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Effectiveness of pelvic floor muscle training in managing urinary incontinence in pregnant women with and without gestational diabetes mellitus

Gestasyonel diyabetli ve diyabetsiz gebe kadınlarda idrar kaçırmayı yönetmede pelvik taban kas eğitiminin etkinliği

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Abstract

Objective: Urinary incontinence (UI) is a common issue during pregnancy. Pelvic floor muscle training (PFMT) may offer an effective solution for managing this condition. This study aimed to evaluate the effect of PFMT on reducing UI symptoms in pregnant women.

Materials and Methods: This study was conducted on 40 UI pregnant women with gestational diabetes mellitus (GDM) and 40 UI pregnant women without GDM. The participants in the experimental group were treated for 10 weeks in the third trimester, whereas the control groups received an educational pamphlet. Quality of life and UI severity were assessed using questionnaires, and pelvic floor muscle performance was measured through ultrasound-based bladder base displacement. Assessments were performed before treatment, after 10 weeks, and 2 weeks postpartum.

Results: In the non-diabetic group, significant reductions in UI symptoms were observed at the end of the third trimester and 2 weeks postpartum [adjusted difference -7.56, 95% confidence interval (CI) -10.62 to -4.49, p<0.001]. However, in the diabetic group, a reduction was noted, but it was not statistically significant. Additionally, the intervention positively impacted quality of life in the non-diabetic group (adjusted difference 30.8, 95% CI 17.6 to 44.1, p<0.001) but not in the diabetic group. Notably, no significant improvement in pelvic floor muscle performance was observed in either group.

Conclusion: This study suggests that PFMT can be more effective than routine pamphlets in reducing UI symptoms and improving the quality of life in pregnant women, both with and without GDM. Further research is needed to explore effects on pelvic floor muscle performance.

Keywords: Urinary incontinence, pregnant women, pelvic floor muscle training, ultrasonography, quality of life

Öz

Amaç: İdrar kaçırma (UI) gebelikte sık görülen bir sorundur. Pelvik taban kas eğitimi (PFMT), bu durumu yönetmek için etkili bir çözüm sunabilir. Bu çalışma, PFMT'nin gebe kadınlarda UI semptomlarını azaltmadaki etkisini değerlendirmeyi amaçlamıştır.

Gereç ve Yöntemler: Bu çalışma, gestasyonel diyabetli (GDM) 40 UI gebe kadın ve GDM'siz 40 UI gebe kadın üzerinde yürütülmüştür. Deney grubundaki katılımcılar üçüncü trimesterde 10 hafta tedavi edilirken, kontrol gruplarına eğitim broşürü verilmiştir. Yaşam kalitesi ve UI şiddeti anketler kullanılarak değerlendirilmiş ve pelvik taban kas performansı ultrason tabanlı mesane tabanı yer değiştirmesi yoluyla ölçülmüştür. Değerlendirmeler tedaviden önce, 10 hafta sonra ve doğumdan 2 hafta sonra yapılmıştır.

PRECIS: We concluded that pelvic floor muscle training effectively reduced urinary incontinence and improved quality of life in pregnant women without gestational diabetes mellitus (GDM), with no impact on pelvic floor muscle performance and limited significant effect in women with GDM.

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Bulgular: Diyabetik olmayan grupta, üçüncü trimesterin sonunda ve doğumdan 2 hafta sonra UI semptomlarında önemli azalmalar gözlemlendi [ayarlanmış fark -7,56, %95 güven aralığı (GA) -10,62 ila -4,49, p<0,001]. Diyabetik grupta bir azalma kaydedildi, ancak istatistiksel olarak anlamlı değildi. Ek olarak, müdahale diyabetik olmayan grupta yaşam kalitesini olumlu yönde etkiledi (ayarlanmış fark 30,8, %95 GA 17,6 ila 44,1, p<0,001) ancak diyabetik grupta etkilemedi. Özellikle, her iki grupta da pelvik taban kas performansında önemli bir iyileşme gözlenmedi.

Sonuç: Bu çalışma, PFMT'nin hem GDM'li hem de GDM'siz gebe kadınlarda UI semptomlarını azaltmada ve yaşam kalitesini iyileştirmede rutin broşürlerden daha etkili olabileceğini öne sürmektedir. Pelvik taban kas performansı üzerindeki etkileri araştırmak için daha fazla araştırmaya ihtiyaç vardır.

Anahtar Kelimeler: İdrar kaçırma, hamile kadınlar, pelvik taban kas eğitimi, ultrasonografi, yaşam kalitesi

Introduction

Urinary incontinence (UI) is recognized by the World Health Organization as one of the ten major health issues affecting women, particularly during the perinatal period[1]. Women with a history of UI during pregnancy or postpartum are at higher risk of developing the condition in the future, with studies indicating that pregnant women are 3.3 times more likely to experience UI than nulliparous women[2,3]. This risk remains elevated: 2.5 times higher one year after childbirth[4]. The prevalence of UI during pregnancy varies widely, ranging from 10.4% to 71.11%, with the highest rates observed in the third trimester and postpartum period[2].

Gestational diabetes mellitus (GDM), a common metabolic disorder characterized by impaired glucose tolerance during pregnancy, has been identified as a contributing factor to pregnancy-related UI through its impact on pelvic floor muscles (PFMs)[5,6]. Although UI is not critical, it significantly affects quality of life (QoL) by limiting physical activity, disrupting social interactions, and causing emotional distress[7]. Despite its impact, many women normalize the condition, delaying treatment and failing to recognize early symptoms[8].

