

# Urinary incontinence in women: biofeedback as an innovative treatment method

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Ther Adv Urol

2020, Vol. 12: 1–12

DOI: 10.1177/  
1756287220934359

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**Abstract:** Urinary incontinence is an involuntary urination (leakage of urine). About 200 million people suffer from this condition, and 60% of cases are concealed and untreated because of shame. It is estimated that an increasing number of young women and women of menopausal age will suffer from urinary incontinence. This disease occurs during the perinatal, perimenopausal period, as a result of brain damage or an unhealthy lifestyle. There are four main types of urinary incontinence: stress, urge, overflow and mixed form. Treatment is adapted to the severity of disease, its type and includes physiotherapeutic treatment (kinesiotherapy, physiotherapy, massage), pharmacological, psychological and surgical treatment. In recent years, growing interest has been observed in the noninvasive biofeedback method. The patient learns to contract the weakened pelvic floor muscles, constantly monitoring progress in treatment. She is also motivated by visual and auditory stimuli. Growing evidence confirms the effectiveness of this method, which to a large extent eliminates urinary incontinence. Nevertheless, attention should also be paid to prevention, which reduces the risk of involuntary leakage of urine.

**Keywords:** biofeedback, physiotherapeutic methods, urinary incontinence

Received: 19 March 2020; revised manuscript accepted: 23 May 2020.

## Introduction

The definition of urinary incontinence (UI) is constantly being improved in order to define the problem more accurately and to adapt it to the progress in treatment and diagnosis of the disease. Until a few years ago, the International Continence Society defined this disease as uncontrolled leakage of urine from the urethra, which causes hygienic problems in a person with this condition, or hinders contact with other people and excludes them from social life, while the same person perceives it as a problem and condition. These symptoms had to be objectively studied in order to be able to diagnose.<sup>1</sup> At present, the simplest definition assumes that UI is any involuntary urinary leak, no matter what the consequences are, and it does not have to be studied or documented.<sup>2–6</sup>

Although the definition does not directly relate the occurrence of UI to social problems, it is

important to remember that this problem causes great discomfort, thus people with incontinence avoid contact with other people. More and more researchers point out that the problem of UI affects not only women, but also their families or caregivers.<sup>7</sup> The World Health Organization estimates that there are more than 200 million people suffering from this disease worldwide. Unfortunately, these figures are approximate, as it is not known how many people suffer from the disease in poorer countries and how many women are hiding from others.<sup>8</sup>

It is believed that about 60% of all UI cases in women are concealed by them, because it is a shameful problem, causing embarrassment and discomfort even in contacts with a doctor.<sup>9</sup> Radziszewski *et al.*<sup>10</sup> estimates in his research that about 5 million people in Poland suffer from UI. Women suffer twice as often as men and it is believed that the problem affects 10–25% of

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women over 30 years of age, and at the age of 50 years, the incidence of UI increases and ranges from 30% to 50%.<sup>3,11</sup> Undoubtedly, the scale of this problem in the population will continue to grow, which is related to the aging population; the number of elderly people is increasing, and thus the number of people with UI is increasing.<sup>2</sup>

There are many ways of treating UI, and along with development of knowledge on this disease, the number of methods, thanks to which it is possible to effectively treat this disease, increases. The most common methods are physiotherapeutic, kinesiotherapeutic, pharmacological and (in extreme cases) surgical procedures.<sup>2,4,12,13</sup> Biofeedback, which is the main topic of this study, is an increasingly common method of this disease treatment.

### Urinary incontinence in women

Most authors dealing with the problem of incontinence in women present a division distinguishing four main types of this disease. They are as follows: (1) Stress UI (SUI), which occurs most often and accounts for about 50–70% of all types of UI, occurs when leakage of urine is caused by a sudden increase in pressure inside the abdominal cavity due to sneezing, laughing, jumping, bending, squatting, sudden change of body position, or when lifting heavy objects without the feeling of pushing on the bladder. SUI occurs as a result of weakened pelvic floor muscles and accompanying ligaments;<sup>2,13–16</sup> (2) Urge incontinence, which is associated with the autonomic nervous system and consists of involuntary urination accompanied by a feeling of pushing. The amount of urination is high and the main causes are central nervous system (CNS), spinal cord, Parkinson's disease and dementia damage. It is estimated that urge incontinence occurs in about 14% of all cases;<sup>2,17–19</sup> (3) Overflow incontinence, which is involuntary leakage of urine caused by a disorder of displacement shrinkage. This results in overflow of the bladder and structural disorders of its tissues. This type of UI occurs in cases of CNS damage and accounts for about 4% of all types;<sup>6</sup> (4) Mixed form, which is a combination of SUI and urge incontinence. It is estimated that the incidence of this type of incontinence is within the range of 14–61%.<sup>11,13,20</sup>

Particular attention should be paid to the risk factors of SUI in women. The most frequently mentioned is menopause age. It is believed that

39–50% of women up to the age of 55 years suffer from this ailment.<sup>4,21</sup> The percentage of women with uncontrolled urine leakage increases with age, as well as with coexisting diseases, dementia or Parkinson's disease.<sup>16</sup> Women also suffer from this disease after a stroke. Natural births, which cause damage to the structures within the uterus, are also indicated. It is estimated that involuntary urinations occur in 36% of women after pregnancy and the risk of their occurrence increases with the number of childbirths, as well as with the multitude of fetuses.<sup>11</sup> An unhealthy lifestyle and obesity have a significant influence on UI in women. Increased body mass index and percentage of adipose tissue are particularly taken into account.<sup>18,22</sup> Alcohol abuse and cigarette smoking are also believed to have a significant effect.<sup>7,22</sup> Injuries to both the organs of urinary tract and the central and peripheral nervous system may be the cause of UI.<sup>3</sup>

Wierzbicka *et al.*<sup>23</sup> in their studies indicate that the frequency of UI increases along with age and depends on the number of deliveries, excessive weight, and as a side effect of surgical procedures.

### Urinary incontinence in female athletes

UI is linked with pelvic floor muscle weakness, and exercise to increase muscle strength has been proposed as a potential risk reduction technique.<sup>24,25</sup> Several studies have indicated that increasing moderate physical activity decreases the risk of UI; however, in recent years, numerous studies have revealed that UI has been frequently found in female athletes, suggesting that sports involving rigorous physical activity increase UI prevalence.<sup>26–31</sup> Da Roza *et al.*<sup>32</sup> concluded this sustained mechanical stimulus endured by female athletes most likely resulted in muscle weakness and depressed responsiveness.

