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Original Article

Effectiveness of hypopressive gymnastics in women with pelvic floor dysfunction

STAMENKA MITOVA[1], MARGARITA AVRAMOVA[2], MARIYA GRAMATIKOVA[3]
[1,2,3,] Department of Kinesitherapy, Faculty of Public Health, Healthcare and Sports, South-West University "Neofit Rilski", BULGARIA

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Abstract
Urinary incontinence is a fairly common problem in women that has a serious impact on their health and quality of life. The problem is associated with significant socio-economic costs. This study aims to trace the effect of hypopressive and specialized Kegel exercises in women with this problem. **Methodology:** UDI-6, IIQ-7 Questionaire and Kiel test for abdominal, back and gluteal musculature are used for assessment of the patients. Fourty-seven women were recruited and randomly divided in tree– experimental group 1 (EG 1 N=15), experimental group 2 (EG2 N=16) and experimental group 3 (EG3 N=16). For the women of EG 1 therapy includes – Hypopressive exersice, the EG 2 received Kegel exercise and EG 3 received – a combination of both. Every women received five procedures per week for 3 months. Assessment form were done before and after therapy. **Results:** Initial measurements from the Kiel test for abdominal muscles for EG 1 is 17.00±3.07 sec. and finally achieve 32.07±5.47 sec. The EG 2 initial values are 18.75±2.89 sec. and 43.75±7.24 sec. after treatment. For EG 3 was 17.63±4.06 sec. and 53.31±4.27 sec. We compare the results obtained after treatment between EG 1 and EG 2, EG 2 and EG 3 and EG 1 and EG 3. There were no differences between tree groups after analyze the results of UDI-6 questionnaire. The mean values of IIQ-7 for the EG 1 were as follows: 70.56±2.48 before and 50.48±2.8 after hyporpessive exercise. For the EG 2 mean values before treatment were 69.98 ±3.26, and decrease to 45.53±3.28 after treatment. There were no statistically significant difereces between EG 1 and EG 2. For the EG 3 mean values before treatment were 72.69±3.37, and decrease to 37.14±2.8 after treatment. We obtained best results in women of this group. **Conclusions:** Hypoprressive exercise leads to the strength of the abdominal musculature for the groups where were applied. The urinary incontinence and the pelvic floor dysfunction are equally well affected by Hypopressive gymnastics and Kegel exercises, as well as a combination of both.
Key words: incontinence, abdominal muscle, pelvic muscle, exercise

Introduction

Urinary incontinence occurs under the influence of a number of factors. The most risk factors for the occurrence of such a condition are ppregnancy, age, childbirth and heavy physical activity. Under the influence of some of these factors or a combination of several abdominal and pelvic muscles of many women significantly weakens. This leads to disruption and reduction of its effective function. As a result, urinary incontinence is becoming a serious and extremely common problem among women (Hamburg, 2019).

Some studies show that epidemiology varies between 24-62% worldwide. It is estimated that approximately between 23.7% and 46.2% of women have had episodes of at least one type of incontinence in their lifetime (Navarro-Brazales et.al, 2020; Verbeek, Hayward, 2019). The symptoms of this pathological condition are very common among women and seriously affect their normal lifestyle. All this leads to high costs for the healthcare system (Aoki et. al, 2017; Kam, et.al, 2019).

Urinary incontinence could be classified into 3 main types. The first subspecies is called stress incontinence. Stress incontinence results in leakage with increased physical activity (higher load). The second subspecies is the so-called emergency incontinence, in which there is a sudden uncontrollable urge to urinate that cannot be stopped. The third type is the one in which symptoms of the two types described above appear. Such women suffer from a mixed urinary incontinence (Aoki et.al, 2017).

The literature describes a number of proven methods for assessing and analyzing this type of problem in women. There are reliable tests to determine exactly what type of incontinence our patient suffers from. Making an accurate diagnosis is extremely important to determine the most adequate treatment. It is important for the specialist to monitor the condition of his patients so that he can dose his treatment correctly and it should be progressive (Irwin, 2019; Wallace, et.al, 2019; Lawson, Sacks, 2018).

