

Specialized kinesitherapy program for core stabilization and low back pain in women sports

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Abstract

Low back pain is a common problem in athletes, especially women who practice strength sports or high impact sports. From a pathokinesiological point of view, core instability inevitably leads to pain and impaired function in the lumbar spine. Various studies have been conducted in an attempt to determine effective methods for conservative treatment of musculoskeletal dysfunction in the back. The majority of studies do not report high evidence or solution to the problem in long term. The present research aims to follow the effect of hypopressive exercise program and myofascial techniques for low back pain in women who practice strength sports.

Methodology: The methodology of the study includes conducting functional studies and tests – Merl d'Aubigne and Visual Analogue Scale (VAS) for pain assessment; Shober and Lasseg test to evaluate range of movement of the lumbar region and manual muscle testing (MMT) for abdominal and back musculature. A contingent of 42 women who practice strength sports were recruited according to the indications of experimental therapy and randomly divided in two– experimental group (EG N=22) and control group (CG N=20). The complex therapy for the EG includes – Hypopressive exercise, position-release techniques (PRT) and muscle-energy techniques (MET). The CG received routine kinesitherapeutic exercise for abdominal and back muscle and massage. Every participant received four procedures per week for 10 consecutive weeks. Measurements and tests were done before and after treatment. **Results:** Mean values of Merl d'Aubigne modified scale for dynamic pain assessment show 3.46 ± 0.6 points before, 0.82 ± 0.73 points after therapy for EG, and 3.5 ± 0.61 points and 2.2 ± 0.62 points respectively for the women of the CG. Mean values of pain threshold measured before the complex therapy for women of EG was 7.13 ± 0.94 mm before and 2.68 ± 0.94 mm after treatment and 7.70 ± 0.86 mm and 5.65 ± 0.67 mm for the women of CG. Shober test initially shows 12.52 ± 0.14 cm for EG and 14.93 ± 1.82 cm for the CG and finally increase to 12.8 ± 1.36 cm and 14.13 ± 1.15 cm respectively. MMT shows much stronger abdominal muscles in women of the EG. Data demonstrates statistically significant differences after treatment ($p < 0.05$).

Conclusions: Pain symptoms decrease significantly, and the range of movement and functionality of the lumbar region improves. The abdominal and back muscles are much stronger which provides stability of the spine in the area. In addition to treatment, the therapy can be successfully used to prevent recurrences of the symptoms especially in women who practice strength sports.

Key words: physiotherapy, abdominal muscle, back pain, treatment

Introduction

Low back pain is a frequent and high-cost problem faced by the majority of people at some point in their lifetime (Brandao Pinto de Castro et.al. 2020). The prevalence of low back pain in adults has been well documented with a lifetime prevalence of over 70%. Non-specific low back pain is described as a diagnosis of exclusion, where pain caused by a suspected or confirmed serious pathology or presenting as a radicular syndrome have been ruled out (Akhtar et.al, 2017).

According to the doctors, the dominant cause of the development of the pain in the lumbosacral spine is the degeneration of intervertebral discs (Bivalentsev, et.al. 2017). It is known that back pain is quite common not only between the physically inactive populations but also between the athletes. The mechanisms of their presence have not been sufficiently studied (Fett, Trompeter, & Platen, 2017). Besides, the athletes spend most of their time in training and competition, which leads to a rather high level of mechanical stress and stress on their spine (Botov et.al. 2018).

It turns out that the problem is also quite common in women doing strength sports. If the abdominal muscles are not well developed and do not provide the necessary stabilization, the lumbar region of the spine is at serious risk of dysfunction and pain. In addition to lumbar pain, women who practice strength sports also often suffer from pelvic floor muscle dysfunction. Hypopressive gymnastics is a very effective method to deal with this problem, but it is not the subject of this study.

The strength of the deep abdominal muscles to ensure the stability of the core is extremely important for the prevention of lumbar pain in sports women.