Pelvic floor muscle training (PFMT) is a non-invasive, cost-effective approach to managing UI[9]. Research has shown that antenatal PFMT can reduce the risk of UI during late pregnancy and the mid-postnatal period[10]. However, its long-term effects, cost-effectiveness, and impact on QoL remain uncertain[11]. Moreover, limited data exist regarding the role of PFMT in women with GDM despite their increased vulnerability to UI[6]. This study addresses the gap by evaluating a structured PFMT program for pregnant women with and without GDM, focusing on UI status, quality of life, and bladder base displacement during late pregnancy. The findings aim to provide practical and effective strategies for managing pregnancy-related UI and improving QoL for this population.

Materials and Methods

Study Design

This single-center, parallel, randomized controlled trial was conducted in 2023. The study was jointly conducted by the Shahid Sadoughi University Faculty of Medicine, Department of Obstetrics and Gynecology, and the Shahid Beheshti University, School of Physical Therapy and Rehabilitation. Ethical approval for this study was obtained from the Iranian Registry of Clinical Trials (IRCT) (approval number: IR.SBMU.RETECH.REC.1400.611, date: 28.11.2021). The registration numbers of these clinical trials are IRCT20200825048523N2 and IRCT20200825048523N3.

Participants

A total of 100 pregnant women at 24 weeks of gestation were recruited. However, twenty participants withdrew, resulting in a final sample of 80 women. Participants were categorized into four groups: two with GDM and two without. This study aimed to evaluate the effectiveness of PFMT in managing pregnancy-related UI.

Randomization was performed using balanced block randomization with sealed envelope concealment, ensuring equal allocation within each category. Participants were sequentially assigned based on the generated randomization sequence. The study followed a single-blind design, with the principal investigator blinded to group assignments during assessments; while an independent researcher conducted the data analysis.

Participants were eligible if they were primiparous women aged 24-30 years, with singleton pregnancies between 24 and 28 weeks of gestation, diagnosed with GDM, and experiencing pregnancy-specific UI. Exclusion criteria included a history of diabetes or UI before pregnancy, orthopedic surgery, mental or personality disorders, or conditions limiting physical activity, such as threatened miscarriage or placenta previa.

Intervention Protocol

The PFMT protocol used in this study was based on the methodology described by Bø[12]. All participants engaged in a structured home-based exercise program after receiving standardized training from a certified physiotherapist. The training session, lasting 20 minutes, was conducted individually and face-to-face at the Shahid Sadoughi Hospital training center in Yazd.

The session began with theoretical education on the anatomy and function of the urinary system, the pathophysiology and risk factors of pregnancy-related urinary incontinence, associated symptoms and complications, and available treatment strategies. This was followed by practical instruction on PFMT techniques using educational pamphlets, visual aids, and hands-on demonstrations.

The PFMT protocol consisted of three sets of ten slow contractions, each held for 6-8 seconds, followed by a rest period equal to the contraction duration. Additionally, participants performed three to four rapid contractions in each

supine, sitting, and standing position, with exercises scheduled at least three times per day. The contractions were executed with controlled breathing, mimicking the action of interrupting urinary flow while ensuring the relaxation of surrounding pelvic muscles.

Participants continued this exercise regimen for ten consecutive weeks. They were instructed to schedule their sessions based on personal convenience. To support adherence, each participant received an instructional pamphlet on PFMT and a self-report checklist to record the number of contractions and total daily repetitions.

To ensure compliance and address potential concerns, the investigator maintained biweekly remote follow-ups via social media and phone calls. This remote approach was adopted due to the Coronavirus disease-2019 (COVID-19) pandemic to minimize infection risk while maintaining effective monitoring of the intervention.

Participants in the control group did not receive any training. They received an educational pamphlet and were instructed to refrain from any additional treatments for UI during the 10-week study period while maintaining their usual daily activities.

Outcomes Evaluation

The outcomes were assessed at three time points: baseline, 10 weeks post-intervention, and 2 weeks postpartum. The UI status was evaluated using the International Consultation on Incontinence Questionnaire Short Form (ICI-Q-SF) (Cronbach's α=0.81)[13], which was localized and validated in Persian[14]. Healing was defined as a significant decrease in the ICI-Q-SF score, according to the guidelines for the diagnosis and treatment of urological diseases[15]. Additionally, the Incontinence Quality of Life Questionnaire (I-QoL) (Cronbach's α=0.963) was used to assess the quality of life[16], using the Persian version of the tool for this study[17]. The examiner remained blinded to group assignments during the evaluation process.

Measurement of Bladder Base Displacement

The bladder base displacement was measured by ultrasound examination. The participants performed the contraction of PFMs. Before the examination for the training and education of PFM contractions, a perineometer with a latex cover was used. To achieve maximal contraction of PFMs: Lie on the back, bend knees 90 degrees, and contract the vagina and anus forcefully, avoiding any movement of the pelvis and buttocks. The ultrasound transducer was placed in the suprapubic area and tilted posteriorly (15-30°) to visualize the lower posterior bladder. At rest, a marker was positioned on the bladder base. Participants were then instructed to perform a voluntary PFM contraction. When the contraction was visible on the ultrasound screen, an image was captured. The indicator was placed at the point of maximum displacement, and bladder base movement was measured in millimeters[18,19]. Ultrasound examination was performed on a diagnostic ultrasound imaging device with B-mode technology and a 3.5-5 MHz convex array transducer (Resona 6, Mindray Co., China) by the same physician. Three measurements were taken.