Notably, increased abdominal pressure has been reported to be the main cause of UI in this population, as it has been shown to morphologically and functionally modify ligaments and connective tissue. These abnormal phenotypes could lead to an imbalance of pelvic floor contraction strength during exercise.<sup>29,32,33</sup> Using magnetic resonance imaging scanning, it was found that nulliparous female athletes partaking in regular high-impact training had increased levator ani muscle cross-sectional area and puborectalis muscle width. It is thought that the increased intra-abdominal

pressure associated with this training results in stress induced hypertrophy.<sup>34,35</sup>

Interestingly, many authors has been reported that UI is variant in people involved in sports and is dependent on the intensity of the individual's activity, movement, and ground impact. Some of them found a dose-response relationship between activity and UI symptoms.<sup>36,37</sup> Jumping is the movement that may cause more incontinence, and consistent with the aforementioned theory, gymnasts report the highest prevalence of UI. In addition, UI prevalence has been found to be as high as 80% in trampolinists.<sup>32,38-40</sup> Despite the relationship between UI prevalence and high-impact sports, meta-analysis of several studies on a wide range of sports indicates that ground impact alone may not be the sole cause of increased intra-abdominal pressure. Situations demanding spinal stability are known to activate abdominal wall muscles and can be attributed to urinary alterations during activities, even those with mild impact. This theory is supported by many studies, including one that indicates swimmers have a 15% UI prevalence despite no ground contact.<sup>41,42</sup> However, others such as Simeone *et al.*<sup>43</sup> assume that persistent pressure on pelvic muscles could be the main cause of UI.

### Biofeedback

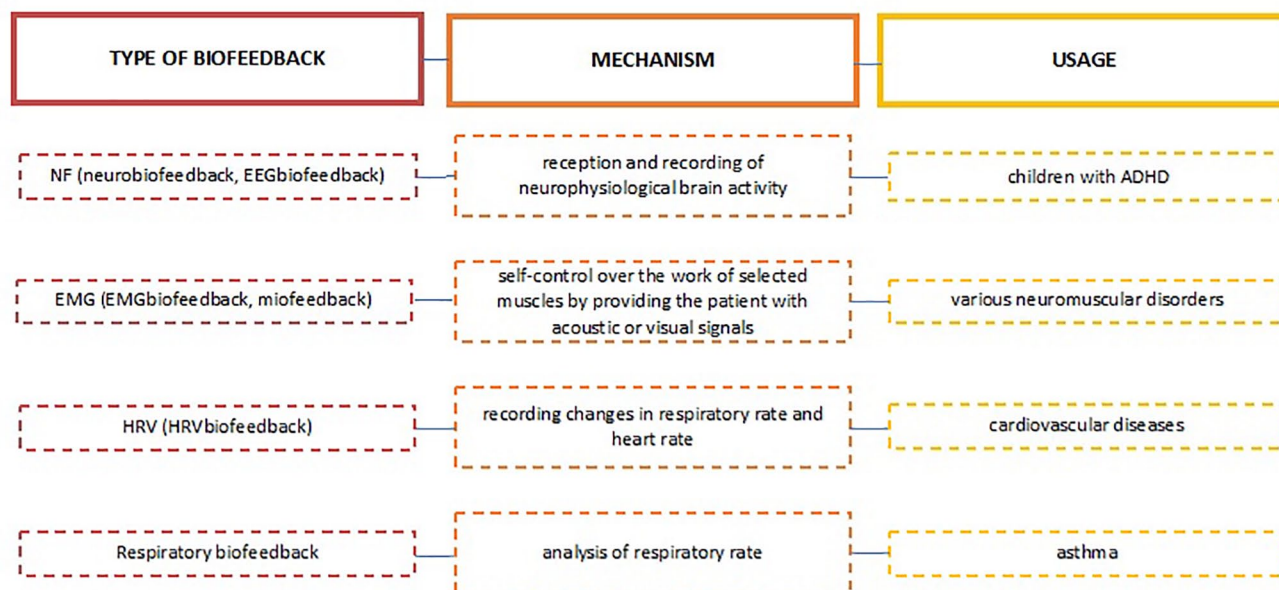
The term “biofeedback” (BF) means biological feedback, and the definition assumes that it is an interdisciplinary field of treatment, based on self-control of physiological processes taking place in our body, which were not previously controlled.<sup>44</sup> A common formulation defining BF is “awareness of previously unaware activities.”<sup>2</sup>

Work on BF treatment began as early as the beginning of the 20th century. E. Jacobson is considered to be one of the precursors of BF, and was the first to use BF to reduce psychomotor tension.<sup>44</sup> An important date is also 1975, when the Shapiro researcher closely related the training and control of brain waves.<sup>45</sup> It can be concluded that the establishment of the Biofeedback Society (USA) in 1969 is the moment when BF was recognized as a method of therapy, the effects of which have been confirmed by numerous studies.<sup>44</sup> This treatment method is based on a technique to provide up-to-date and real feedback on the specific body parts undergoing therapy.<sup>46</sup> The main task of BF in therapy is to influence the psychophysical state of examined person. Thanks to

the possibility of self-monitoring, the patients are motivated, they also increase the awareness of physiological activity of their bodies, as well as their possibilities, about which they had not known before or were not aware. They can also directly control the progress of treatment through their visualizations.<sup>45</sup> There are many types of BF, their number continues to grow along with increasing interest in this treatment method, and the choice of method is adapted to specific disease entities. The most commonly used types of BF are as follows (Figure 1): (a) NF (neuro BF, electroencephalograph (EEG) BF), which consists of the reception and recording of neurophysiological brain activity (frequency of brain waves), which are a response to a given stimulus, by the apparatus designed for this purpose. This type of BF is used to treat children with ADHD attention deficit hyperactivity disorder (ADHD);<sup>7</sup> (b) Electromyography (EMG BF, miofeedback), which is a part of exercises where the main element is self-control over the work of selected muscles by providing the patient with acoustic or visual signals. This method is used in various neuromuscular disorders;<sup>47</sup> (c) Heart rate variability (HRV BF), which records changes in respiratory rate and heart rate in case of cardiovascular diseases; (d) respiratory BF, which is based on the analysis of respiratory rate. This method has been used in the treatment of asthma.<sup>44,45</sup>