In addition to good assessment methods, we have a number of tools to positively influence and prevent this type of problem. Some methods are well described and studied, but others are not yet. The biggest limitation here is the fact that a very large number of women still avoid talking about this problem until it seriously affects

Corresponding Author: MARGARITA AVRAMOVA, E-mail: margo.arrials@gmail.com

their quality of life. Improper treatment and untimely measures seriously reduce the chance that the applied conservative treatment will be effective and successful.

"Hypopressive exercises are postural techniques that aim to reduce the pressre in the abdominal cavity" (Avramova, 2020; Alonso-Clavete, Cuna-Carrera, Gonzalez, 2019; Juez et.al, 2019). The original idea and application of this type of exercise was aimed at women's postpartum recovery. At a later stage and after studying their effectiveness, the method began to become more widespread in rehabilitation and sports practice.

Exercise generally represents a very strong volitional contraction of the superficial and deeper abdominal muscles during expiratory apnea. This strong contraction in apnea involves and causes reflex contraction of the pelvic floor muscles (Avramova, 2020; Alonso-Clavete, Cuna-Carrera, Gonzalez, 2019; Juez et.al, 2019). In addition to the reflex action that causes the contraction of the abdominal muscles on the pelvic floor, it also increases abdominal strength.

Strengthening of this muscle groups leads to the construction of a good muscular corset in the area and stabilization of the spine (Caufriez et.al, 2007; Caufriez et.al, 2006; Bellido-Fernandez et.al, 2018). Hypopressive exercises in their nature and their effect in detail have not yet been well studied. (Rodriguez, 2019; Navarro-Brazales et.al, 2020).

Rather, their clinical effect has been proven, and a positive result from their application, but there is no theoretical data and physiological explanation of their effect (Martin-Rodriguez et.al, 2015).

Arnold Kegel first described Kegel exercises for pelvic floor muscle strengthening. Dr. Kegel's study showed that the exercises could help to prevent cystocele, rectocele, and urinary stress incontinence. Exercises consist in intentional, purposeful volitional contraction done in different start position. (Nguyen et.al, 2019).

Studies in women with pelvic-reservoir dysfunction are not sufficient at this stage. The effect of hypopressive gymnastics and other known specialized methods such as the Kegel method in women with stress incontinence has not yet been well studied. This motivates us to trace their effect in our own study and to compare it with similar studies available so far.

Material and Methods

Participants

Forty-seven women of middle age with proven stress incontinence were included. They all have symptoms for more than 12 months and do not receive other treatment. We made sure that all of them have no contraindications for conducting the experimental methodology. An important condition for inclusion in the study was that they had not had any surgery (especially abdominal) in the last two years. All participants in the study were divided into 3 groups at random.

The experimental group 1(EG 1) consists 15 women mean age ($\overline{X}$ ±SD) 38.53±2.92 years. The experimental group 2 (EG 2) was formed of 16 women mean age 39.13±3.09 years and the experimental group 3 (EG 3) – 16 women mean age 39.44±3.12 years.

Test protocol and Instruments

The methodology of the study included functional assessment and tests – UDI-6, IIQ-7 Questionnaire and Kiel test for abdominal, back and hip extensors musculature;

- ***Methods for assessing urinary incontinence***

UDI -6 Questionnaire – "The short form of Urogenital Distress Inventory (UDI - 6) is an instrument that assess life impact and symptom distress, respectively, of urinary incontinence and related conditions for women" (Uebersax, Wyman, Shumaker, et al., 1995). An online calculator is available and we used it in our study to make it easier for patients (https://www.thecalculator.co/health/Urogenital-Distress-Inventory-Short-Form-(UDI-6)-Calculator-1127.html).

IIQ – 7 Questionnaire- Incontinence Impact Questionnaire - short form is a validated tool for assessing daily life activities in women with episodes of urinary incontinence. Contains 4 parts related to physical activity, travel, social contacts and emotional health. The ratings given by the patients are from 0 to 3. Zero is not at all, 1 point - very light, 2 points - moderate and 3 points - a lot. To obtain the final result and the mathematical and statistical calculations, the points are multiplied by 33.33. This gives us a scale with scores from 0 to 100 (Uebersax, Wyman, Shumaker, et al., 1995; Shumaker et al., 1994).