There are number of studies on the effect of using different physiotherapy methods and devices that would have a positive effect on limiting factors (pain, stiffness, reduced ability to work, etc.) and would improve the quality of life of such patients. In recent years, complaints of back pain have increased. Studies show that it may be related to modern lifestyle (Mitova et.al, 2020; Mitova et.al, 2020). But in view of the methodological heterogeneity of the studies the rates of the back pain which the athletes have can vary quite significantly including a description of the exact area of the pain, its duration and intensity (Trompeter, Fett, & Platen, 2017).

There is a high frequency and prevalence of chronic pain syndrome in the spine area including athletes. This significantly worsens their functionality and working capacity. In addition, they report a high intensity of pain, limiting movement and activities of daily living (Stoyanov, 2020).

Different systematic reviews conducted in past decade have raised a significant concern over the role of exercise in management of low back pain, with scarcity of concrete evidence supporting any specific type of exercise; e.g. flexion / extension biased, strengthening of abdominals, McKenzie, stretching or Williams.

Kinesiotherapy uses great number of methods and interventions whose goal is the treatment and functional recovery of the non-specific low back pain. Myofascial techniques leads to an instant pain reduction and better the muscle elasticity. It has great benefits for health and improves the circulatory, muscular, and nervous system but the effect is short term and insufficient.

Therapeutic exercise, also controversial, is currently gaining ground regarding effectiveness in clinical and scientific practice (Bramberg et.al, 2017). There are many approaches concerning active recovery, but there is no clear evidence of a specific protocol. The training of the muscles which give stability to the trunk, as well as that of the pelvic floor muscles, helps improve the often cited low back pain (Bellido-Fernandez et.al, 2018).

One of the outstanding techniques is the *Abdominal Hypopressive Gymnastics* which is becoming increasingly popular. It is about postural exercises, which allow a decrease in pressure in the abdominal, perineal, and thoracic cavities (Avramova, 2020). The hypopressive exercise produces the direct activation of the transverse abdominal muscle and core muscle which allows strengthening the abdominal muscles and stabilizing the spine (Caufriez et.al, 2007). It provides benefits such as strengthening the abdominal muscles, making the lumbar spine and the hamstring muscles more flexible, and rearranging the body posture (Bellido-Fernandez et.al, 2018).

The aim of the present study is to follow the effect of hypopressive exercise program and myofascial techniques (PRT and MET) in women with chronic non-specific low back pain.

Material and Methods

Participants

A contingent of 42 women were included in the study. All they met the inclusion criteria – low back pain for more than 12 weeks, do not receive other treatment, do not present any contraindication for the experimental methodology and kinesiotherapy, age between 35 and 45 years old and no surgical or other invasive intervention for last two years. All they were randomly divided in two experimental and a control groups.

The experimental group (EG) consists 22 women mean age ($\bar{X} \pm SD$) 39.64 \pm 3.13 years. The control group (CG) was formed of 20 women mean age 40.40 \pm 3.32 years.

Functional tests and physiotherapy procedures were performed for the period of January 2019 to March 2020 in the Research Sports and Recreation Center "Bachinovo" South-West University "Neofit Rilski", Blagoevgrad. All participant involved in the research signed a statement of informed consent that was approved by the Ethics Committee of the SWU "N. Rilski".

Test protocol and Instruments

The methodology of the study included functional assessment and tests –; Pain assessment using modified Merl d'Aubigne scale for dynamic pain and Visual Analog Scale of the Pain (VAS). Schober and Lasegue test for assess the range of movement of the lumbar region. MMT were used for muscle strength measurement.

Merl D'Aubigne scale - for examination of dynamic pain, we used Modified Merl d'Aubigne Scale. This is a subjective scale, which was used to assess dynamic pain - pain when moving according to Todorov T., 1989. The strength of pain is determined in 6 degrees with the numbers from 0 to 5, where at 0 - no pain, free movement, and in grade 5 there is severe pain at the beginning of the movement, blocking it, a weak effect of analgesics.

VAS is a subjective scale from 0 to 10 for assessment of pain threshold, where 0 is no pain, and 10 is unreportable pain. Testing were done after experimentally induced palpable pain (measurements were done at the same pressure, the same person) in TT and evaluated of the patient.

