Assessment of the relationship between the incidence of urogenital complaints in young women and pelvic floor muscle weakness

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Abstract

Background: Modern society is increasingly seeing urogenital complaints in increasingly younger women. Early diagnosis and reducing the impact of dysfunction on other systems is an important issue. Fast, objective, and portable tools for assessing pelvic floor muscles (PFM) include digital assessment methods, such as surface electromyography (sEMG).

Aim: The main aim of the study was to assess the relationship between conditions of the urogenital system in young women and the weakening of the PFM. The PFM were also assessed indirectly by analyzing the rectus abdominis and adductors muscles, as well as the baseline tension of these muscles.

Material and methods: The Pelvic Floor Bother Questionnaire (PFBQ) was used to identify the study group. A questionnaire study was carried out on 50 women, and 31 of them were qualified for sEMG. A Noraxon MyoTrace EMG device and MyoResearch XP Master 1.07 software were used for the study. The study was based on the Glazer protocol and the maximal voluntary contraction (MVC) measurement of the rectus abdominis and adductors muscles.

Results: The questionnaire showed a large number of women struggling with different types of complaints affecting their daily functioning. Statistical analysis in most parameters showed no significant differences between muscles.

Conclusions: Non-skeletal complaints may weaken the PFM, causing increased activation of synergistic muscles. It is possible to assess the pelvic floor indirectly, but no baseline increased tension of the rectus abdominis and adductors muscles is found.

Key words

surface electromyography, pelvic floor muscles, PFBQ questionnaire, Glazer protocol.

Introduction

Modern society is increasingly recognizing urogenital complaints in increasingly younger women. Early diagnosis and reducing the impact of dysfunction on other systems is an important issue. Accurate and reliable methods to identify women with early symptoms of disorders are important. The urogenital system and the pelvic floor muscles (PFM) exist in symbiosis, so they can directly affect each other. It is impossible to isolate the PFM, so in the diagnosis, it is also necessary to evaluate the abdominal muscles and mm. that have attachments in the pelvic area. The primary function of the PFM is to surround and support the organs of the pelvis minor. They are also part of the abdominal pressor, generating intra-abdominal pressure [1].

Digital assessment methods, including surface electromyography (sEMG), are among the fast, objective, and portable tools for assessing PFM. This method is one of the non-invasive, well-tolerated methods, as the electrodes read the electrical potential from the surface of the skin. Applying sEMG to the muscles cooperating with the pelvic floor helps ensure the test subject's comfort and reduces the test cost. The Glazer protocol is one tool for examining and treating PFM [2].

Etiology of pelvic floor muscle weakness

Weakening (hypotonia) of the PFM is a situation in which the muscles cannot achieve full relaxation, do not respond/weaken to the command to contract, and lack automatic response to an increase in intra-abdominal pressure [3]. Factors that weaken the pelvic floor include a history of pregnancy and childbirth, especially by natural means, increasing the risk of weakness by 2-3 times [4], partial denervation [5], and overstretching or muscle atrophy. In addition, chronic constipation and intestinal diseases, age, obesity [4], diseases that accompany coughing (asthma, COPD), and weight training with heavy loads, and jumping sports play a big role. Symptoms of impaired PFM include sexual dysfunction, lowering/fall of the pelvic organs (vagina, uterus, bladder), urinary incontinence [5], menstrual disorders, chronic inflammation, and pain, localized to the pelvic area.

Diagnosis of the pelvic floor muscle

Assessment of PFM most often takes the form of manual examination - based on the experience and skills of the examiner, ultrasound - a dynamic, non-invasive examination in trans-abdominal examination or minimally invasive in trans-vaginal assessment. Ultrasonography is becoming more common in physiotherapy practice due to the speed of obtaining data and the possibility of observing reflex activity. The pelvic floor can also be assessed using perineometer - assessment of vaginal pressure, dynamometry - assessment of PFM contraction strength using a speculum [6], and standardized questionnaires to help diagnose the patient. Questionnaires provide an opportunity to assess the severity of symptoms, impact on quality of life, and evaluate therapy [7]. sEMG allows to assess the electrical activity of muscle fibers. From the data obtained, it is possible to draw information about whether the muscle is working properly, observe the increase and decrease in activity and the effect of fatigue, and use sEMG to work with biofeedback [8].