### Stress urinary incontinence and Kegel muscles

BF is mainly used in SUI, because this method increases the muscle strength of pelvic floor muscles, which in this type of incontinence are weakened. The pelvic floor muscles (Kegel muscles) are a specific basket supporting the internal organs within abdominal cavity. They are supported in this task by the fascia within pelvis. The following muscles play an essential role in maintaining urine and feces: levator ani, muscles of this group (coccygeus, iliococcygeus and pubococcygeus), as well as urethral sphincters and transverse perineal muscles.<sup>6,48</sup> Weakening of the previously mentioned muscles is a result of degradation of collagen structures in the tissue, and injuries during childbirth. During pregnancy, as well as after delivery, an increased synthesis of estrogen, a hormone that weakens collagen in pelvic floor muscle tissues, is observed in a woman. This results in tissue limpness and weakness of their contractility. This causes problems with maintaining urine and often even feces. Collagen



**Figure 1.** The most commonly used types of biofeedback.

damage in tissues is also observed very intensively during and after menopause.<sup>4,49,50</sup>

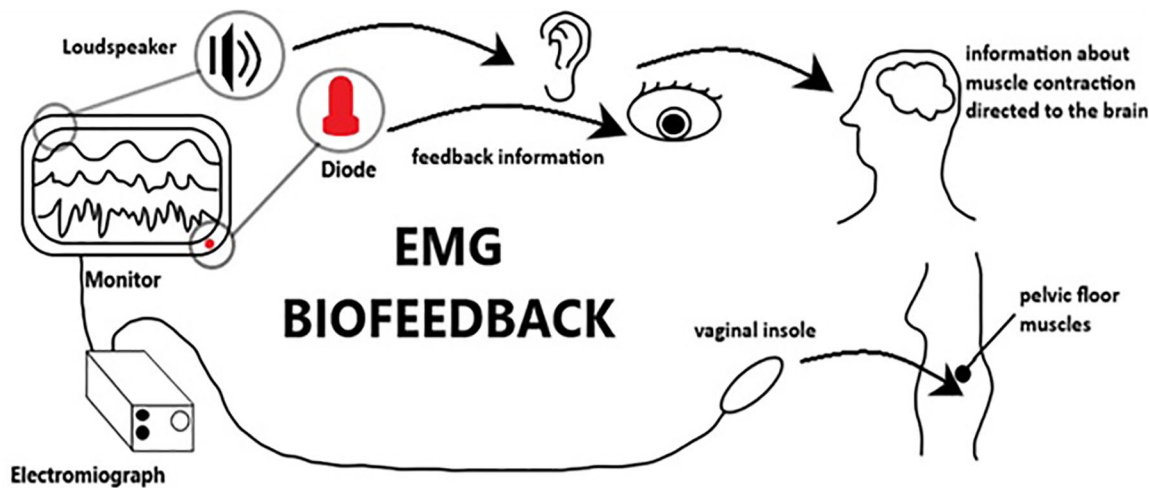
Pelvic floor muscle training has a significant influence on UI prevention in women. Unfortunately, the knowledge on appropriate contraction and training of these muscles is limited, as shown by research conducted by Piernicka *et al.*<sup>51</sup> on 98 students, where about 20% of them were unable to perform adequate Kegel muscle contraction, and most of them pointed to the need to improve access to knowledge about both the muscles and their training methods.

### Biofeedback in urinary incontinence treatment

Although BF in UI treatment was discovered and invented many years ago, it is only in recent years that the popularity of BF has increased and more doctors are using biological feedback as a noninvasive therapy. The precursor of BF in pelvic floor muscle treatment is undoubtedly the American gynecologist Arnold Kegel. The woman undergoing this examination was vaginally injected with a probe, which was connected to a pressure recording device, in this case it was an observation of the deflection of a mercury pole, which moved with a change in vaginal pressure caused by muscle contraction. Thanks to this, the examiner was able to record the pelvic floor

muscles on an ongoing basis, while the person under examination was able to realize when the contraction was occurring, when it is most effective and to understand that she has control over body parts of which she was previously unaware.<sup>6,46,52</sup> This method has now been modernized. Part of the apparatus is an educator in the form of a vaginal contractions can detect pressure changes in the vagina. The vaginal insoles are designed so that they do not impede the patient's movements and are comfortable to apply. The educator is connected to a device that records muscle contraction. The patient continuously monitors the quality of contractions through visual stimuli (which can also be auditory). There is also an indicator and a range of normal muscle tension. During therapy, the patient must contract the muscles in such a way that the value on monitor is close to the physiological range of contraction.

EMG is often added to the BF method, which in addition to biological feedback is used for muscle electromyography. The electromyogram is a device that records the electrical activity of muscles and nerves. In this method it is possible to use both vaginal and surface electrodes, which are placed in the lower abdomen and perineum (surface electromyographic, sEMG BF). The electrodes capture the tension of pelvic floor muscles, record them and then send information about



**Figure 2.** EMG biofeedback scheme of urinary incontinence treatment.

their contraction to the apparatus connected to them. The patient is able to monitor the quality of muscle contractions she exercises on the monitor on an ongoing basis. Her task is to perform such a Kegel muscle contraction to fit within the limits of their appropriate physiological tension. In addition, the device has a built-in loudspeaker or a diode. Both the auditory and visual stimulus is activated when the patient correctly performs the muscle contraction.<sup>6</sup> In BF treatment method, it is possible to list the main advantages (Figure 2): (a) the patient and person conducting; (b) examination monitor their progress in the treatment on an ongoing basis; (c) examined person by visual or auditory stimuli knows when she is performing the task correctly; (d) by bringing the contraction closer to the normal values, the patient has an opportunity to directly modify the way in which she performs the muscle contraction; (e) psychotherapeutic effects through increased motivation and willingness to undertake treatment.

### Clinical studies on urinary incontinence and biofeedback therapy

The knowledge on the use of BF in UI treatment is still relatively low. Koziol *et al.*<sup>11</sup> conducted research on 40 women aged 20 to over 50 years, including women without symptoms and those with UI symptoms. Women completed detailed questionnaires, which provided important information related to disease. It turned out that only five women had heard of BF, while four of them used this method. All women treated with BF saw improvement and were satisfied with the course of treatment.