Statistical Analysis

In this study, quantitative variables were presented as a mean, while qualitative variables were expressed as a frequency. The mean values of quantitative outcomes after the intervention were compared between the control and intervention groups, stratified by diabetes status, using analysis of covariance (ANCOVA). Additionally, partial eta squared (η^2p) was reported for ANCOVA, where values of 0.01-0.06, 0.06-0.14, and >0.14 indicated small, moderate, and large effect sizes, respectively[20]. Data analysis was conducted using SPSS software, version 20, with a significance level set at 0.05. Graphs were generated using GraphPad Prism, version 8.0.1.

The participant flow diagram for non-diabetic women is presented in Figure 1. Flow diagram of pregnant women without diabetes. A total of 50 individuals were screened, and 44 were selected through convenience sampling. The first participant was randomized in October 2021 and the last in June 2023. Follow-up data were available for 40 participants who were included in the intention-to-treat analysis.

Similarly, the participant flow diagram for women with diabetes is shown in Figure 2. Flow diagram of pregnant women with diabetes. Out of 50 screened individuals, 46 were selected, with randomization occurring between October 2021 and June 2023. Follow-up data for 40 participants were available for inclusion in the intention-to-treat analysis.

Results

The baseline characteristics of participants:

Three patients in each group were lost to follow-up. A total of 20 patients in the training groups and 20 patients in the control group were included in the analysis. The baseline characteristics of these participants are listed in Table 1.

Comparison of UI Status Before and After Training

The effects of PFM training on UI were explored (Table 2). In women without GDM, after controlling for baseline scores at the beginning of the third trimester, the mean total ICI-Q-UI SF score in the intervention group at the end of the third trimester was significantly lower by 6.38 points [95% confidence interval (CI): 4.82, 7.93] than in the control group (η^2p=0.651, p<0.001, F=69.15, df=1, 37). The partial eta squared value of 0.651 indicates a large effect size. Furthermore, two weeks postpartum, the mean total ICI-Q-UI SF score in the intervention group was 7.56 points significantly lower (95% CI: 4.49, 10.62) than in the control group (η^2p=0.403, p<0.001, F=24.98, df=1, 37).

In women with GDM the mean total ICI-Q-UI SF score in the intervention group was lower than in the control group at the end of the third trimester, although this difference was not statistically significant (η^2p=0.094, p=0.058, F=3.83, df=1, 37). Two weeks postpartum, the mean total ICI-Q-UI SF score in