Schober test is a functional test used to measure the range of movement in the lumbar spine. From L5, 10 cm are measured in the cranial direction. The patient performs flexion of the body. At full range of movement the distance between the two points increases by about 3.5 - 4 cm, when there is limited mobility the distance increases by 1 - 2 cm or does not change in more serious pathology.

Lasegue test – the therapist performs passive flexion in the hip joint. Pain in the lumbar segment positive test. It goes in degrees. In the case of a root lesion, it is provoked by low back pain at a smaller angle of

flexion (about 30-40 °). At an angle above 70 ° the pain can be provoked by hip joint, lumbar muscles and sacroiliac joint. Testing is always performed first for the healthy leg.

MMT - We used the standard manual muscle testing to assess muscle weakness of the back (m. erector spinae, m. iliocostalis, m. longissimus dorsi, m. spinalis, m. quadratus lumborum) and abdominal muscles (m. rectus abdominis, m. obliquus externus et internus abdominis). Values of MMT were obtained before kinesitherapy and 8 weeks after application of specialized techniques.

Functional assessment were done before and after kinesitherapy for both groups.

Procedure:

The complex therapy for the EG includes – Hypopressive exercise, position-release techniques (PRT) and muscle-energy techniques (MET).

Hypopressive exercise are postural techniques that aim to reduce the pressure in the abdominal cavity. Their original purpose was for postpartum recovery, but at a later stage they began to be widely used in many other areas of rehabilitation and sports. Their use in gynecological practice is based on the fact that during voluntary contraction of the superficial and deep abdominal muscles, during expiratory apnea, pelvic muscle fibers are activated reflexively. In this way, not only the entire abdominal wall is strengthened and toned, but also the pelvic floor muscles (Alonso-Clavete et.al, 2019; Navarro-Brazales, 2020;). When performing the hypopressive exercise, breathing goes through three phases. The first phase involves deep diaphragmatic inhalation, followed by a second phase of full and slow exhalation, and finally the so-called inspiratory apnea with lifting and dissolving the ribs. In this last phase, a decrease in intra-abdominal pressure occurs. This in turn leads to strong activation of the abdominal muscles (Figure1). Hypopressive gymnastics was applied 4 times a week for 45 minutes, and exercises were performed from different starting positions - standing, four supporting standing and lay down position (Avramova, 2020).

Position-release techniques (PRT) are a non-invasive method, a tissue-sparing method that improves their condition. By "positioning" a single segment of the human body (or the whole body), a certain physiological response to impact is elicited.

Muscle-energy techniques (MET) are defines as mobilization and manipulative treatment, in which the patient actively puts in tension and movement his muscles to perform movement from a specific position in a specific direction against dosed resistance. Muscle-energy techniques are the basis of methods for overcoming muscle imbalance.

The CG received the rutine kinesitherapeutic exercise for abdominal muscle and therapeutic massage. Every participant received 4 procedures per week for 10 consecutive weeks. Each procedure last for 45 minutes.



Figure 1. Hypopressive exercise in different start position

Statistical analysis

The evaluation of research results were realized by statistical and mathematical methods and procedures using Graph Pad Prism 3.0. We used the primary statistics variables like: Median (Mdn), arithmetic mean (\pm), variation range (VR = max - min) standard deviation (Sd). In term to calculate statistically, significant differences we use Wilcoxon for depend quantitative variables and Mann-Whitney test to compare independent quantitative variables.

Results

The primary characteristics of the research contingent are represented on the Table 1. for the EG and on Table 2. for the CG.

Table 1. The primary characteristics of experimental group

Measured values	Experimental group (N=22)
Age (years)	39.64 \pm 3.13
Body weight (kg)	66.36 \pm 6.5
Body height (cm)	171.0 \pm 5.86

Kg – kilogram; cm- centimeters;

Table 2. The primary characteristics of control group

Measured values	Experimental group (N=20)
Age (years)	40.40 \pm 3.32
Body weight (kg)	65.95 \pm 5.34
Body height (cm)	171.1 \pm 5.68

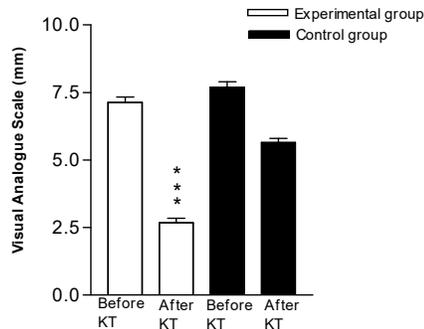
Kg – kilogram; cm- centimeters;

Mean age of the women of the EG were respectively 39.64 \pm 3.13 years. Mean height and weight were as follows 171.0 \pm 5.86cm and 66.36 \pm 6.5kg. (Tab.1).