BF also supports other physiotherapeutic methods to treat UI. Terlikowski *et al.*<sup>53</sup> in a study of 102 women divided them into two groups: 68 women were treated and 34 belonged to the placebo group. The complete treatment process lasted 2 weeks and women were electro-stimulated with superficial EMG BF. Subsequently, differences between the two groups were observed by means of a lapse test, supplementation of the quality of life questionnaire, muscle strength and a diary of urination. Significant improvement and decrease in the frequency of uncontrolled urinary leaks in the group treated by electrostimulation (ES) combined with EMG BF compared with the placebo group was observed. The authors concluded that feedback significantly influences the treatment process, and the use of this method with ES increases its effect.<sup>53,54</sup>

Another noteworthy study was carried out in Slovakia by Hagojska and Takac.<sup>55</sup> The research group consisted of 66 women (46 reported symptoms of UI), while the rest of the women had no UI problem. They were treated with EMG BF, during which they exercised pelvic floor muscles twice a day for 15 min each day and twice a week for 30 min for the whole group. Treatment progress was assessed using the Conlife survey. Results of conducted studies show an improvement and decrease in the frequency of involuntary urinations in women undergoing treatment.

Rett *et al.*<sup>56</sup> conducted research on 26 women of childbearing age, before menopause. These women were treated with superficial BF (sEMG). Only 12 therapeutic sessions were used, which

may seem like a small number of treatments. However, the results showed that even a short treatment reduced the symptoms of UI in 61.5% of women. The authors emphasize that EMG BF therapy is highly effective and should be used as a noninvasive UI treatment.

The role of BF and palpation feedback in UI treatment is the main topic of study of Burgio *et al.*<sup>57</sup> The study involved 222 women aged 55–92 years. They were divided into three groups, of which the first group was treated with BF, the second group with palpable feedback, while the third group exercised the muscles on its own, without the help of feedback from distributed brochures. In the first group it was observed that the number of involuntary urinations decreased in 61.3% of patients, in the second group symptoms subsided in 69.4% of women, while in the third group an improvement was observed in 58.6% of respondents. Although the main aim of study was to observe the role of BF in the treatment of UI, the second aspect should also be noted. Women were also asked about the sensations of treatment, 75% of women were satisfied with BF, 85.5% with palpation feedback and only 55.7% with the use of brochures. In conclusion, both BF and palpation feedback significantly influence incontinence treatment, and the therapy is satisfactory for patients.<sup>57</sup>

Herderschee *et al.*<sup>58</sup> conducted a long-term study of 24 out of 1583 women and analyzed various methods and aspects of UI treatment. Part of the research on feedback, BF and pelvic floor muscle training is noteworthy. The results show that women treated with biological feedback report a significant reduction in the symptoms of involuntary urination compared with pelvic floor muscle training (PFMT). The second, equally important aspect of the study is contact with medical personnel, which was much higher in women using BF. The author points out that in order to increase the results of UI treatment in women, BF should also be used for basic pelvic floor muscle exercises, as it significantly reduces the intensity of involuntary urinary leaks.

Studies conducted by Burns *et al.*<sup>59</sup> on 135 women of perimenopausal age with UI were aimed to illustrate the efficacy of EMG BF. The study was divided into three groups, of which EMG BF was used in the first group, pelvic floor muscle exercise in the second group, and no treatment was undertaken in the third

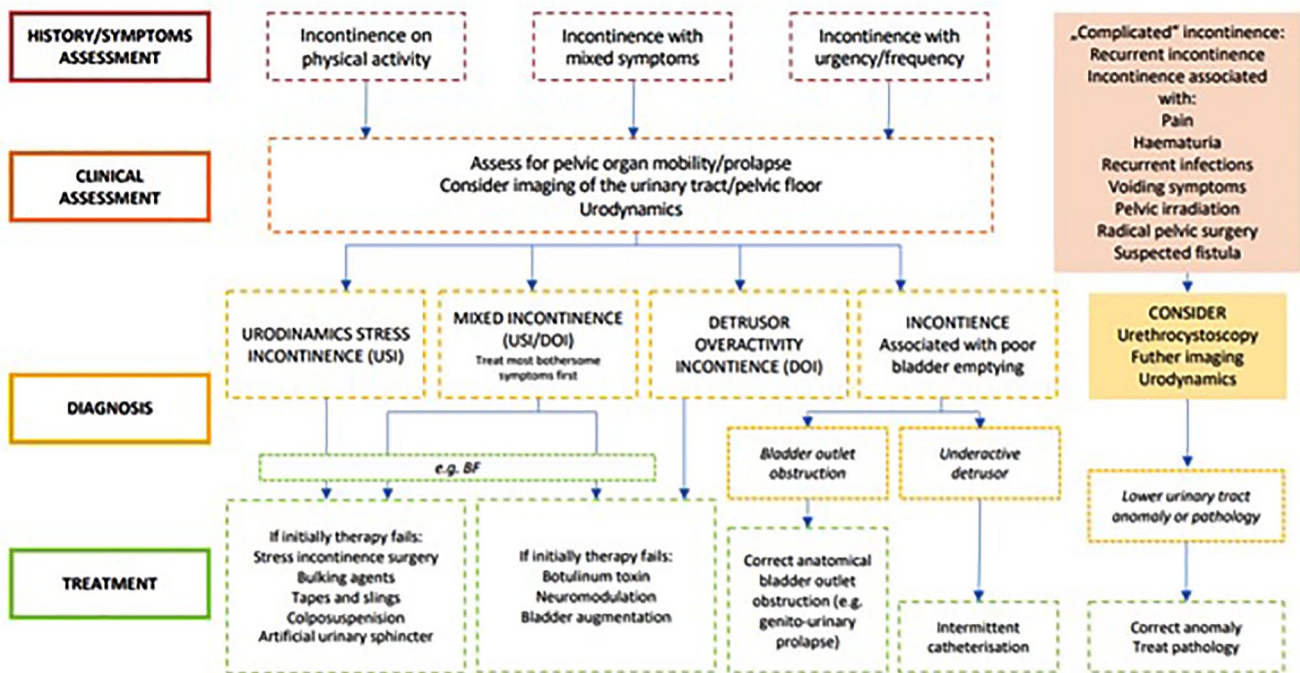
group. In the first and second group a significant reduction of involuntary urination ailments was observed, while in the third group there were no significant changes. In the group of women with BF combined with electromyography treatment results were significantly better than in the group with PFMT. The authors of study state that the use of biological feedback has a greater influence on the learning of adequate Kegel muscle contraction than on the exercise itself, and thus it is a method that significantly reduces involuntary urination in women.<sup>6</sup>