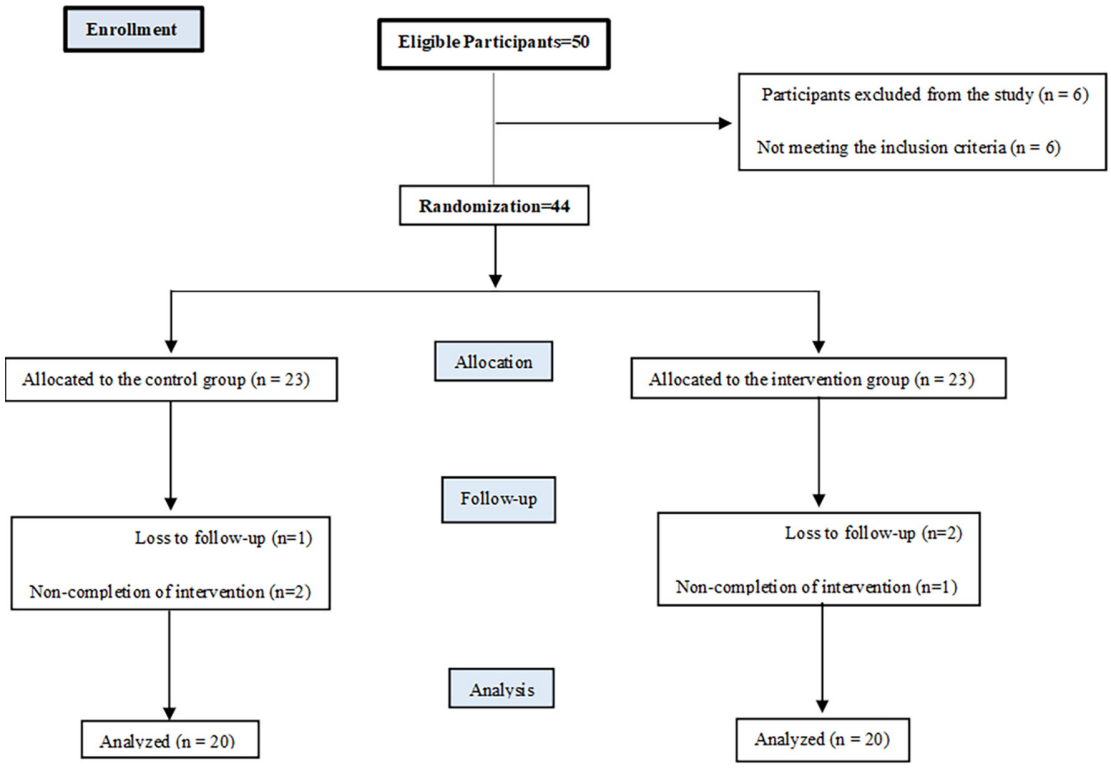

Figure 1. Flow diagram of pregnant women without diabetes

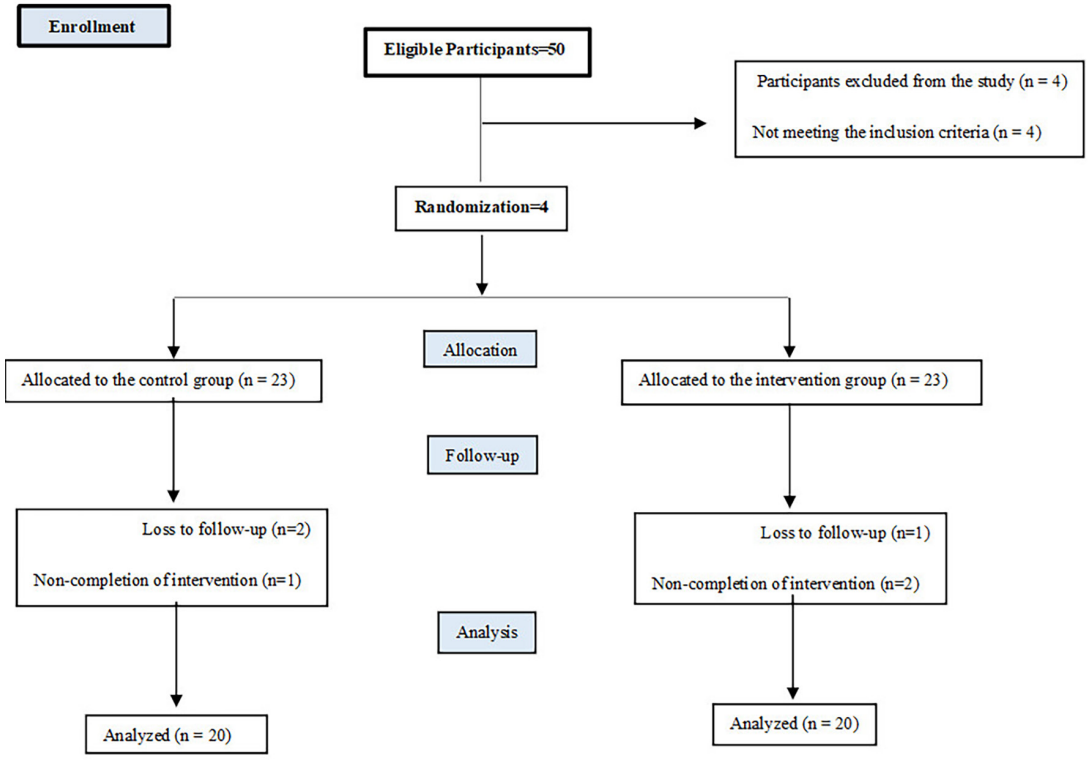

Figure 2. Flow diagram of pregnant women with diabetes

the intervention group was significantly lower by 4.62 points (95% CI: 1.21, 8.04) than in the control group (ηp^2=0.169, p<0.001, F=7.51, df=1, 37). The partial eta squared value of 0.169 indicates a large effect size (Figure 3). The training did not cause any side effects.

Comparison of Quality of Life Before and After Training

The effects of the training on QoL were further evaluated. As shown in Table 3, in non-diabetic women, after controlling for the initial scores at the beginning of the third trimester, the mean total I-QoL score in the intervention group at the end of the third trimester was significantly 18.7 points higher (95% CI: 12.0 to 25.4) than in the control group [p<0.001, ηp^2=0.464, F (1, 37)=31.98]. The partial eta-squared value of 0.464 indicates a large effect size. Furthermore, two weeks postpartum, the mean total I-QoL score in the intervention group was 30.8 points significantly higher (95% CI: 17.6 to 44.1) than in the control group [p<0.001, ηp^2=0.376, F (1, 37)=22.31].

In diabetic women, at the end of the third trimester, there was no statistically significant difference between the mean total I-QoL scores of the intervention and control groups [p=0.690, ηp^2=0.004, F (1, 37)=0.16]. However, two weeks postpartum, the mean total I-QoL score of the intervention group was 15.4 points, significantly higher points (95% CI: 1.4 to 29.4) than in the control group [p=0.032, ηp^2=0.119, F (1, 37)=4.99]. The partial eta-squared value of 0.119 indicates a large effect size (Figure 4).

Table 1. Baseline characteristics of participants

	Total	Control group (n=20)	Intervention group (n=20)
Non-diabetic			
Age (year)	26.3±3.5	25.6±3.7	27.0±3.3
Weight (kg)	72.4±12.1	74.2±11.9	70.6±12.3
Height (cm)	161.4±5.1	161.8±4.7	160.8±5.6
Body mass index (kg/m^2)	27.7±3.7	28.2±3.8	27.2±3.6
Diabetic			
Age (year)	26.3±3.5	25.8±3.7	27.0±3.3
Weight (kg)	71.3±13.9	72.5±14.3	70.0±13.8
Height (cm)	162.1±5.6	161.7±5.7	162.5±5.6
Body mass index (kg/m^2)	27.0±4.6	27.7±5.1	26.4±4.0

Quantitative data aligned to a normal distribution were presented as mean ± standard deviation

Table 2. Comparison of mean total of ICIQ-UI SF score between the control and intervention groups, categorized by diabetes status