- ***Methods for assessing muscle strength and endurance***

Kiel test for strength endurance of the muscles - including three test movements to study the strength endurance of the back, abdominal and gluteal muscles. This type of endurance is tested by taking a specific test position for each muscle group or muscle, which should be maintained as much as possible (according to the patient's capabilities). The time is timed and read in seconds (sec.).

The first test movement includes a study of - the strength endurance of the abdominal muscles. The patients is in laying position on his back with outstretched lower limbs, with the arms folded in front of the chest. The person raises his body to 45 degrees flexion of the thorax and holds in this position (static part). The examiner fixes the lower limbs, not allowing the knee joints flexion. The position of the head is important, which should be an extension (flexion is not allowed).

The second test movement includes a study of - strength endurance of the back muscles. The person is lying face down, with the upper part of his body outside the narrow side of the couch. The hands are behind the nape.

The body is raised to a horizontal plane, then held in this position (static part). The lower limbs are fixed by the examiner to the couch.

The third test movement includes a study of - the strength endurance of the gluteal muscles. The starting position is lying face down. The lower limbs are off the couch. For better support, make the person hold hands on both sides of the couch. Raise the lower limbs to a horizontal position and hold in this position (static part). It is considered to be muscle weakness if the test cannot be performed on its own or if the static part of the test cannot be held for at least 20 seconds. Test results between 20 and 30 seconds are considered to have muscle weakness.

Procedure:

In the patients from the first research group we applied a specialized set of exercises according to the Kegel method. Specialized exercises from different starting positions are applied (Lolowang, Afiyanti, Ungsianik, 2020).

In the second research group, exercises under the hypopressive method are applied (Figure 1.). Exercises are categorized as postural techniques that aim to reduce intra-abdominal pressure and cause strong contraction of the abdominal muscles. They are performed in several steps with deep breathing in three stages. In the final phase, the so-called expiratory apnea persists, in which the patient must make a strong contraction of the abdominal muscles. This contraction reflexively affects the pelvic floor muscles (Alonso-Clavete et.al, 2019; Navarro-Brazales, 2020). Hypopressive postural techniques are also performed from different starting positions (Avramova, 2020).

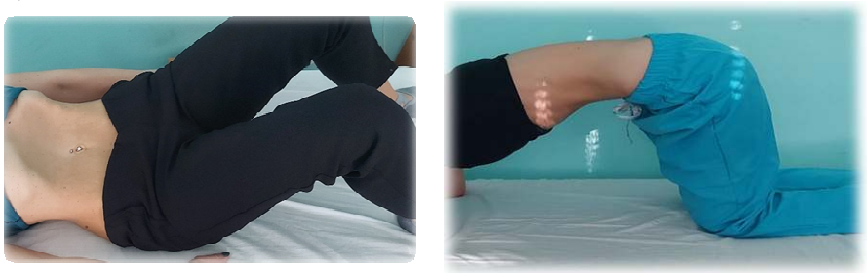

Figure 1. Hypopressive postural technique from the initial position of the occipital position and quadrilateral standing

In the patients of the third research group a combination of the two specialized methods was applied.

Hypopressive techniques administered in a dosage of 5 times a week for 12 weeks. Each individual procedure lasts 45 minutes. Kegel exercises were applied twice a day, every day of the week for a total period of 12 weeks.

Statistical analysis

The statistical processing of the results obtained by the three research groups was performed with the statistical package Graph Pad Prizm 3.0. Some standard averages are derived and compared: Median (Mdn), mean (±), variation range (VR = max - min) standard deviation (Sd). Specialized tests have been applied to verify statistical reliability.

Results

The characteristics of the research contingent are represented on the Tab1. For the EG 1, EG 2 and EG 3.