Dannecker *et al.*<sup>60</sup> conducted a 7-year study between 1996 and 2003, in which 444 women of around 50 years of age participated. Women were treated with EMG BF of pelvic floor muscles, then 320 women after the treatment period provided completed questionnaires showing the treatment effects. Among surveyed women, as many as 71% of them observed improvement or even subsidence of involuntary urination, and only 13% opted for surgical treatment. The authors of the study concluded that the use of EMG BF, noninvasive treatment method, had a significant impact on the treatment process in examined women. It can also be concluded that the use of biological feedback combined with electromyography of pelvic floor muscles may protect against the necessity to undergo a much more invasive method of treatment, which is undoubtedly a surgical procedure.<sup>60</sup>

Capelini *et al.*<sup>61</sup> conducted research on 14 women suffering from SUI. The treatment period lasted 3 months and they were treating pelvic floor muscles using the BF method. The changes during treatment were shown by means of a tampon test, urological tests and a bladder diary, where the examined patients entered when and in what amount they urinated, and at the end of treatment they completed a special King's health questionnaire (KHQ). Collected and summarized results after the end of therapy showed the improvement of involuntary urinary leaks in all examined women. The authors summarize the study, pointing out that BF treatment significantly affects the reduction of symptoms in women with SUI.

### Other urinary incontinence treatments

There are many possibilities of using therapeutic methods in UI in women, and their selection



**Figure 3.** Specialized management of urinary incontinence in women.

depends on the diagnostic process, which consists in determining the severity and origin of disease. Specialized management of UI in women is presented on Figure 3. UI treatment is a multistage process in which we distinguish between conservative therapy, the cheapest and least invasive form, and surgical treatment, which is the last resort if a patient does not consent to conservative treatment, or if the conservative measures do not produce the expected results for an extended period of therapy. Behavioral management requires significant commitment not only on the part of the patient, but also on the part of physiotherapist, because only systematic and conscientious work will bring the expected results. We divide conservative measures into: (1) Physical therapeutic methods (passive methods of treatment), which include ES procedures. It is a very popular method of conservative therapy, increasing rest tension, strength and length of pelvic floor muscle contraction. This is confirmed by a study conducted by Cendrowska *et al.*<sup>62</sup> on a group of 28 patients treated with vaginal ES in the Department and Clinic of Obstetrics, Women's Diseases and Oncological Gynaecology of the 2nd Medical University of Warsaw, which shows a positive effect of applied therapy in 89% of the examined patients.

Variable magnetic field is also used, which may be in the form of mini applicators or an armchair, which is the source of magnetic field. These applicators are attached to the patient's underwear, which allows for permanent exposure of the pelvic organs of the smaller pelvis to electromagnetic fields. Laser therapy is an uncommon therapeutic method used due to the role of collagen in ligament structures of the smaller pelvic region. It is important to remember the contraindications to procedures;<sup>4,63,64</sup> (2) Therapeutic massage, which is used as a supplement to re-educational exercises of the smaller pelvic floor muscles. Its task is to improve the tension of connective tissue around the bladder and to improve blood and lymph flow;<sup>65</sup> (3) Behavioral methods, which is a therapy consisting of modification of the patient's habits and development of specific behaviors, which include taking a certain amount of fluids, dropping excessive obesity, limiting smoking and limiting consumption of products causing urinary tract irritation, (citruses, alcohol, sugars, dairy products, caffeine and tomatoes). A strenuous effort, which may cause an increase in pressure in the abdominal prelum, should also be avoided;<sup>66,67</sup> (4) Kinesitherapeutic methods, which include pelvic floor muscle training, consisting primarily of conscious and regular stretching and relaxation of the smaller pelvic floor

muscles. Regular Kegel exercises improve pelvic floor muscle tension and blood supply. We can also exercise gluteal muscles and adductors of thighs and abdomen. Pilates exercises are also applicable in UI;<sup>5,14,64,68</sup> (5) Pharmacotherapy is where medicines are selected for each patient individually, with particular emphasis on coexisting diseases and reactions to given agents. This type of therapy must often be improved due to the constant modernization of pharmacotherapeutic agents. Unfortunately, it does not affect anatomical structures, but only the increase in urethral closure pressure or the reduction in volume of urine production at night. Pharmacotherapy also includes hormone therapy, which is used in women during menopause and estrogen deficiency. The therapy results in reduction of urination disorders symptoms;<sup>68-70</sup> (6) Surgical treatment, which is one of the invasive methods of UI treatment. The most common and effective surgical procedure is pubic influenza suspension. A less invasive measure is injection of the coil area with sealing agents such as Contigen and Durasphere. Unfortunately, this procedure is unsustainable and requires several repetitions.<sup>16,67,69</sup> The use of these methods in combination with properly selected kinesitherapy is more effective than physical therapy alone.

### Urinary incontinence and women's quality of life

The problem of UI, at the same time affects the quality of life in private, social and professional terms. This is expressed, among others, by a change in the patient's own and loved ones' lifestyle, limited sexual contacts, increased spending on pharmaceuticals and specialists in order to treat UI, and resignation from social life and even work.<sup>9</sup> A study conducted by Dutkiewicz and Kapusta<sup>20</sup> on a group of 60 women older than 50 years of age from the Department of Care and Medicine in Kielce showed a negative impact of UI on the quality of life in examined women. A change in lifestyle and a decrease in social contacts were confirmed by 91.7% of female residents. On the other hand, 65% feel ashamed, 16.7% of women are worried about the lack of control over unexpected urine leakage, and 66.7% of respondents are worried about wet clothes. There is a high risk that these factors may have a negative impact on the mental health of patients. Slow isolation from society, limitations of everyday activities (e.g. shopping, travelling, arguing), and the constant fear of uncontrolled urination

lead to emotional or even depressive disorders.<sup>20,71</sup> UI is a taboo subject and due to the intimate nature of disease, it is a serious barrier to appropriate treatment, and many women believe that bladder anomalies are a consequence of the passing time. This is confirmed by a study carried out by Cichonska *et al.*<sup>72</sup> on the knowledge level on UI, for example, the cause, source of knowledge and treatment method of the disease in question. A questionnaire containing 22 questions was filled in by 110 women. The analysis of results showed that 88% of respondents did not take advantage of a visit to specialist after occurrence of the ailment. It is unsatisfactory that 16% of respondents obtained information about UI from a qualified person, 28% through friends and 32% from the Internet and press.