				ANCOVA results		
	Control group (n=20)	Intervention group (n=20)	Adjusted mean differences[a] (CI 95%)	F (1, 37)	p	ηp^2
Non-diabetic						
Early third trimester	9.85 (3.03)	10.90 (3.31)				
Late third trimester	13.05 (3.30)	7.55 (3.79)	-6.38 (-7.93, -4.82)	69.15	<0.001	0.651
Two weeks postpartum	10.25 (6.70)	3.60 (3.66)	-7.56 (-10.62, -4.49)	24.98	<0.001	0.403
Diabetic						
Early third trimester	12.25 (3.42)	12.75 (3.31)				
Late third trimester	14.55 (3.95)	13.20 (4.19)	-1.78 (-3.63, 0.06)	3.83	0.058	0.094
Two weeks postpartum	12.70 (6.10)	8.65 (6.92)	-4.62 (-8.04, -1.21)	7.51	0.009	0.169

CI: Confidence interval, ANCOVA: Analysis of covariance, ICIQ-UI SF: International consultation on incontinence questionnaire-urinary incontinence short form values are presented as "(standard deviation) mean". [a]: Adjusted for pre-intervention values. Partial eta squared ($\eta^2 p$) values of 0.01-0.06, 0.06-0.14, and >0.14 indicate small, moderate, and large effect sizes, respectively

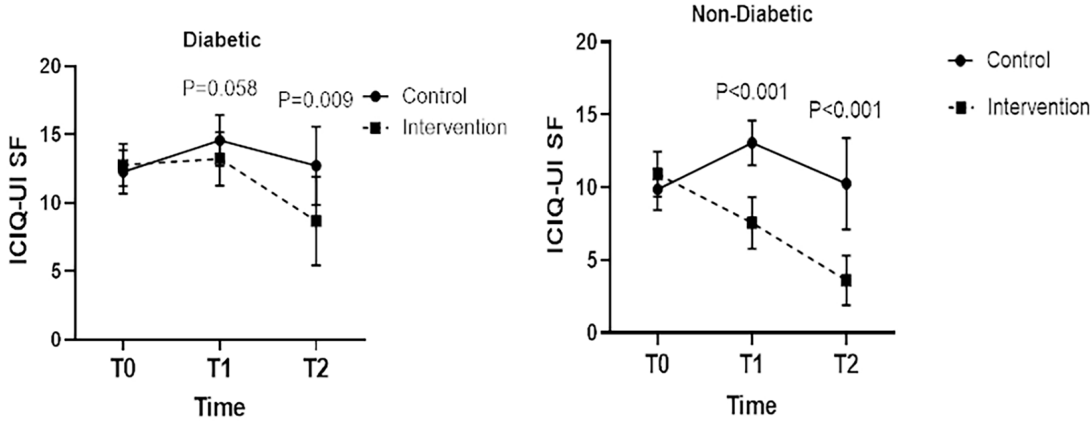

Figure 3. a) Comparison of mean total of ICIQ-UI SF score between the control and intervention groups, categorized by diabetes status

T0: Beginning of the third trimester, T1: End of the third trimester, T2: Two weeks postpartum. The values are presented as "mean with 95% confidence interval". P-values are based on ANCOVA

Table 3. Comparison of mean total I-QoL score between the control and intervention groups, categorized by diabetes status

				ANCOVA results		
	Control group (n=20)	Intervention group (n=20)	Adjusted mean differences[a] (CI 95%)	F (1, 37)	p	ηp^2
Non-diabetic						
Early third trimester	38.0 (17.6)	36.5 (17.3)				
Late third trimester	28.0 (17.2)	45.5 (18.0)	18.7 (12.0, 25.4)	31.98	<0.001	0.464
Two weeks postpartum	34.8 (17.09)	64.5 (19.0)	30.8 (17.6, 44.1)	22.31	<0.001	0.376
Diabetic						
Early third trimester	41.7 (21.9)	33.2 (15.3)				
Late third trimester	36.0 (21.9)	30.8 (15.2)	1.5 (-6.1, 9.1)	0.16	0.690	0.004
Two weeks postpartum	45.2 (28.8)	52.7 (26.1)	15.4 (1.4, 29.4)	4.99	0.032	0.119

CI: Confidence interval; ANCOVA: Analysis of covariance; I-QoL: Incontinence quality of life. Values are presented as "(standard deviation) mean". [a]: Adjusted for pre-intervention values. Partial eta-squared ($\eta^2 p$) values of 0.01-0.06, 0.06-0.14, and >0.14 represent small, medium, and large effect sizes, respectively

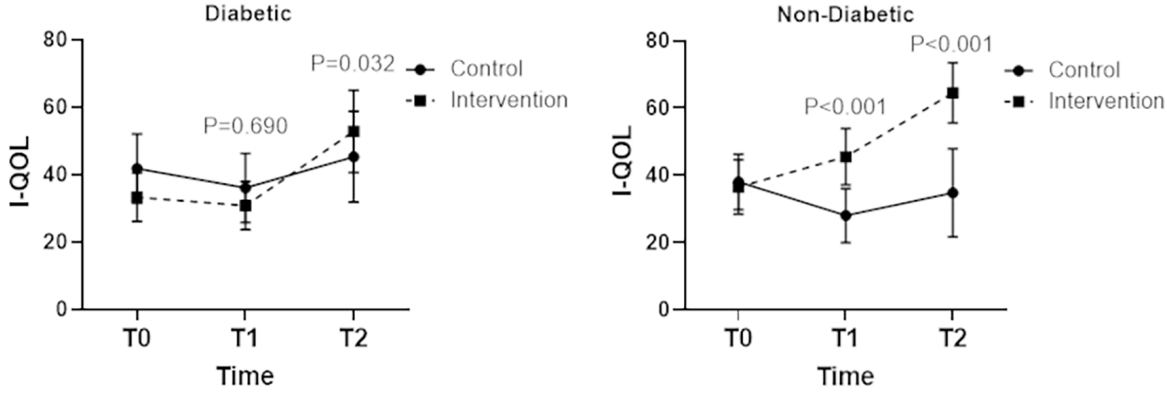

Figure 4. Comparison of mean total I-QoL score between the control and intervention groups, categorized by diabetes status

