Effect of Aquatic Exercises on Severity of Urinary Incontinence and Estrogen Level in Postmenopausal Women

Abbas Saremi1, PhD; Karim Zohrevandian2, PhD; Mohammad Parastesh1, PhD; Samira Khalegi1, MSc

1Department of Exercise Physiology, Faculty of Sport Sciences, Arak University, Arak, Iran
2Department of Exercise Management, Faculty of Sport Sciences, Arak University, Arak, Iran
3Faculty of Sport Sciences, Arak University, Arak, Iran

Abstract

Background: Urinary incontinence (UI) is prevalent among women and seriously impairs the quality of life. Urinary incontinence is believed to be associated with a decrease in estrogen and estrogen regeneration improves these signs. We conducted the present study to assess the effects of aquatic exercise on multiple domains of urinary leakage and estradiol level in postmenopausal women.

Methods: In this semi-experimental study, 24 postmenopausal women with UI were selected from October to December 2019 in Arak, Iran. They were randomized into the aquatic exercise (n=12) and control (n=12) groups. Aquatic exercise was carried out at moderate intensity, three days per week for eight weeks in 33–34°C, swimming pool. The control group did not participate in a supervised program. The International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF) was used to assess urinary incontinence and blood samples were collected 48 hours before and after the last sessions of exercise training. In addition, UI-related practices and the use and modification of daily protection were examined. Estradiol was assessed using enzyme-linked immunosorbent assay (ELISA assay). The data were analyzed utilizing paired t test or Wilcoxon test in SPSS version 21.

Results: The mean age of the subjects was 56.77 years old; 78.6% were married and 58% were overweight. The ICIQ-SF score (P=0.03) as well as severity of urinary incontinence symptoms (P=0.05) in the exercise group improved significantly compared to those in the control group. Furthermore, no significant differences in estradiol level were observed between the groups (P>0.05).

Conclusion: Aquatic exercise was found to be beneficial and improved fitness and severity of urinary incontinence in postmenopausal women although this improvement occurred without changes in estrogen levels.

Keywords: Aquatic exercise, Estradiol, Postmenopausal, Urinary incontinence


1. Introduction

Urinary incontinence is a discontent of involuntary loss of urine. Urinary incontinence is divided as stress incontinence, emergency incontinence, postural incontinence, enuresis, mixed incontinence, persistent incontinence, numb incontinence, and sexual incontinence. The most popular form of involuntary loss of urine owing to exercise training, sneezing or coughing is stress incontinence (1). Urinary incontinence is a usual disorder among women. Urinary leakage is reported at least once a year by 25-45% of women (2). Along with age, the prevalence of urinary incontinence increases from 7% in non-pregnant women aged 20 to 32% in women over 80 (3). Major causes of urinary incontinence in women include age, childbirth, obesity, diabetes, stroke, smoking, depression, dysfunction, strenuous physical activity, estrogen deficiency, and genitourinary surgery (for example, hysterectomy) (4). Urinary incontinence is related to clinical and psychological complications that strongly affect the quality of life; stress urinary incontinence increases following menopause (5). Although the exact mechanism is not clear, it has been suggested that a decrease in estrogen levels in...
postmenopausal women leads to atrophy of the urogenital system and urinary mucosa and narrowing of the mucosal vascular network in the urethra eventually leads to hypersensitivity and urinary incontinence (6). Several studies have emphasized the role and importance of estrogen in pelvic organ prolapse and incontinence. Therefore, hormone therapy is a recommended procedure for the treatment of urinary incontinence in postmenopausal women (7, 8). However, the results have been contradictory and several complications have been reported in women undergoing hormone therapy. Numerous alternative therapies are currently available and are claimed to provide a range of benefits to postmenopausal women even though in some cases, there is little scientific support for them (8).

Physical activity was suggested by the ancient Greeks for health and peace of mind. Hippocrates (460-370 BC) stated that eating is good for human health as well as exercise (9). According to the Centers of Disease Control and Prevention, regular exercise is conducive to elimination of menopausal side effects including psychological stress, decreased overall quality of life, weight gain, and loss of strength and muscle mass (10). It is recommended that people do at least 150 minutes of aerobic activity or 75 minutes of strenuous activity per week to stay healthy (11). Participating in a long-term exercise program in postmenopausal women has been associated with improved physical and mental health and overall quality of life (12). Therefore, exercise has been suggested as an important intervention in reducing menopausal symptoms. Interestingly, such progresses could be attained even with low-intensity exercise such as walking (10). Choosing a woman’s exercise activity based on her ability increases her likelihood of adhering to this treatment (13). While we know a lot about the effects of exercise on a variety of diseases, there are few studies on the interaction between exercise and women’s urinary incontinence. Major research has reported the positive effect of pelvic floor muscle exercises on urinary incontinence (8, 14). However, there is evidence that the prevalence of urinary incontinence is high in elite female athletes (1). However, the scientific evidence for the effect of other exercise programs, including moderate-intensity aquatic exercise (a common and desirable form among postmenopausal women) on women’s incontinence is very limited. Thus, the current study aimed to assess the effects of aquatic exercise on multiple domains of urinary leakage and estradiol level in postmenopausal women.