Aims

This study aimed to assess the relationship between the presence of urogenital complaints and PFM weakness. Research questions: Can non-musculoskeletal complaints affect PFM? Is it possible to indirectly assess PFM using surface electrodes? Is it possible to observe excessive abdominal and tight adductor muscle tension in subjects reporting pelvic floor complaints, and does any group show significantly higher activity?

Material and methods

Study course

The study included two stages. The first stage was a questionnaire survey, based on which participants were qualified for the rest of the study. In the second stage, sEMG was used.

Study group

The survey was conducted on 50 women under the age of 30. Eligibility for the sEMG study was based on those who gave at least one affirmative answer indicating the possibility of urogenital complaints. A total of 44 female participants were invited to the sEMG study, 31 of whom participated. The others did not consent to further participation. Before taking part in the sEMG study, each participant signed a consent for participation and processing of personal data.

Questionnaire assessment

The Pelvic Floor Bother Questionnaire (PFBQ) was used to identify the study group, allowing to indicate and determine the level of severity of symptoms of stress urinary incontinence (SUI), frequent urination, the urgency of pushing on the bladder, the urgency of incontinence, painful or difficult urination, lowering or prolapse of the pelvic organs, difficult defecation, fecal or gas incontinence, and painful intercourse. For the purposes of the study, the questionnaire was translated from English and supplemented with a self-administered questionnaire to complete the data and indicated the symptoms of painful menstruation, the severity of pain and painkillers used; the duration of bleeding, changes in the abundance of bleeding and medications affecting it; complaints of localized pelvic or lumbar pain; pelvic inflammation; diseases associated with chronic cough; use of trampolines or participation in jumping sports; performance of strength exercises, associated with lifting heavy weights; past pregnancies and how they were resolved.

Electromyographic assessment

The sEMG equipment used for the study was Noraxon MyoTrace EMG equipment. The signal was processed using MyoResearch XP Master 1.07 software. Channel 1 read the activity of the inferior rectus abdominis muscle (RAM), and channel 2 read the tight adductors muscles (TAM) of the non-dominant leg. The raw data were checked for artifacts. The subjects were in a supine position, with the upper extremities along the torso, with slight flexion at the hip and knee joints. Electrodes were applied to the disinfected skin of the lower abdominal mm. above the pubic symphysis and on the inner thigh. The reference electrode was located on the superior anterior iliac spine, on the non-dominant side. The subjects were familiarized with the test procedure and instructed on how to sense the PFM and activate it in a controlled manner. The test consisted of two consecutive tests: the first was based on the Glazer protocol, and the second tested the maximal voluntary contraction (MVC) of the RAM and TAM muscles.

Glazer Protocol

The Glazer protocol is a therapeutic tool for assessing the functioning of the urogenital system and also allows working with biofeedback [9, 10]. For the purposes of the present study, the protocol was modified: the vaginal electrode was replaced by electrodes applied to the lower part of the RAM and the TAM. The duration of the various stages was also shortened. The course of the study was as follows: 10-second rest; five 2-second phasic contractions, with a 2-second rest in between; five 10-second tonic contractions, with a 10-second rest in between; one 30-second endurance contraction; 10-second rest.

Maximum voluntary contraction

The MVC test of the RAM was performed by lifting by the subjects their upper torso against external resistance at shoulder height. The starting position was lying supine, upper limbs crossed at chest level; lower limbs flexed at the hip and knee joints. The MVC test of the TAM consisted of adduction of the lower limb against external resistance at the level of the knee, in the starting position of lying supine, with the test limb flexed at the knee and hip joints, with the foot resting on the recliner, the other limb freely placed on the recliner, the upper torso freely placed on the recliner, the upper limbs along the torso. For each participant, the test was carried out once.

Statistical analysis

The following descriptive statistics were performed for each type of contraction: mean, minimum and maximum value, and standard deviation (included in the Results section) separately for the abdominal and thigh adductor muscles. A Student's t-test was also performed to indicate the significance of differences between the muscles tested. The same parameters from readings of different muscles were taken into account.