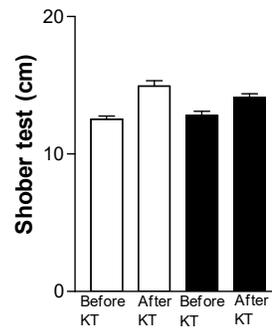
Mean age of the women of the CG were respectively 40.40 \pm 3.32 years. Mean height and weight were as follows 171.1 \pm 5.68cm and 65.95 \pm 5.34 kg (Tab. 2).

Different variables of the Schober test, Lasegue test, Merl d'Aubigne, VAS and MMT were obtain before and after the therapy for both groups and data is represented on Fig. 1.

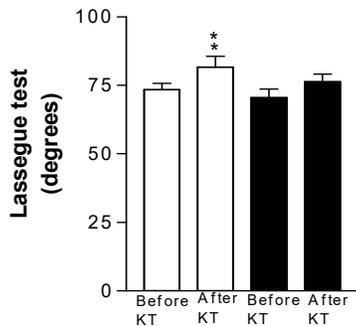
A.



B.



C.



D.

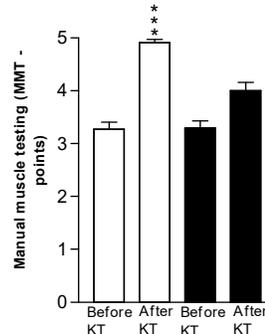


Figure 2. Dynamic of the results of the Visual Analogue Scale (VAS) – A; Schober test – B Lasegue test– C and MMT m. rectus femoris - D for the experimental group before and after treatment - □, and for the control group before and after treatment - ■;

*** Statistically significant differences, Mann-Witney test $p < 0,001$ after complex therapy

**Statistically significant differences, Mann-Witney test $p < 0,03$ after complex therapy

Mean values of the pain threshold measured before and after the author's therapy for the women of the EG were 7.13 ± 0.94 mm. After therapy the pain threshold was reduced to 2.68 ± 0.94 mm for the CG mean values of the pain threshold was 7.70 ± 0.86 mm before and reduced to 5.65 ± 0.67 mm after treatment. Differences between two experimental groups in both in final measurements were statistically significant ($p < 0.05$) (Figure 2. A.) Furthermore, we obtain statistically significant differences comparing data of the measurements of two groups after therapy (Mann Whitney $p < 0.001$). This proves the positive effect of the applied complex therapy (Figure 2. A.).

Mean values of Merl d'Aubigne modified scale for dynamic pain assessment show 3.46 ± 0.6 before and 0.82 ± 0.73 after therapy for EG and 3.5 ± 0.61 and 2.2 ± 0.62 respectively for the women of the CG. The differences between the results of two experimental and CG after treatment, indicate statistically significant differences (Mann Whitney, $p < 0, 001$).

Mean values of the Schober test for the EG, measured before and after the administered complex therapy were 12.52 ± 0.14 cm, 14.93 ± 1.82 cm. For the CG obtained data before and after the administered complex therapy were respectively: 12.8 ± 1.36 cm, 14.13 ± 1.15 cm. The results obtained from the Schober test did not show statistically significant differences between patients from the two study groups (Mann Whitney, $p > 0, 05$) (Figure 2 B.). Lassegue test average values for the EG obtain before, were $73.41 \pm 2.27^\circ$ and $81.74 \pm 3.83^\circ$ after complex therapy. For the CG obtained results were $70.50 \pm 3.14^\circ$ before and $76.25 \pm 2.81^\circ$ after (Mann Whitney, $p < 0, 03$). (Figure 2.C.). MMT were done for three different muscle groups – muscles of the back - m. erector spinae, m. iliocostalis, m. longissimus dorsi, m. spinalis, m. quadratus lumborum and abdominal muscles – rectus and obliquus internus and externus abdominis. The test were done before and 10 weeks after therapy. The results we obtained for the back muscles before treatment for EG were 3.14 ± 0.71 before and 4.73 ± 0.46 at the end. For the CG data shows 2.85 ± 0.75 before and 3.85 ± 0.67 10 weeks after therapy (Figure 2. D.).