2. Methods

This research was a quasi-experimental study (from October to December 2019) conducted as a pre-test-post-test. The study population included women with stress urinary incontinence under the auspices of Arak Health Centers, Iran.

The sample size was calculated using G Power software (15). Based on the changes in estradiol levels before and after exercise intervention, which were respectively 18.3±2.0 and 16.9±2.3 pg/mL (8), the calculated effect size was 0.64. The alpha level and power were set as 0.05 and 0.80, respectively, which indicated a minimum sample size of 22. In order to diminish the imaginable problems in the study methods, such as the probability of sample lose and the increase in the statistical precision, 24 people were included in the research. Therefore, 24 postmenopausal women (age: 56.77±3.5 years and body mass index: 28.13±3.4 kg/m2) living in Arak were purposefully and voluntarily selected. The participants were invited through the announcements in health centers affiliated to Arak University of Medical Sciences, Arak, Iran. Urinary incontinence is caused by any involuntary discharge of urine from the body, which is characterized by wetting the pad or underwear (5). The criterion for this choice was a positive answer to the following questions: Do you have urinary incontinence (spontaneous and uncontrolled urination)?, Do you experience urinary incontinence when exercising, coughing, sneezing, or laughing? Subsequently, the subjects completed the demographic and clinical information form, which included a brief description of their urinary status. This form was completed by three people in one month until the required sample size was achieved. The individuals were identified as having urinary incontinence and were examined by a gynecologist at this stage to confirm the diagnosis of stress urinary incontinence. According to other inclusion and exclusion criteria, 24 patients were then selected as the research sample. The samples were then randomly divided into two groups of aquatic training (n=12) and control (n=12). For this purpose, an outside researcher produced a computer sequence of odds numbers and the woman was assigned to the aquatic training group or the control group according to the
order of participation in the research. This randomization was performed following the evaluation of the patient, which was a blind evaluation. The University Ethics Committee approved this study with the code of IR.IAU.B.REC.1398.019. This work was conducted after receiving written consent from the candidates. The participants were women who had been menopausal for at least three years and had not received hormone therapy. To be eligible, women must also be able to exercise and have not previously participated in a regular exercise program. Menopause is determined as the suspension of the menstrual cycle for over one year (7). The exclusion criteria were vasculopathy, diabetes mellitus, genital prolapse, neuropathy, thyroid disease, hyperprolactinemia, intolerance or discomfort during exercise (pain, allergy to water and chlorine or other disorders), and reluctance to continue the study and absence for more than two consecutive practice sessions or three sessions during the study.

Exercise intervention

All the training sessions were performed under the supervision of a hydrotherapist and a researcher in the swimming pool of Arak University. The aquatic training was performed in the pool with a depth range of 0.75 to 1.5 meters and a water temperature of 28°C. The aquatic training program was performed three times a week (non-consecutively) with 40 to 60-minute sessions over a period of two months. Each training session included 10 minutes of stretching exercises to warm up, 20 to 50 minutes of core exercises, and 10 minutes of light stretching exercises in water to cool down. The exercise group underwent interval training programs with the following schedule: 10 exercises in each session; each exercise was performed as three sets of 30 second with 15-second intervals three sessions a week. The intensity of the exercises was controlled based on the Borg scale and the ability of people to speak during the exercises at a moderate level. This training program complies with the recommended exercise guidelines through the American College of Sports Medicine for healthy adults (16). Upper and lower body movements were performed alternately to provide additional healing. The control group was asked to maintain their normal activity during the study and not to participate in any exercise programs.