Table 1. The primary characteristics of experimental groups

Measured values	*Experimental group 1 (EG 1) N=21*	*Experimental group 2 (EG 2) N=21*	*Experimental group 3 (EG 3) N=20*
Age (years)	38.53±2.92	39.13±3.09	39.44±3.12
Body weight (kg)	65.07±4.48	64.75± 5.02	68.19± 4.81
Body height (cm)	169.1±2.50	169.2±2.56	171.1±2.99

Kg – kilogram; cm- centimeters;

The women of the EG 1 are mean age 38.53±2.92 years, their mean height is 169.1±2.50cm and mean weight 65.07±4.48 kg. Patients of the EG 2 are 39.13±3.09 years. Their Mean height and weight were as follows 169.2±2.56cm and 64.75± 5.02 kg. The third experimental group women mean age is 39.44±3.12 years. Their height is 171.1±2.99cm and the weight 68.19± 4.81 kg (Tab. 1).

The various results we received at the beginning and after the specialized therapy are presented graphically on Fig. 1. Results of Kiel test for abdominal muscles for EG 1 before and after therapy were 17.00±3.07 sec. and 32.07±5.47 sec. For the patients of the second group before and after therapy were respectively 18.75±2.89 sec. and 43.75±7.24 sec., and for EG 3 were 17.63±4.06 sec. and 53.31±4.27 sec. We compare the results obtained after treatment between EG 1 and EG 2, EG 2 and EG 3 and EG 1 and EG 3 and show statistically significant differences for the EG 2 (Mann Whitney, p<0, 03) and EG 3 (Mann Whitney, p<0, 001) (Fig. 2. A.).

Mean values of Kiel test for back muscles for the EG 1 before and after therapy were respectively 10.07±2.60 sec. and 14.60±5.17 sec. For the women of the second group were 11.50±3.18 sec. and 21.88±4.24 sec. and for EG 3 were 11.31±3.05 sec. and 22.44±2.66 sec. We obtain significant differences between mean values of EG 1 and EG 2 and EG 1 and EG 3 ($p<0.005$). There is no statistical reliability in the results between EG 2 and EG 3 (Mann Whitney $p>0.05$). Mean values of Kiel test for gluteal muscles for the first group at the beginning and end of the research period were 13.87±1.51 sec. and 19.73±3.39 sec., the EG 2 before, after therapy were respectively 13.94±2.02 sec. and 24.19±4.14 sec, and for EG 3 were 15.31±4.01 sec. and 24.19±5.29 sec. We obtain significant differences between mean values of EG 1 and EG 2 and EG 1 and EG 3 ($p<0.05$). No significant difference between EG 2 and EG 3 (Mann Whitney $p>0.05$). (Fig. 2. B.).