MMT of m. rectus abdominis for the EG before and after therapy was respectively 3.27 ± 0.63 and 4.91 ± 0.29 . For the CG before and after therapy was respectively 3.30 ± 0.57 and 4.00 ± 0.73 .

MMT of m. obliquus externus and internus abdominis for the EG before and after therapy was respectively 3.14 ± 0.64 and 4.82 ± 0.39 . For the CG before and after therapy was respectively 2.8 ± 0.7 and 4.05 ± 0.51 . The results shows statistically significant differences (Mann Whitney, $p < 0.03$) (Figure 2.D.).

Discussion

Discussion of the results proves to be a complex task given the fact that there are still not enough conducted and reliable studies on the effect of the use of hypopressive exercises in women who practice strength sports and even fewer studies on the effect of this kind of exercise program for lumbar and lumbosacral pain and musculoskeletal dysfunction (Martin-Rodriguez, 2017).

There have been few studies in this research, in which abdominal hypopressive exercise isolated is used for the chronic low back pain, although it has been used with healthy patients (Caufriez et.al, 2007; Caufriez et.al, 2006; Jaromi et.al, 2012) or with different pathologies (Caufriez et.al, 2011; Rami-Colras, Martrin-Nogueras, 2016). Only two study mentions the use of the Abdominal Hypopressive Gymnastics method for the chronic non-specific low back pain (Torres, Espinosa, 2009; Bellido-Fernandez, 2018).

This study assesses effectiveness of abdominal hypopressive gymnastics and myofascial techniques and the combination of both to decrease pain and lumbar disability while increasing joint mobility and quality of life in women with chronic non-specific low back pain who practice strength sports. Over time, no matter how highly developed the muscles, lumbar region begins to suffer from overload and overexertion and begins to appear pain and musculoskeletal dysfunction. From a pathokinesiological point of view, it is clear that core stabilization is extremely important in these women. Hypopressive gymnastics is a method that contributes to the strengthening of the deep abdominal muscles, provides core stabilization, and thus leads to stability in the lumbosacral region. In this way the load in the area is reduced and the pain symptoms, mobility and impaired function are improved. The results we obtained in this pilot study confirm these claims.

Data obtained of VAS and Merl d'Aubigne scale show significantly better results for the EG women. Pain relief much more from 7.13 ± 0.94 mm (very strong, limiting pain) to 2.68 ± 0.94 mm (quite light with almost no pain). Pain symptoms are significantly reduced, both static and dynamic pain assessed by the scale of Merl D' Aubigne. One of the few recent studies on this topic, reported that a specialized kinesitherapy program consisting of 40 sessions of 40 minutes of hypopressive gymnastics leads to improved elasticity of the lower limbs and lumbar spine (Bellido-Fernandez et.al. 2018). In the present study, we performed 40 procedures of 45-minute the procedure on women from both study groups. The obtain data demonstrate similar results in terms of muscle strength and elasticity of the abdominal, back muscles and the muscles of the lower limbs of the women.

In addition to chronic lumbar pain, women who practice strength sports often suffer from pelvic floor muscle dysfunction. The effect of hypopressive gymnastics in such problems has been proven, but is not the subject of this study. In our previous study, we prove that performing a specialized combined kinesitherapy program of hypopressive exercises and Kegel exercises leads to strengthening of the abdominal muscles and pelvic floor muscles. This in turn significantly improves their function. In addition, an improvement in the muscular elasticity of the lower extremities and the lumbar spine is reported as a secondary positive effect (Avramova, 2020).