I-QoL: Incontinence quality of life, T0: Beginning of the third trimester; T1: End of the third trimester; T2: Two weeks postpartum. The values are presented as "mean with 95% confidence interval" P-values are based on ANCOVA

Comparison of Bladder Base Displacement Before and After Training

In non-diabetic women, at the end of the third trimester, there was no statistically significant difference in the mean bladder base displacement between the control and intervention groups after adjusting for the initial third trimester values [p=0.300, ηp^2=0.029, F (1, 37)=1.10]. A similar finding was observed two weeks postpartum [p=0.307, ηp^2=0.028, F (1, 37)=1.07] (Figure 5).

In diabetic women at the end of the third trimester, no statistically significant difference in the mean bladder base displacement was found between the control and intervention groups after adjusting for the initial third trimester values [p=0.514, ηp^2=0.012, F (1, 37)=0.43]. A similar result was observed two weeks postpartum [p=0.643, ηp^2=0.006, F (1, 37)=0.22] (Table 4).

Discussion

The demographic and clinical characteristics were comparable in the intervention and control groups, creating a balanced study population, which is crucial for comparing these groups. PFMT is a common conservative strategy for preventing UI with promising effects. However, the therapeutic potential of PFMT on UI under the pathological condition of GDM remains unclear. This study showed that 10 weeks of PFMT significantly alleviated UI and improved the QoL in non-diabetic pregnant women during the third trimester and postpartum. In pregnant women with GDM, no immediate effect was observed, but the intervention led to significant improvements in I-QoL and ICI-Q-UI SF scores two weeks postpartum. Additionally, the intervention did not lead to significant changes in bladder base displacement in either non-diabetic or diabetic women, both at the end of the third trimester and two weeks postpartum. PFMT

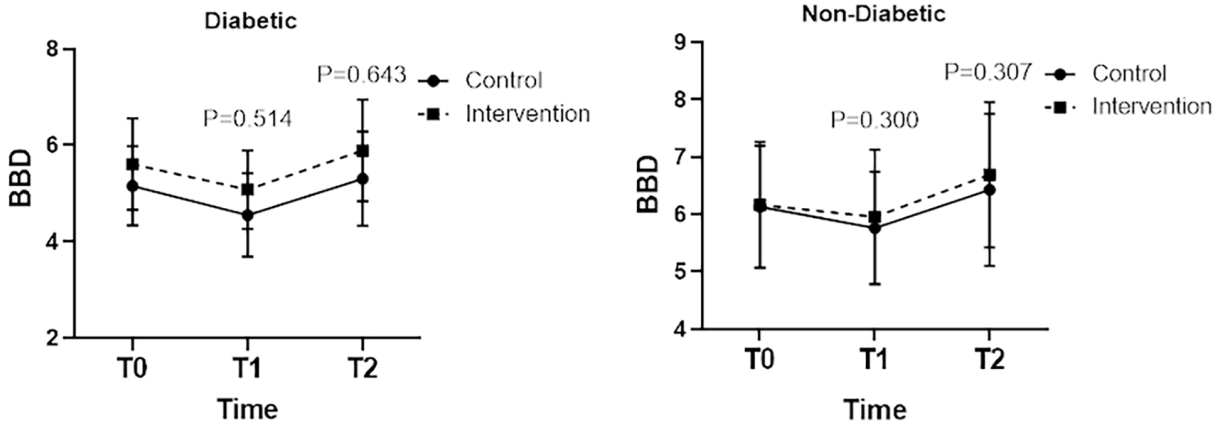

Figure 5. Comparison of mean bladder neck displacement between the control and intervention groups, categorized by diabetes status

BBD: Bladder base displacement, T0: Beginning of the third trimester; T1: End of the third trimester; T2: Two weeks postpartum. The values are presented as "mean with 95% confidence interval". P-values are based on ANCOVA

Table 4. Comparison of mean bladder neck displacement between the control and intervention groups, categorized by diabetes status

				ANCOVA results		
	Control group (n=20)	Intervention group (n=20)	Adjusted mean differences[a] (CI 95%)	F (1, 37)	p	ηp^2
Non-diabetic						
Early third trimester	6.13 (2.27)	6.16 (2.34)				
Late third trimester	5.76 (2.10)	5.96 (2.50)	0.16 (-0.15, 0.47)	1.10	0.300	0.029
Two weeks postpartum	6.42 (2.84)	6.69 (2.70)	0.22 (-0.21, 0.66)	1.07	0.307	0.028
Diabetic						
Early third trimester	5.16 (1.76)	5.60 (2.02)				
Late third trimester	4.55 (1.85)	5.07 (1.74)	0.12 (-0.25, 0.49)	0.43	0.514	0.012
Two weeks postpartum	5.30 (2.09)	5.89 (2.25)	0.09 (-0.29, 0.46)	0.22	0.643	0.006