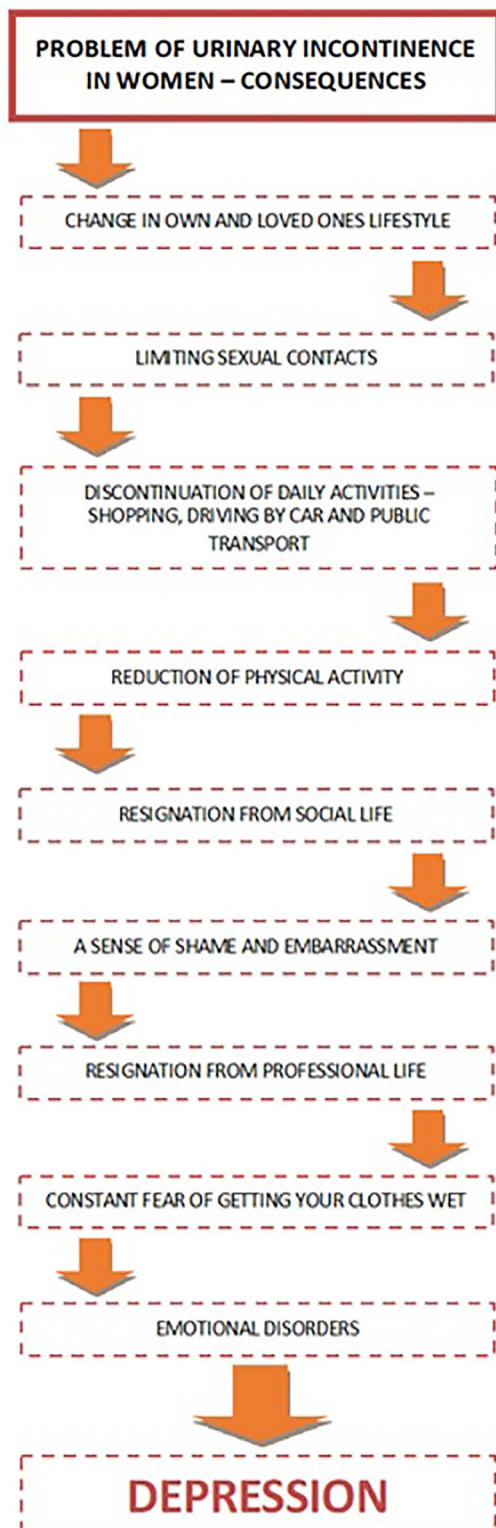
### Prevention of urinary incontinence

In the prevention of incontinence, the most important role is medical personnel, whose task is to make patients aware of the most beneficial possibilities of primary prevention and of the resources of modern medicine in UI treatment. It is believed that incontinence is a very embarrassing and uncomfortable issue. Many women do not receive adequate treatment, as it turns out, not because of shame,<sup>11</sup> but because of the lack of information from medical staff on the possibilities of receiving treatment, which will certainly improve the quality of life in the private, professional and social spheres. Women in the prenatal and postnatal period should take particular care of physical activity, with particular emphasis on Kegel muscle training, which increases muscle tension and improves their functionality. Implementation of early preventive measures in young women may reduce the risk of this disease (Figure 4). That is why it is so important to mobilize women to change their lifestyle to a healthier one; to reduce body weight (especially the percentage of body fat ratio), to limit the use of stimulants, to prevent constipation and to use systematic physical activity.<sup>11,14,73</sup>

### Conclusion

BF has become an increasingly popular method of UI treatment, at the same as time teaching women self-awareness of their bodies and the physiological processes taking place in them. Insufficient information on treatment options, prevention methods and possible complications resulting from not treating this embarrassing





**Figure 4.** Diagram showing the problems of women with urinary incontinence.

disease is worrying. Encouraging women to take preventive action and making patients aware of

the benefits of prevention should be the responsibility of every healthcare professional to reduce the significant number of people suffering from UI.

#### Conflict of interest statement

The authors declare that there is no conflict of interest.

#### Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

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#### References

1. Abrams P, Andersson KE, Birder L, *et al.*; Members of Committees, Fourth International Consultation on Incontinence. Fourth international consultation on incontinence recommendations of the international scientific committee: evaluation and treatment of urinary incontinence, pelvic organ prolapse, and fecal incontinence. *Neurourol Urodyn* 2010; 29: 213–240.
2. Borowicz AM and Wieczorowska-Tobis K. Physiotherapy treatment in urinary incontinence. *Gerontol Pol* 2010; 18: 114–119.
3. Derewiecki T, Mroczek M, Majcher P, *et al.* Importance of urinary incontinence problem among women over 40 years of age. *Hygeia Publ Health* 2015; 50: 219–225.
4. Fiodorenko-Dumas Z and Paprocka-Borowicz M. Physiotherapy in urinary incontinence. *Med Og Nauk Zdr* 2014; 20: 12–16.
5. Hrycyna M and Strupińska-Thor E. Exercises strenghtening muscles of the true pelvis fundus in women with stress urinary incontinence. *Zeszyty Naukowe WSKFiT* 2016; 11: 21–28.
6. Opara J, Socha T, Prajsner A, *et al.* Physiotherapy in stress urinary incontinence in females Part I. Contemporary recommendations for Kegel exercises (PFME). *Physiotherapy* 2011; 19: 41–49.
7. Chmielewska DD and Piecha M. Urinary incontinence: a problem of the modern woman. *Menopause Rev* 2013; 5: 378–384.
8. Wlzlak E, Surkont G, Stetkiewicz T, *et al.* Influence of selected non-operative treatment methods of urinary stress incontinence on