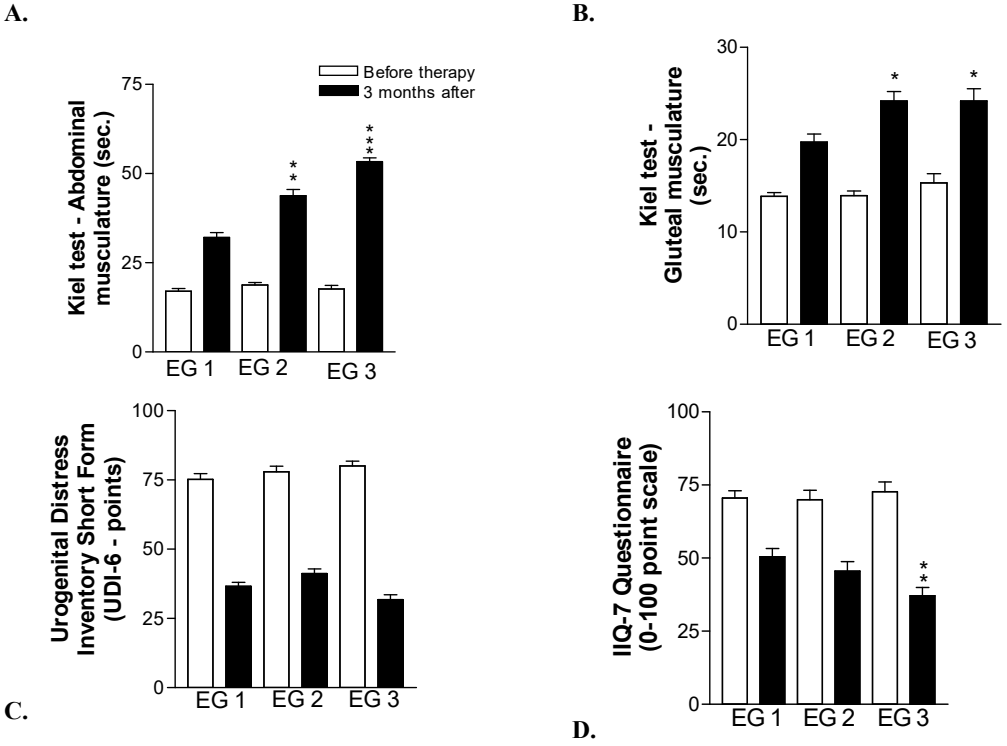

Figure 2. Results of the Kiel test – abdominal musculature– **A**; Kiel test – gluteal musculature– **B;** UDI - 6 Questionnaire – **C;** IIQ-7 Questionnaire **–- D** for the EG 1, EG 2 and EG 3- before treatment - □ and after treatment - ■;
*** Mann-Witney test $p < 0,001$ after therapy
** Mann-Witney test $p < 0,03$ after therapy
* Mann-Witney test $p < 0,05$ after therapy

Mean values of UDI – 6 Questionnaire for the EG 1 before and after therapy were 75.20±8.19 and 36.60±5.63, for the EG 2 before and after therapy were 77.94±8.07 and 41.19±6.80 and for EG 3 respectively 80.00±7.13 and 31.81±7.05. We compare mean values after treatment between EG 1 and EG 2 EG 2 and EG 3 and EG 1 and EG 3 and there were no significant differences ($p>0.5$) (Fig. 2 C.).

Mean values of IIQ – 7 Questionnaire for the EG 1 were as follows: 70.56±2.48 before and 50.48±2.8 after Kegel exercise. For the EG 2 mean values before Hypopressive program were 69.98 ±3.26, and decrease to 45.53±3.28. There were no statistically significant differences between EG 1 and EG 2. For the EG 3 mean values before treatment were 72.69 ±3.37, and decrease to 37.14±2.8 after treatment.

The results of this group were most significant, so we considered mean values in more detail for each of the individual parts of which the test consists: physical activity: baseline - 71.11±5.51, after - 36.66±4.36; travel: baseline - 78.88±3.44, after - 40.0±3.56; social contacts: baseline - 71.1±6.4 after - 35.55±5.11 and emotional health: baseline - 71,11±4.73, after - 35.55±3.94. In this group values decrease significantly after therapy comparing the results of EG 1 and EG 3 and EG 2 and EG 3 ($p<0.03$) (Fig. 2 D.)

Discussion

Stress incontinence is a high prevalent problem, but due to the fact that most women ignore it or are ashamed to talk about it, the possibilities for conservative treatment have not yet been sufficiently well studied and proven (Martin - Rodriguez, Bo, 2019; Duarte et.al, 2020). The studies performed are too few, not reliable enough, or have been performed on a small number of patients.

In our previous pilot study of the influence of such hypopressive techniques, we obtained a good result in terms of the studied parameters such as: muscle strength, better muscle elasticity and function of certain muscle groups of the body and lower extremities (Avramova, 2020; Avramova 2021).

In this current study, we wanted to examine in detail and compare the effect of Kegel exercises and hypopressive gymnastics as well as the combination of the two methods in order to positively affect the symptoms of stress incontinence in middle-aged women.

The results obtained from the Kiel test clearly show a significant strengthening of the abdominal muscles for women from EG 2 and EG 3, namely those who underwent Hypopressive gymnastics. This is quite logical because the main purpose of this method is to strengthen these muscle groups. The best results were obtained in women from EG 3 where the combined methodology was applied. "The PFMs, abdominal, gluteal, and adductor muscles are activated during the performance of a hypopressive exercise" (Brazalez et.al, 2020).

In terms of back and gluteal muscles, again the results are better in patients of EG 2 and EG 3 but the obtained differences are not significant. We could conclude that Hypopressive gymnastics and the combination of both affect these two muscle groups equally, while the Kegel method does not show much effect on strengthening the back and gluteal muscles. Kegel exercises are specifically aimed at the pelvic floor muscles.