CI: Confidence interval; ANCOVA: Analysis of covariance; BBD: Bladder base displacement. Values are presented as "(standard deviation) mean". [a]: Adjusted for the initial third trimester values. Partial eta-squared ($\eta^2 p$) values of 0.01-0.06, 0.06-0.14, and >0.14 represent small, medium, and large effect sizes, respectively

is a repetitive exercise designed to enhance urethral support by strengthening the PFMs[21]. One review summarized that pregnant women who participated in antenatal PFMT had a lower risk of UI in late pregnancy and the early postnatal period compared to those who received standard care[10]. However, evidence regarding the effectiveness of PFMT for treating pregnancy-related UI remains debated. Some earlier studies have found that 12 weeks of PFMT reduced the prevalence of pregnancy-related UI in late pregnancy and/or 3 to 6 months postpartum[22]. Conversely, some studies have shown that PFMT is not effective in treating pregnancy-related UI in late pregnancy, and the later postpartum period[23]. In this study, the QoL and ICI-Q-SF scores improved in non-diabetic pregnant women, in pregnant women with GDM at 2 weeks postpartum. The overall healing was higher in the training group than in the control group after 10 weeks, at 2 weeks postpartum in non-diabetic pregnant women. These results show that consistent PFMT exercises are effective in reducing UI in participants without GDM and with GDM 2 weeks postpartum, aligning with previous research findings[24]. These results may be attributed to a combination of physiological and metabolic factors specific to diabetic mothers. Since UI is not life-threatening, QoL has become a key measure for assessing the effectiveness of intervention strategies. A review concluded that PFMT can significantly enhance the QoL for women suffering from UI[25]. This study found that the total I-QoL score was significantly higher in the training group compared to the control group, both 10 weeks later and 2 weeks postpartum. These results highlight the positive impact of the training on enhancing the QoL for incontinent women without GDM, aligning with previous studies[26]. Despite the observed improvements in UI and QoL in pregnant women, there were no significant changes in bladder base displacement at the end of pregnancy and two weeks postpartum. Several physiological and anatomical factors may explain this discrepancy[27]. During pregnancy, the growing uterus exerts mechanical pressure on the pelvic organs, including the bladder, which could result in displacement. This pressure may counteract the effects of PFMT on structural changes like bladder base displacement, even if it improves muscle function and reduces UI symptoms[9]. Furthermore, hormonal changes during pregnancy, such as elevated levels of progesterone and relaxin, lead to tissue softening, which may reduce the effectiveness of PFMT in producing structural changes in the pelvic floor[28]. Additionally, childbirth, especially vaginal delivery, can lead to further weakening of the PFMs, making it more challenging to achieve immediate structural changes in bladder base displacement. However, PFMT can still improve functional aspects, such as muscle strength and UI symptoms, without significantly altering the anatomical position of the bladder[29,30].

Study Limitations

Despite the positive outcomes, there are some limitations to this study. One issue was low and inconsistent participation, as well as a lack of control over the regularity of daily training. A training diary would have been beneficial to track adherence. Additionally, the control group received only a pamphlet, with no direct instructions, which may not fully simulate the reality of daily exercise. Given the challenges of implementing clinic-based programs more than three times a week during the COVID-19 pandemic, participants were asked to continue with the exercises they had learned independently. Another limitation is the high number of participants lost to follow-up, which affected the final analysis, as well as the timing of the follow-up assessments. Ideally, this study would have been extended over a longer period to assess long-term effects.

Conclusion

In conclusion, PFMT effectively improves UI symptoms and QoL in pregnant women, particularly in those without GDM. While no immediate effects were observed in the GDM group, significant improvements were noted postpartum. However, PFMT did not lead to structural changes in bladder base displacement. Given these findings, further long-term studies are required to explore the mechanisms of PFMT in pregnancy and optimize its implementation for different populations.

Ethics

Ethics Committee Approval: Ethical approval for this study was obtained from the Iranian Registry of Clinical Trials (IRCT) (approval number: IR.SBMU.RETECH.REC.1400.611, date: 28.11.2021).
Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.M.H., Design: P.G.H., F.D.M., Data Collection or Processing: S.M.H., A.J., Analysis or Interpretation: A.A.B., Literature Search: S.M.H., A.J., Writing: P.G.H., S.M.H., F.D.M.
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References

1. Agarwal BK, Agarwal N. Urinary incontinence: prevalence, risk factors, impact on quality of life and treatment seeking behaviour among middle aged women. Int Surg J. 2017;4:1953-8.
2. Nygaard CC, Schreiner L, Morsch TP, Saadi RP, Figueiredo MF, Padoin AV. Urinary incontinence and quality of life in female patients with obesity. Rev Bras Ginecol Obstet. 2018;40:534-9.