Results of a study conducted by Akhtar et.al. showed that both exercise program proved to be effective in management of low back pain statistically but clinically there was greater pain reduction in core stabilization exercise group as compared to routine physical therapy exercise group. A pilot randomized controlled trial conducted by Areudomwong et al. measured the effect of 10 weeks core stabilization program on pain presentation pattern, disability and activation of trunk muscles in subjects with clinical instability of the lumbar spine. The subjects in the CG were treated with stretching of the trunk muscles and hydro collator therapy. Results of their study indicated decreases in pain and disability in both treatment groups similar to the findings of this study (Areudomwong et.al, 2012).

After proceeding 40 procedures for 45 minutes, pain symptoms significantly reduced in women of the EG (n=22). Lower limb flexibility also improve for women where specialized kinesitherapy program was applied. This, in our opinion, and a number of other studies is due to the combination of myofascial techniques fo the lumbar spine region and hypopressive exercise.

In comparison with the study of Torres and Espinosa, our results are closer to an effective result, because we carried out fewer treatment sessions and they lasted a shorter time. Caufriez et.al. show effectiveness in the body posture by increasing the trunk self-stretching and strengthening the paravertebral muscles, but not according to Schober's test values; this may be because they were subjects with a normal parameter in lumbar spine mobility. However, in our study we did not obtain statistically significant differences of Shober's values between women of control and EG. Therefore, the Hypopressive exercise program appears to have an impact on spine flexibility in women who practice strength sports. On the other hand, Lassegue test data show better results for the women of the EG. So, we obtain a significant improvement in terms of lower limb flexibility ($p < 0,05$). Same results are reported in study of Bellido-Fernandez et.al.

MMT data shows significant differences between patients of EG and the CG. After the course of treatment, the entire abdominal wall of the women in the EG and the back muscles were much stronger and toned than those of the women in the CG. Special hypopressive exercises strengthen the particularly deep abdominal muscles, which provides core stabilization and leads to a reduction in pain symptoms and better functionality of the lumbar spine. Other studies, such as Lin's et.al and Pappas et.al. have looked at the effects of Pilates on patients with chronic non-specific low back pain. In patients with chronic low back pain, Pilates showed significant improvement in pain relief and functional enhancement. Other exercises showed effects similar to those of Pilates, if waist or torso movement was included and the exercises were performed for 20 cumulative hours (Lin et.al, 2016; Pappas et.al, 2013).

Study of Russo et.al show that restorative neurostimulation to cause contraction of the lumbar multifidus holds promise as a new and different approach to treating primarily nociceptive mechanical chronic LBP (Russo et.al, 2017). Obtain data in another study of Akhtar show that core stabilization exercise is more effective than routine physical therapy exercise in terms of greater reduction of pain in patients with non-specific low back pain. Exercise intervention programs involving either muscular strength, flexibility or aerobic fitness is beneficial for chronic non-specific low back pain but not acute low back pain. Non-specific acute low back pain patients recover in 4–6 weeks with or without a treatment, and exercising should be avoided to reduce the swelling of the affected area (Gordon, Bloxham, 2016).

Limits of the Study:

- (1) This is a pilot study having a small sample, with lack of sample size calculation; its generalizability and applicability are difficult.
- (2) There is a lack of standardized intervention parameters.
- (3) There is a need of more studies on this topic in order to achieve a greater level of evidence.

Conclusion:

As a result of the study, several main conclusions can be drawn:

Combined abdominal hypopressive exercise and myofascial techniques protocol applied in athletes women with low back pain could improve the lumbar disability, reducing significantly pain levels. On the other hand the pain reduction increase flexibility of the lumbar spine in the short term.

Hypopressive gymnastic increase core stabilization and better the lumbar dysfunction and symptoms and could be used to prevent lumbar lesions. In addition, it turned out to be more effective in reducing symptoms caused by low back pain than the application of a routine kinesitherapy.

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Conflicts of interest: There have been no conflict of interest situations in the course of the research and the publication of the manuscript. The experimental work meets the ethical requirements concerning research and involving the participation of people asset for the Helsinki Declaration.

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