Results

The results are divided into two parts. Part one deals with PFBQ survey assessments. Part two deals with sEMG assessments conducted on qualified women.

PFBQ results

The questionnaire was completed by 50 women aged 18 - 30 years, whose weight was between 50 and 83 kg and whose height was between 156 and 183 cm. Of these, 9 could be identified as having symptoms of SUI, 7 had frequent urinary incontinence, 8 women reported symptoms of urgency to urinate on the bladder, 3 women had painful/obstructed urination and 9 had obstructed bowel movements, 2 women reported symptoms of lowered reproductive organs, 1 each reported symptoms of urgency incontinence and gas or fecal incontinence. Of those surveyed, 34 women are sexually active, with 14 of them reporting pain or discomfort during intercourse. The occurrence of painful periods was indicated by 35 women, 7 recently noticed a change in the duration of menstrual bleeding, and 9 a change in the abundance. The occurrence of pelvic or lumbar spine pain was reported by 13 people, and pelvic inflammation by 3 people. One person reported illnesses running with a chronic cough, 2 people regularly use trampolines or engage in jumping sports, and 8 people engage in strength training associated with lifting heavy weights. Six women indicated that they were or are currently pregnant. At the time of completing the questionnaire, two women were pregnant: one was pregnant for the first time, and the other had given birth by natural force in the past. One woman had been pregnant in the past, but had a miscarriage.

sEMG results

Statistical parameters describing the study group are presented in the tables below. **Table 1** shows the statistical analysis data from the recordings of the lower RAM. **Table 2** shows the statistical analysis data from the readings of the TAM. **Table 3** shows the data of the significance of the differences between the muscles tested, where the comparison was made using the Student's t-test.

The p-value for most comparisons is above or equal to 0.05. This means that there is no statistically significant difference between the variables evaluated. Comparison of the average time after peak (s) of the RAM with Average Time after peak (s) of TAM with phasic contractions, and comparison of the average (%) of the RAM with the mean (%) of TAM in resting tension, yields a p-value less than 0.05. This means that the evaluated parameters differ and this is statistically significant.

Table 1. Statistical analysis of the parameters of rectus abdominis muscles.

Activation type	Variable	M	Min	Max	SD
Resting tension	Average (%)	1.74	0.05	6.88	1.25
	Variability (%)	9.72	5.84	22.90	4.43
Phasic contractions	Average Time before peak (s)	0.97	0.20	4.53	0.86
	Average Time after peak (s)	0.82	0.27	1.75	0.43
	Average Peak (%)	38.77	0.09	656.00	154.05
	Average Time before break (s)	2.44	0.26	13.60	3.58
	Average Time after peak (s)	1.71	0.36	9.36	2.14
Tonic contractions	Average (%)	17.55	0.70	436.00	80.49
	Average Peak (%)	22.16	0.86	560.00	103.46
Endurance contraction	Change by average (%)	-144.90	-4778.00	103.00	875.51
Resting tension	Average (%)	1.54	0.07	3.80	0.74
	Variability (%)	9.18	5.37	54.00	8.44

Abbreviations: *M, mean; Min, minimum value; Max, maximum value; SD, standard deviation.*

Table 2. Statistical analysis of tight adductor muscle parameters.

Activation type	Variable	M	Min	Max	SD
Resting tension	Average (%)	1.23	0.26	3.69	0.84
	Variability (%)	9.69	5.88	48.10	8.41
Phasic contractions	Average Time before peak (s)	1.28	0.20	3.74	1.02
	Average Time after peak (s)	1.30	0.30	3.83	0.92
	Average Peak (%)	1.50	0.35	3.93	0.97
	Average Time before break (s)	1.05	0.32	3.28	0.74
	Average Time after peak (s)	1.94	0.42	8.10	2.17

Tonic contractions	Average (%)	1.92	0.25	11.00	2.29
	Average Peak (%)	2.18	0.28	12.40	2.65
Endurance contraction	Change by average (%)	10.93	-30.40	160.00	42.07
Resting tension	Average (%)	1.09	0.25	3.28	0.68
	Variability (%)	7.18	5.60	10.20	1.03