3. Hansen BB, Svare J, Viktrup L, Jørgensen T, Lose G. Urinary incontinence during pregnancy and 1 year after delivery in primiparous women compared with a control group of nulliparous women. Neurourol Urodyn. 2012;31:475-80.
4. Chen L, Liu S, Zhang D, Cai W. Sitting on the fence: A qualitative study of perceptions regarding pelvic floor muscle training among pregnant women with urinary incontinence. Int J Nurs Sci. 2023;10:540-8.
5. Gu ZJ, Song QJ, Gu WQ, Zhang GP, Su Y, Tang Y, et al. New approaches in the diagnosis and prognosis of gestational diabetes mellitus. Eur Rev Med Pharmacol Sci. 2023;27:10583-94.
6. França DCH, França EL, Sobrevia L, Barbosa AMP, Honorio-França AC, Rudge MVC. Integration of nutrigenomics, melatonin, serotonin and inflammatory cytokines in the pathophysiology of pregnancy-specific urinary incontinence in women with gestational diabetes mellitus. Biochim Biophys Acta Mol Basis Dis. 2023;1869:166737.
7. Sangsawang B. Risk factors for the development of stress urinary incontinence during pregnancy in primigravidae: a review of the literature. Eur J Obstet Gynecol Reprod Biol. 2014;178:27-34.
8. Moossdorff-Steinhauser HFA, Berghmans BCM, Spaanderman MEA, Bols EMJ. Urinary incontinence during pregnancy: prevalence, experience of bother, beliefs, and help-seeking behavior. Int Urogynecol J. 2021;32:695-701.
9. Soave I, Scarani S, Mallozzi M, Nobili F, Marci R, Caserta D. Pelvic floor muscle training for prevention and treatment of urinary incontinence during pregnancy and after childbirth and its effect on urinary system and supportive structures assessed by objective measurement techniques. Arch Gynecol Obstet. 2019;299:609-23.
10. Woodley SJ, Lawrenson P, Boyle R, Cody JD, Mørkved S, Kernohan A, et al. Pelvic floor muscle training for preventing and treating urinary and faecal incontinence in antenatal and postnatal women. Cochrane Database Syst Rev. 2020;5:CD007471.
11. Dumoulin C, Morin M, Danieli C, Cacciari L, Mayrand MH, Tousignant M, et al. Group-based vs individual pelvic floor muscle training to treat urinary incontinence in older women: a randomized clinical trial. JAMA Intern Med. 2020;180:1284-93.
12. Bø K. Pelvic floor muscle exercise for the treatment of stress urinary incontinence: An exercise physiology perspective. International Urogynecology Journal. 1995;6:282-91.
13. Avery K, Donovan J, Peters TJ, Shaw C, Gotoh M, Abrams P. ICIQ: a brief and robust measure for evaluating the symptoms and impact of urinary incontinence. Neurourol Urodyn. 2004;23:322-30.
14. Hajebrahimi S, Nourizadeh D, Hamedani R, Pezeshki MZ. Validity and reliability of the international consultation on incontinence questionnaire-urinary incontinence short form and its correlation with urodynamic findings. Urol J. 2012;9:685-90.
15. Huang H. Chinese Guidelines for Diagnosis and Treatment of Urology and Andrology Diseases (2022 edition) - Urinary Incontinence. 2022.
16. Wagner TH, Patrick DL, Bavendam TG, Martin ML, Buesching DP. Quality of life of persons with urinary incontinence: development of a new measure. Urology. 1996;47:67-71; discussion 71-2.
17. Nojomi M, Baharvand P, Moradi Lakeh M, Patrick DL. Incontinence quality of life questionnaire (I-QOL): translation and validation study of the Iranian version. Int Urogynecol J Pelvic Floor Dysfunct. 2009;20:575-9.
18. Dehghan Manshadi F, Parnianpour M, Ghanbari Z, Sarrafzadeh J, Kazemnejad A. An ultrasonic investigation of stability of pelvic floor in women with and without urinary stress incontinence. The Iranian Journal of Obstetrics, Gynecology and Infertility. 2012;15:16-25.
19. Ghadiri Harati P, Hosseini SM, Javaheri A, Dehghan Manshadi F, Akbarzadeh Baghban A. The Reliability of the Rehabilitative Ultrasound Imaging Method for Assessing Pelvic Floor Muscles Function in Pregnant Women. Caspian Journal of Neurological Sciences 2024;10:132-8.
20. Cohen J. Statistical Power Analysis for the Behavioral Sciences. L. Erlbaum Associates; 1988.
21. Cho ST, Kim KH. Pelvic floor muscle exercise and training for coping with urinary incontinence. J Exerc Rehabil. 2021;17(6):379-87.
22. Johannessen HH, Frøshaug BE, Lysåker PJG, Salvesen KÅ, Lukasse M, Mørkved S, et al. Regular antenatal exercise including pelvic floor muscle training reduces urinary incontinence 3 months postpartum-follow up of a randomized controlled trial. Acta Obstet Gynecol Scand. 2021;100:294-301.
23. Fritel X, de Tayrac R, Bader G, Savary D, Gueye A, Deffieux X, et al. Preventing urinary incontinence with supervised prenatal pelvic floor exercises: a randomized controlled trial. Obstet Gynecol. 2015;126:370-7.
24. Stafne SN, Salvesen KÅ, Romundstad PR, Torjusen IH, Mørkved S. Does regular exercise including pelvic floor muscle training prevent urinary and anal incontinence during pregnancy? A randomised controlled trial. BJOG. 2012;119:1270-80.
25. Radzimińska A, Strączyńska A, Weber-Rajek M, Styczyńska H, Strojek K, Piekorz Z. The impact of pelvic floor muscle training on the quality of life of women with urinary incontinence: a systematic literature review. Clin Interv Aging. 2018;13:957-65.
26. Cruz CdS, Riesco MLG, Zanetti MRD. Supervised pelvic floor muscle training to treat urinary incontinence during pregnancy: a randomized controlled trial. Neurourology and Urodynamics, 2014.
27. Wisser J. The effect of pregnancy on the pelvic floor. Childbirth Trauma. 2017:43-56.
28. Kamisan Atan I, Zhang W, Shek KL, Dietz HP. Does pregnancy affect pelvic floor functional anatomy? A retrospective study. Eur J Obstet Gynecol Reprod Biol. 2021;259:26-31.
29. Pires TF, Pires PM, Costa R, Viana R. Effects of pelvic floor muscle training in pregnant women. Porto Biomed J. 2020;5:e077.
30. Romeikienė KE, Bartkevičienė D. Pelvic-floor dysfunction prevention in prepartum and postpartum periods. Medicina (Kaunas). 2021;57:387.