A recent very similar study of Navarro-Brazales et.al. the authors report positive results due to a specialized combined kinesitherapy technique that includes various hypopressive methods, Kegel volitional contractions, a combination of both. The authors also offer a program for independent home training and the results show a positive effect on muscle strength in emergency and stress incontinence (stage I-II). In addition, they monitored the retention of these results in the longer term and found that in 53% of patients they persisted 12 months later. However, they all continue with the home exercise program as part of their daily lives (Navarro-Brazales et.al, 2020).

Resende et.al. in a randomized controller trial try to track whether hypopressive gymnastics had a positive effect on pelvic floor prolapse and whether they were more effective than direct training and contraction of the pelvic muscles. In conclusion, the authors report an improvement in all monitored indicators - prolapse, severity of symptoms, muscle strength and function. All the results have are better of the group were direct muscle contraction of the pelvic muscles is performed (Resende et.al, 2019).

Several studies have proven the effect of hypopressive exercises on the muscular elasticity of the lower extremities and the lumbar spine. Bellido-Fernandez et al. offer a kinesitherapy program consisting of 40 sessions of 40 minutes of Hypopressive gymnastics and obtain good results (Bellido-Fernandez et.al, 2018; Keizer et.al, 2019; Avramova 2021). The positive effect on the lower limbs and lumbar region has been proven, but is not the subject of this study and therefore have not been discussed in detail.

Jacomo et.al. and other authors in turn show that methods such as Pilates, Hypopressive Gymnastics and Paula's method conducted individually, do not lead to significant improvements in muscle strength of the pelvic floor. This study claims that direct training of the pelvic muscles is the gold standard for strengthening them and improving their function (Jacomo et.al, 2020; Preda, Moreira, 2019).

There are studies that report that in order to achieve a positive effect on the strength and pelvic muscles, it is necessary to apply a program for a minimum of 8 to 12 weeks (Da Cuna-Carrera et.al, 2018). The program proposed in the present study also lasted 12 weeks and the results obtained in terms of pelvic muscles and its dysfunction were very good in patients from the three study groups.

This is evidenced by the results obtained by IIQ-7 Questionnaire and UDI - 6 Questionnaire, in which we reported very good results on the impact of the program on incontinence and the extent to which it affects the lives of women included in the study. Most likely, these good results are due to the fact that the program of Hypopressive exercises is combined very successfully with Kegel exercises, and this combination has an extremely good effect on the toning of the before mentioned muscle groups and improves their basic function.

Regarding the symptoms of stress incontinence, after analyzing the results obtained from UDI - 6 The questionnaire shows that at the end of the study there were no significant differences in women from the three study groups. Therefore, we could say that the two methods separately, as well as their combination, lead to a similar effect on the symptoms of incontinence. Nevertheless, if we look at the results in detail, we can see that in EG 3 the greatest improvement was reported.

We come to a similar conclusion looking at the results of the IIQ-7 Questionnaire. The results were reviewed and processed in more detail for the EG 3 by dividing and calculating for each of the parts of the test - physical activity, travel, social life and emotional health. In this way it becomes clear in which area the kinesitherapy program was more effective. The best results were reported in EG 3 in the sections physical activity and social life ($p < 0.002$), but in the other two sections the tendency is to improve, but with slightly less statistical significance ($p < 0.05$).

In our opinion, the combined application of the two methods is the most effective because at the same time significantly strengthens abdominal and pelvic muscle groups. Both methods complement each other and significantly improve the symptoms of stress incontinence in women and significantly improves their quality of life.

Conclusions:

Hypopressive postural techniques lead to a definite increase in the muscular strength of the abdominal and pelvic muscles of the women in the groups in which they are applied.– EG 2 and EG 3.

In the group of women who used the combined methodology, the results are significantly better and superior in all indicators. This in turn significantly improves both muscle function and the symptoms of incontinence.

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Conflicts of interest:

No conflict of interest situations during the research and the publication of the manuscript.

The research meets the ethical requirements of people asset for the Helsinki Declaration.

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