Measurements

Information about demographic data and risk factors for urinary incontinence in women was recorded through interviews. Weight was measured using a Seca scale with an accuracy of 100 grams and height was measured with a tape measure with an accuracy of 0.1 cm. Body mass index was calculated by dividing weight by height in square meters. The status of urinary incontinence was assessed utilizing the International Short-Form Urinary Incontinence Questionnaire (ICIQ-SF). The validity of the questionnaire was assessed through content validity. For this purpose, a questionnaire was sent to a five-member expert board to obtain their opinions. According to their recommendations, the questionnaire was redrafted. Afterwards, based on their opinions, the questionnaire was revised. Moreover, in a recent study by Hajebrahimi and colleagues, the construct validity of the Persian version of ICIQ-SF was evaluated and confirmed (17). The translation validity of the ICIQ-SF was verified by Mokhlesi and colleagues through forward and backward translation. The objective of this questionnaire is to determine the degree of administrative incontinence and its impact on quality of life (18). Moreover, the reliability of questionnaire was evaluated via the pilot study. To test the internal consistency of the instrument, a pilot study was executed 30 days prior to the study. The findings revealed that the structure and language of the questionnaire could be understood by respondents with different demographic characteristics. On the other hand, Cronbach's alpha coefficient for reliability of knowledge about urinary incontinence was 0.79, which is appropriate. This questionnaire evaluates the frequency of urinary incontinence, the rate of incontinence, and how these parameters affect a person's daily life. These items represent the final quality of life score. An interview form was also used to determine the severity of urinary incontinence including questions about the duration of urinary incontinence symptoms (by year), the use of daily sanitary pads, the number of day and night changes, and sanitary pads.

Estrogen evaluation

In order to measure serum estradiol levels, before and after eight weeks of intervention, 5 cc of fasting blood samples were taken from the anticubital vein of each person's left hand and stored in a -30 °C freezer.
after separation. Serum estradiol levels were measured employing a human ELISA kit (DRG Germany) at a sensitivity of 10 pg/mL.

Statistical analyses

Following data collection, SPSS version 22 was used for data analysis. The normality of the data was assessed with the use of the Shapiro-Wilk test. Depending on the data distribution, paired t-test or Wilcoxon test were utilized for intragroup comparison and independent t-test or Mann-Whitney test was used for intergroup comparison. The significance level in all the tests was considered to be less than 0.05.

3. Results

In this study, 24 elderly women were randomly selected, 12 in the control group and 12 in the exercise intervention group. There was some sample drop during the study. Accordingly, 12 people in the intervention group and 11 people in the control group completed the study. The participants in the control group had a mean age of 57.13±3.5 years, most of whom were married (78%) and had 10 years of education (71.5%). The average body mass index of the control group was 28.05±3.8 kg/m2 and 57% of them were overweight. The subjects in the intervention group had a mean age of 56.42±4.1 years; most women were married (79.2%) and had seven to nine years of education (61.1%). The average body mass index of the intervention group was

<table>
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<tr>
<th>Table 1: Baseline participant characteristics by intervention assignment</th>
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<td>Variables</td>
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<tr>
<td>Age(yr.)</td>
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<tr>
<td>Weight(kg)</td>
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<tr>
<td>Body mass index(kg/m2)</td>
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<tr>
<td>Menopause time(yr.)</td>
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<td>Normal birth(n)</td>
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Data are presented as mean± standard deviation.

<table>
<thead>
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<th>Table 2: Comparison of the risk factors of urinary incontinence in the study groups</th>
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<td>Risk Factors and Severity Measurements</td>
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<td>Ul time years; Mean ± SD</td>
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<tr>
<td>Activities causing incontinence yes; n(%)</td>
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<td>Coughing</td>
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<td>Weight lifting</td>
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<td>Daily protection use number; n(%)</td>
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<tr>
<td>Always</td>
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<tr>
<td>Occasionally</td>
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<tr>
<td>Never</td>
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<td>Daily protection changes number; median (IQR)</td>
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<td>Nocturnal protection changes number; median (IQR)</td>
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Note: Subscript texts represent the units of the variable; for a numerical variable it can be expressed by median and amplitude, or mean and standard deviation, or n =absolute frequency; % =relative frequency. The symbol (*) indicates intragroup significant differences (P<0.05).
28.21±3.35 kg /m2 and 58% of them were overweight. The duration of menopause was 5.2±2.6 years in the intervention group and 5.45±2.44 years in the control group. The number of normal births was 3.11±1.52 in the intervention group and 2.75±1.4 in the control group (Table 1). In addition to the symptoms of stress incontinence, older women in the control group (57.2%) and the intervention group (54.1%) had urgency-associated urinary incontinence. The training program was well tolerated.

Table 2 compares certain risk factors for the development of administrative incontinence and difficulty measures between the control group and the intervention group before and after the study. The data indicated that at the baseline, both groups were similar in terms of risk factors and severity of measures (P>0.05). After eight weeks of aquatic training, urinary incontinence improved following coughing (P=0.02), jumping (P=0.03), and lifting weights (P=0.02). Moreover, after performing the exercise in the water, the "always" (P=0.04) and "never" (P=0.02) options for using daily protection were improved (Table 2).

