther*, 12: 146–150.
- Filhol G., Bernard P., Quantin X. i wsp. (2014). Activité physique durant la grossesse: point sur les recommandations internationales. *Gynécol Obst Fert*, 42: 856–860.
- Gilleard W.L. et al. (2002). Effect of pregnancy on trunk range of motion when sitting and standing. *Acta Obstet Gynecol Scand*, 81: 1011–1020.
- Gross A.G., George J.W., Babczyk D. (transl.) (2017). Zaburzenia ortopedyczne u kobiet w ciąży. *Med Prakt Gineko Położ*, 6(112): 63–66.
- Hueter-Becker A., Doelken M.; Szczegielnik J. (red.) (2018). *Badanie kliniczne w fizjoterapii*, Edra Urban&Partner: 54–56, 194.
- Jaworek J., Barłowska-Trybulec M., Lisowska S., Zarembo M., Porębski Ł., Leja-Szpak A. (2018). Wpływ wysiłku fizycznego w wodzie na samopoczucie ciężarnej kobiety. *Sztuka Leczenia*, 2: 21–29.
- Lewandowski G. (2012). Masaż u kobiet w okresie przygotowania do ciąży, w czasie ciąży i w połogu – sposoby wykonywania, wskazania i przeciwwskazania. *Ginekol Dypl*, 43–48.
- Maitre C. (2013). Sport et grossesse: une nécessaire prescription. *Sci Sport*, 28: 103–108.
- Majchrzycki M., Mrozikiewicz P., Kocur P. et al. (2012). Dolegliwości bólowe dolnego odcinka kręgosłupa u kobiet w ciąży. *Ginekol Pol*, 81: 851–855.
- Miksza A., Smolarek N., Chmaj-Wierzchowska K., Zgrzeba L. (2017). Dolegliwości bólowe okolicy lędźwiowo-krzyżowej u kobiet w ciąży. *Pol Prze Nauk Zdr*, 1(50): 115–122.
- Przewłocka-Gągała M. (2016). Ocena stanu funkcjonalnego kobiet w ciąży z dolegliwościami bólowymi odcinka lędźwiowego kręgosłupa (in): Paprocka-Borowicz M., Jarzab S. et al.: *Interdyscyplinarność współczesnej rehabilitacji*. Volume 2: 75–84.
- Redl-Pieprzyca I., Kisiełewska A. (2010). Cięża i połów. Ćwiczenia w wodzie. *Publication JET*: 6–21.
- Sklempe Kocic I., Ivanisevic M., Uremovic M., Kocic T., Pisot R., Simunic B. (2017). Effect of therapeutic exercises on pregnancy-related low back pain and pelvic girdle pain: secondary analysis of a randomized controlled trial. *J Rehabil Med*. 49: 251–257.
- Skolimowski T. (2012). *Badanie czynnościowe narządu ruchu w fizjoterapii*, Academy of Physical Education in Wrocław: 122.
- Skorupińska A., Sekuła N. (2017). Zmiany zachodzące w organizmie kobiety w ciąży. *Kosmetologia Estetyczna*, 3(6): 283–286.
- Starzec M., Truszczyńska-Baszak A. (2017). Ból lędźwiowo-miedniczny w ciąży: klasyfikacja i diagnostyka w świetle europejskich wytycznych i przeglądu piśmiennictwa. *Rehabil Med*, 21(3): 58–63.
- Szpala M., Skorupińska A., Kistorz K. (2017). Występowanie zespołów bólowych kręgosłupa – przyczyny i leczenie. *Pomeranian Journal of Life Science*, 63(3): 41–47.
- Vallim A.L., Osis M.J., Cecatti J.G., Baciuk E.P., Silveira C., Calvalcante S.R. (2011). Water exercises and quality of life during pregnancy. *Reprod Health*: 8–14.

Manuscript received: 17.12.2019 / manuscript accepted: 30.03.2020

Praca zgłoszona do czasopisma: 17.12.2019 / praca zaakceptowana do druku: 30.03.2020