- patients' life quality. *Menopause Rev* 2005; 2: 53–60.
9. Klimaszewska K. The social aspects of urinary incontinence of women. *Pielęg XXI w* 2017; 16: 57–61.
  10. Radziszewski P, Dobrobski P and Borkowski A. Chirurgiczne leczenie wysiłkowego nietrzymania moczu ukobiet. *Terapia* 2002; 4: 15–19.
  11. Zygmunt R, Kozioł S, Hładki W, *et al.* The influence of physiotherapy on incontinence in women. *Emergency Duty* 2017; 10: 77–83.
  12. Berghmans LCM, Hendriks HJM, De Bie RA, *et al.* Conservative treatment of urge urinary incontinence in women: a systematic review of randomized clinical trials. *BjU Int* 2000; 85: 254–263.
  13. Klisowska I, Dabek A, Zborowska I, *et al.* Urinary incontinence – task for the physiotherapist. Part II. *Piel Zdr Publ* 2012; 2: 145–152.
  14. Opara JA, Socha T and Poswiata A. Pelvic floor muscle exercise as the best stress urinary incontinence prevention method in women practising competitive sport. *Physiotherapy* 2013; 21: 57–63.
  15. Opara J, Socha T and Prajsner A. Physiotherapy in stress urinary incontinence in females Part III. Electrical stimulation in stress urinary incontinence. *Physiotherapy* 2012; 20: 79–86.
  16. Purc D and Rasala A. Method of treating urinary incontinence. *Eur J Med Technol* 2015; 3: 29–38.
  17. Nowara A, Witek A and Wilk K. Diagnostic and treatment of over active bladder. *Ginekol Pol* 2007; 78: 549–553.
  18. Ptak M. The impact of pelvic floor muscle exercises with and without synergistic muscles on the quality of life of women with stress urinary incontinence. *Pomeranian J Life Sci* 2017; 63: 49–55.
  19. Surkont G and Wlazlak E. Urinary incontinence in women – social, medical and scientific problem. *Menopause Rev* 2003; 1: 59–65.
  20. Dutkiewicz S and Kapusta K. Risk factors and quality of life in urinary incontinence females in the care and medical centre in Kielce. *Menopause Rev* 2011; 6: 493–499.
  21. Kubik A and Kubik P. Influence of the neurofeedback therapy on EEG pattern in children with ADHD syndrome. *Przeł Lek* 2011; 68: 1092–1097.
  22. Olsen AL, Smith VJ, Bergstrom JO, *et al.* Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol* 1997; 89: 501–506.
  23. Wierzbicka M, Urban K, Murawski M, *et al.* Prevalence and risk factors of urinary incontinence in women. *Physiotherapy* 2009; 17: 38–44.
  24. Garcia-Sanchez E, Rubio-Arias JA, Avila-Gandia V, *et al.* Effectiveness of pelvic floor muscle training in treating urinary incontinence in women: a current review. *Actas Urol Esp* 2016; 40: 271–278.
  25. Townsend MK, Danforth KN, Rosner B, *et al.* Physical activity and incident urinary incontinence in middle-aged women. *J Urol* 2008; 179: 1012–1016; discussion 1016–1017.
  26. Cardoso AMB, Lima C and Ferreira CWS. Prevalence of urinary incontinence in high-impact sports athletes and their association with knowledge, attitude and practice about this dysfunction. *Eur J Sport Sci* 2018; 18: 1405–1412.
  27. Carvalhais A, Natal Jorge R and Bo K. Performing high-level sport is strongly associated with urinary incontinence in elite athletes: a comparative study of 372 elite female athletes and 372 controls. *Br J Sports Med* 2018; 52: 1586–1590.
  28. Casey EK and Temme K. Pelvic floor muscle function and urinary incontinence in the female athlete. *Phys Sportsmed* 2017; 45: 399–407.
  29. Dos Santos KM, Da Roza T, Tonon da Luz SC, *et al.* Quantification of urinary loss in nulliparous athletes during 1 hour of sports training. *PM R* 2019; 11: 495–502.
  30. Hagovska M, Svihra J, Bukova A, *et al.* The impact of physical activity measured by the international physical activity questionnaire on the prevalence of stress urinary incontinence in young women. *Eur J Obstet Gynecol Reprod Biol* 2018; 228: 308–312.
  31. Poswiata A, Socha T and Opara J. Prevalence of stress urinary incontinence in elite female endurance athletes. *J Hum Kinet* 2014; 44: 91–96.
  32. Da Roza T, Brandao S, Mascarenhas T, *et al.* Volume of training and the ranking level are associated with the leakage of urine in young female trampolinists. *Clin J Sport Med* 2015; 25: 270–275.
  33. Bo K. Urinary incontinence, pelvic floor dysfunction, exercise and sport. *Sports Med* 2004; 34: 451–464.
  34. Kruger JA, Murphy BA and Heap SW. Alterations in levator ani morphology in elite nulliparous athletes: a pilot study. *Aust N Z J Obstet Gynaecol* 2005; 45: 42–47.