Abbreviations: *M, mean; Min, minimum value; Max, maximum value; SD, standard deviation.*

Table 3. Student's t-test of the significance of differences between muscles.

	t	df	p-Value	F	p-Value
RAM Average (%) vs. TAM Average (%)	1.91	60	0.06	2.22	0.03
RAM Variability (%) (%) vs. TAM Variability (%)	0.01	60	1.00	3.61	0.00
RAM Average Time before break (s) vs. TAM Average Time before break (s)	-1.21	53	0.23	1.41	0.38
RAM Average Time after peak (s) vs. TAM Average Time after peak (s)	-2.53	53	0.01	4.53	0.00
RAM Average Peak (%) vs. TAM Average Peak (%)	0.87	29	0.4	25382.90	0.00
RAM Average Time before break (s) vs. TAM Average Time before break (s)	1.37	29	0.18	23.69	0.00
RAM Average Time after peak (s) vs. TAM Average Time after peak (s)	-0.28	29	0.78	1.03	0.94
RAM Average (%) vs. TAM Average (%)	1.04	56	0.90	1240.74	0.00
RAM Average Peak (%) vs. TAM Average Peak (%)	1.04	56	0.30	1529.55	0.00
RAM Change by average (%) vs. TAM Change by average (%)	-0.99	59	0.33	433.00	0.00
RAM Average (%) vs. TAM Average (%)	2.45	60	0.02	1.19	0.63
RAM Variability (%) vs. TAM Variability (%)	1.31	60	0.20	66.92	0.00

Abbreviations: *RAM, rectus abdominis muscles; TAM, tight adductor muscles; t; t-Student test; df, degrees of freedom; p-Value; level of statistical significance; F, F-test of equality of variances.*

Discussion

Analysis of the PFBQ questionnaire results allows noting the large number of people reporting the presence of urogenital complaints. The large variety of symptoms in the survey group may not be very precise, so the degree of severity and causes of the complaints were not analyzed. It might be more precise to analyze one problem and its impact on the pelvic floor. Most respondents reported complaints of painful menstruation and pelvic floor pain. From the analysis of the literature, many authors indicate that abnormalities such as SUI, lowering of the pelvic organs, and sexual dysfunction have common risk factors, which include natural childbirth, heavy lifting, and nerve damage [4, 11].

The PFBQ questionnaire is not one of the most commonly chosen questionnaires by researchers for clinical trials [7]. However, it provides an opportunity to evaluate symptoms in four dimensions: urinary, bowel, sexual and vaginal, where mainly pelvic floor lowering is evaluated. The use of the PFBQ questionnaire in the present study provided the opportunity to assess the study group very broadly in terms of the intensity of the symptoms indicated, but also because of the wide list of complaints assessed by a single questionnaire.

The Glazer protocol is a therapeutic tool (also known as biofeedback) [2] that also allows assessment of the urogenital system in women with abnormalities in this area. Currently, data are being collected from groups with specific dysfunctions and from a control group. One of the first studies in which researchers attempted to collect data among healthy women for all phases of the protocol is that conducted by Oleksy et al. [10].

Based on a review of the literature, it was concluded that there are no studies with similar methodology and study groups to the present one. However, there are a number of other studies evaluating the pelvic floor, largely based on sEMG, but these studies mostly used an endovaginal electrode.

Analysis of the sEMG study allows to observe the activity of the synergistic muscles during pelvic floor activity, as well as slight variations in the average values of the muscles tested during specific types of contractions. The scatter in the values obtained in the electromyographic study may be due to the difficulty of sensing and isolating the work of the pelvic floor among the subjects, so one should be cautious in interpretation. A study by Kocur et al. [12] also underscores that it is difficult for participants to localize PFM and consciously activate them, despite awareness of the existence of such muscles, better known as "Kegel muscles."