Figure 1 represents that the ICIQ-SF score in the aquatic training group decreased significantly following eight weeks of intervention (P=0.03). These findings indicated the positive effect of aquatic training on reducing the frequency and rate of urinary incontinence and its effect on the quality of life of older women. Additionally, as shown in Figure 2, after eight weeks of intervention, estradiol levels did not change significantly in neither of the groups (P=0.34).

4. Discussion

Overall, our results revealed that participating in an aquatic exercise program significantly reduced the risk of urinary incontinence in women aged 54 to 61 years without any changes in estrogen levels.

Physical activity during menopause and after menopause is of numerous benefits including preventing weight gain, strengthening bones and maintaining muscle mass, and reducing the risk of other diseases (cancer, diabetes, heart disease) (19). Participating in exercise programs has been shown to improve menopausal symptoms including physical, sexual, and psychological difficulties and eventually, the quality of life (20). However, a few studies have been conducted on the effect of physical activity and exercise on incontinence in older women. Previous studies have reported that elite female athletes are more likely to have urinary incontinence (1). This is probably due to the effect of strenuous physical activity on the pelvic floor muscles (21); for example, a recent cross-sectional study showed that following a session of strenuous physical activity, the average voluntary contraction pressure decreased by about 20%, suggesting that such exercise may strain the pelvic floor muscles and increase the risk of urinary incontinence (22). Even though there are several clear studies on the negative effects of strenuous exercise on the symptoms of urinary incontinence (21, 22), little has been done on the effects of moderate-intensity exercise on various physiological aspects of urinary incontinence. In the present study, the ICIQ score significantly decreased in the water-trained group compared to that before the intervention period. On the other hand, this decrease was associated with improved
Therefore, lower urinary tract symptoms (recurrence and incontinence) are thought to indicate estrogen deficiency and restoring normal estrogen levels improve these symptoms (29). Nevertheless, there are conflicting results regarding the effect of hormone therapy on improving the symptoms of urinary incontinence (7, 8). Some studies have suggested that exercise, as a potential intervention strategy, plays a pivotal role in controlling and preventing menopausal complications, such as osteoporosis and muscle atrophy, by altering the levels of anabolic hormones, specifically estrogen (19, 20). Contrary to this belief, in the present study, eight weeks of exercise in water had no significant effects on estradiol levels. In this regard, Razzak and co-workers showed that 12 weeks of exercise is associated with improved estradiol levels in postmenopausal women and that anaerobic exercise is more effective than aerobic exercise (30). On the other hand, in certain studies (31), such as the present paper, no changes have been reported in estrogen levels after exercise in postmenopausal women. Thus, it seems that the fat burning effects of exercise play an important role in the estrogen response because in exercises that reduce fat mass, estrogen levels decrease while no changes in fat mass has been associated with the changes in estrogen levels. Hence, it seems that in the present study, the intensity and duration required for weight loss and subsequent increase in estradiol levels were not provided. In fact, in the present study, no changes were observed in estradiol levels along with the improvement of incontinence symptoms and the ICIQ-SF score, indicating that the positive effects of exercise in water may occur independently of the changes in estrogen levels. Although aquatic exercise has long been an effective treatment, there is little scientific evidence in this regard. The benefits of water exercise include increased aerobic capacity, increased muscle strength and endurance, increased joint range of motion, reduced muscle fatigue and joint pain, reduced risk of cardiovascular disease, and improved mental disorders, such as stress, anxiety, and depression (27, 31, 32). In the present study, the improvement observed in urinary incontinence in women after eight weeks of exercise in water was probably owing to the mechanisms like the improvement in psychological stress and increase in muscle strength and endurance (including in the core and pelvic floor muscles), which requires further study in this area. Herein, we encountered several significant limitations. Urodynamic evaluation is the best way to determine the type of urinary incontinence; meanwhile,
this bias decreases by using the ICIQ-SF questionnaire, which detects the frequency and intensity of signs. Clinically, this tool is easier and cheaper to use than urodynamic examination. Another limitation was the small number of samples; thus, it could be recommended to conduct further studies with larger sample sizes and longer time periods to achieve more accurate results.

5. Conclusion

The findings of the present study revealed that a period of aquatic exercise, independent of the changes in estradiol levels, could have positive effects on the symptoms of urinary incontinence in postmenopausal women. In fact, the present study, with an interdisciplinary approach to specialists in sports science, physiotherapy and obstetrics, provided a short-term treatment procedure for elderly women with urinary incontinence.

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Conflict of interests: None declared.

Ethical considerations: The study was approved by the University Ethics Committee with the code of IR. IAU.B.REC.1398.019 and the research was conducted after receiving written informed consent from the participants.

References


Aquatic exercises and severity of urinary incontinence