35. Louis-Charles K, Biggie K, Wolfinbarger A, *et al.* Pelvic floor dysfunction in the female athlete. *Curr Sports Med Rep* 2019; 18: 49–52.
36. de Mattos Lourenco TR, Matsuoka PK, Baracat EC, *et al.* Urinary incontinence in female athletes: a systematic review. *Int Urogynecol J* 2018; 29: 1757–1763.
37. Teixeira RV, Colla C, Sbruzzi G, *et al.* Prevalence of urinary incontinence in female athletes: a systematic review with meta-analysis. *Int Urogynecol J* 2018; 29: 1717–1725.
38. Fozzatti C, Riccetto C, Herrmann V, *et al.* Prevalence study of stress urinary incontinence in women who perform high-impact exercises. *Int Urogynecol J* 2012; 23: 1687–1691.
39. Moser H, Leitner M, Eichelberger P, *et al.* Pelvic floor muscle activity during jumps in continent and incontinent women: an exploratory study. *Arch Gynecol Obstet* 2018; 297: 1455–1463.
40. Saeuberli PW, Schraknepper A, Eichelberger P, *et al.* Reflex activity of pelvic floor muscles during drop landings and mini-trampolining-exploratory study. *Int Urogynecol J* 2018; 29: 1833–1840.
41. Bo K, Bratland-Sanda S and Sundgot-Borgen J. Urinary incontinence among group fitness instructors including yoga and pilates teachers. *Neurourol Urodyn* 2011; 30: 370–373.
42. Dornowski M, Makar P, Sawicki P, *et al.* Effects of low- vs high-volume swimming training on pelvic floor muscle activity in women. *Biol Sport* 2019; 36: 95–99.
43. Simeone C, Moroni A, Petteno A, *et al.* Occurrence rates and predictors of lower urinary tract symptoms and incontinence in female athletes. *Urologia* 2010; 77: 139–146.
44. Gebska M, Wojciechowska A, Weber-Nowakowska K, *et al.* The use of biofeedback training in physiotherapy. *Acta Balneol* 2013; 55: 293–296.
45. Kubik P. Types of biofeedback. *Przegl Lek* 2016; 73: 191–193.
46. Szymanowski P, Wojcik A, Szepieniec WK, *et al.* Complex treatment of urogynecological conditions. The role of physiotherapy. *Rehabilitacja w ginekologii* 2014; 3: 15–18.
47. Walkowiak H. EEG biofeedback: characteristics, application, opinions of specialists. *Studia Edukacyjne* 2015; 36: 307–325.
48. Oleksy L, Mika A, Kielnar R, *et al.* The use of transabdominal ultrasound in pelvic floor muscles evaluation in physiotherapy. *Acta Bio-Opt Inform Med Inż Biomed* 2017; 23: 270–277.
49. Jozwik M and Jozwik M. Impact of vaginal delivery on the function of the Lower urinary tract and pelvic floor innervation – an overview of current knowledge. *Nowa Med* 2000; 5: 44–48.
50. Lochowska M, Szumilewicz A, Dornowski M, *et al.* Changes in the neuromuscular activity in pelvic-floor muscles in health nulliparas after supervised or unsupervised training – a randomized trial with two experimental groups. *Rocznik Naukowy AWFIS w Gdańsku*, 2015; 25: 52–58.
51. Piernicka M, Szumilewicz A, Dornowski M, *et al.* Teaching the technique of pelvic-floor muscle exercises among sport university females students – a randomized controlled trial. *Rocznik Naukowy AWFIS w Gdańsku* 2015; 25: 45–51.
52. Jarzebicka D, Sleczkowska J, Ryzko J, *et al.* Biofeedback therapy in the treatment of functional constipation. *Stand Med Pediatr* 2014; 11: 396–401.
53. Terlikowski R, Dobrzycka B, Kinalski M, *et al.* Transvaginal electrical stimulation with surface-EMG biofeedback in managing stress urinary incontinence in women of premenopausal age: a double-blind, placebo-controlled, randomized clinical trial. *Int Urogynecol J* 2013; 24: 1631–1638.
54. Weber-Rajek M, Bulatowicz I, Radziminska A, *et al.* Evaluation of the efficacy of physical methods in the treatment of urinary incontinence in women - a review of research. *J Educ Health Sport* 2015; 5: 11–34.
55. Hagovska M and Takac P. EMG biofeedback as a diagnostic and therapeutic method in the treatment and prevention of women's urinary incontinence. *Prz Med Univ Rzesz Inst Leków* 2010; 4: 410–418.
56. Rett MT, Simoes JA, Herrmann V, *et al.* Management of stress urinary incontinence with surface electromyography-assisted biofeedback in women of reproductive age. *Phys Ther* 2007; 87: 136–142.
57. Burgio KL, Goode PS, Locher JL, *et al.* Behavioral training with and without biofeedback in the treatment of urge incontinence in older women: a randomized controlled trial. *JAMA* 2002; 288: 2293–2299.
58. Herderschee R, Hay-Smith EJ, Herbison GP, *et al.* Feedback or biofeedback to augment pelvic floor muscle training for urinary incontinence in women. *Cochrane Database Syst Rev* 2011; CD009252.
59. Burns PA, Pranikoff K, Nochajski T, *et al.* Treatment of stress incontinence with pelvic floor exercises and biofeedback. *J Am Geriatr Soc* 1990; 38: 341–344.
60. Dannecker C, Wolf V, Raab R, *et al.* EMG-biofeedback assisted pelvic floor muscle training

- is an effective therapy of stress urinary or mixed incontinence: a 7-year experience with 390 patients. *Arch Gynecol Obstet* 2005; 273: 93–97.
61. Capelini MV, Riccetto CL, Dambros M, *et al.* Pelvic floor exercises with biofeedback for stress urinary incontinence. *Int Braz J Urol* 2006; 32: 462–468; discussion 469.
62. Cendrowska A, Nalewczynska A and Kowalska J. Pelvic floor electrical stimulation (PFES) as a conservative method of urinary incontinence treatment in women. *Ginekol Prakt* 2010; 18: 34–38.
63. Debinski P and Niezgoda T. Classification of urinary incontinence and methods of treatment. *Przeegl Urol* 2014; 5: 1–6.
64. Hojan K, Tyminska A, Kurnatowski J, *et al.* Physiotherapy in neurogenic bladder therapy. *Prakt Fizjoter Rehabil* 2016; 6–16.
65. Wierzbicka M, Urban K, Murawski M, *et al.* The treatment of urinary stress incontinence with particular consideration of physiotherapeutic methods. *Physiotherapy* 2010; 18: 53–60.
66. Dalewska M, Kasicka-Jonderko A, Jonderko K, *et al.* Physical exercise – a prescription-free remedy: physical activity in prophylaxis and treatment of female urinary stress incontinence (set of suggested exercises in appendix). *Ann Acad Med Siles* 2013; 67: 384–392.
67. Elliott CS and Sokol ER. New methods of treatment of urinary incontinence. *Contemporary OB/GYN* 2011; 52: 12–23.
68. Rechberge T and Kulik-Rechberger B. Dysfunctions of the lower urinary tract – evaluation and therapeutical approach in family practice. *Forum Med Rodz* 2010; 4: 397–407.
69. Dadej R and Jedrzejczak-Dadej A. Urinary incontinence – treatment. *Geriatrics* 2009; 3: 103–111.
70. Stachowicz N, Maciejczyk-Pencula M, Morawska D, *et al.* Urgent Urinary Incontinence – preliminary diagnostics and pharmacological treatment. *Wiad Lek* 2012; 65: 162–166.
71. Plocka-Molinska M, Jakobczak B and Plagens-Rotman K. The Influence of urinary incontinence on the quality of women’s live. *Pol Prz Nauk Zdr* 2017; 2: 161–167.
72. Cichonska M, Maciag D, Zboina B, *et al.* The assessment of women’s knowledge concerning urinary incontinence. *Zdrowie i Dobrostan* 2013; 4: 45–64.
73. Chmielewska DD, Kwasna K, Piecha M, *et al.* Selected methods of conservative treatment of stress urinary incontinence: current views. Part 1. *Menopause Rev* 2012; 11: 264–268.