Numerous authors show a correlation between the activity of the PFM, RAM, and TAM muscles [13, 14, 15]. Workman et al. [13] used electrodes on the abdominal layers and the rectal area; their results show a linear relationship in muscle tone when performing vaginal EMG and abdominal EMG. They emphasize the relevance of modern alternative methods to assess the pelvic floor, especially for men and children, without the need for internal electrodes. Bo et al. [14], in their study assessing the activity of the urethral wall muscles, noted that the PFM contract synergistically with the abdominal muscles during activities that increase intra-abdominal pressure. In addition, they noted SWF activity during contraction of the gluteus maximus and TAM., which is important because of the involvement of these muscles in synergistic activity.

Sapsford et al. [15], examining readings from the endovaginal electrode, the gluteus maximus muscle, and the TAM, assessed the presence of cross-signal, interfering with EMG readings from the pelvic floor. The data obtained from the electrode readings showed a low probability of cross-signal activity due to correlations during which an increase in activity received by an electrode located on the pelvic floor causes a decrease in the activity of an electrode on the TAM. Thus, it can be suggested that the occurrence of tension in the area of the TAM during an isolated activation of pelvic floor contractions may be due to failure of the PFM. The authors also note that the coactivation of abdominal muscles and PFM they observed is consistent with the model assuming that the muscles surrounding the abdominal cavity activate in a coordinated manner with changes in abdominal pressure to support the pelvic floor. This is necessary to maintain continence, and therefore increased tension in the abdominal mm. may be present in people struggling with urinary incontinence; moreover, pelvic floor testing by synergistic muscles could be used when examining people in whom the use of an internal electrode is not possible. However, it seems necessary to determine normative values for the RAM and TAM muscles since changes in tension in these areas during pelvic floor activation are expected.

Madill et al. [16] assumed the presence of predictable activation patterns for each of the abdominal muscles studied, which could describe the relationship between abdominal muscle activity and changes in pelvic floor pressure. The study was conducted in healthy women, measuring the activation levels of the PFM and abdominal muscles alone and in combination with thigh adduction, external hip rotation, squat with resistance, contraction of the transversus abdominis muscle, and contraction of the gluteal muscles. The interaction between pairs of muscles appeared to be minimal, with only PFM contraction generating significantly greater activation of the transverse abdominis muscle than isolated contraction of this muscle. The authors note the existence of a high degree of variability in the strength of PFM contractions, even in healthy women who report no complaints.

In another study, Madill et al. [17] pointed to the weakness of the pelvic floor and the disruption of its work in patterns as a cause of incontinence. In addition, abdominal muscle activity may also be disturbed. After analyzing the results, they concluded that all of the abdominal mm. studied correlated with PFM activity, and the rate of their activation depended on the position in which the test was performed.

Thompson et al. [18], on the other hand, conducted a study on a group of healthy women and a group of women reporting symptoms of incontinence. The EMG study evaluated the RAM, thoracic muscles, external and internal oblique abdominal muscles, transverse abdominal muscles, and PFM using an internal electrode. The authors noted that the incontinence group showed a lower level of pelvic floor activation during contraction and a higher level of activation of the mm. abdominis and chest wall compared to the asymptomatic group. Women with urinary incontinence find it more difficult to isolate and engage the pelvic floor, resulting in an increase in the activation of the synergistic muscles. This suggests the presence of muscle substitution.

All the studies cited above predominantly deal with women struggling with incontinence of various causes and severity. This is certainly a problem that is becoming more widely recognized and diagnosed. Therefore, more research is needed exploring the topic of incontinence and research describing treatment options, both conservative and invasive. Attention should also be paid to other causes of PFM weakness, the changes that occur in the musculoskeletal system of patients, and the change in the quality of life of these women. The sEMG examination offers great opportunities in the non-invasive evaluation of patients, allows for a detailed assessment of a specific case, and, most importantly, provides the opportunity to view the "real-time" assessment, which facilitates the conduct of therapy.

Conclusions

Complaints from outside the musculoskeletal system can affect the PFM, causing it to weaken and activate synergistic muscles. It is possible to assess the PFM using sEMG, without needing an internal electrode, but this assessment is not as widely used as direct assessment. Activation of the RAM and TAM muscles is observed in patients reporting pelvic floor discomfort during PFM activation. However, it is not possible to unequivocally determine the initial over-tension of the RAm and TAM or which muscle group shows more activity.

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