Does Perinatal Period Pelvic Floor Muscle Exercises Affect Urinary Incontinence? A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Abstract

Aim: Pelvic floor dysfunction (PFD) consists of urinary incontinence (UI), anal incontinence, pelvic organ prolapses, and sexual dysfunction. This study aimed to conduct a systematic compilation and meta-analysis of randomized controlled studies examining urinary incontinence symptom severity and quality of life of pelvic floor muscle exercises performed on women during pregnancy, birth, and postpartum period.

Method: Databases, including PubMed, Cochrane Library, and Web of Science, were scanned using MeSH-based keywords. Only randomized controlled trials (RCT) were included. The data were analyzed using the Review Manager computer program (Version 5.3).

Results: Pooled standardized differences in incontinence mean (SMD) between pre-intervention groups were -0.09 (95% CI: [-0.018, -0.00], p=0.04). Initially, the exercise group had lower average scores in UDI-6 (mean difference (MD) =-3.32 [-4.61-2.03], p<0.00001). MD was higher after exercise (MD = -2.85 [-3.10 -2.61], p<0.00001). There was little evidence of a difference in quality of life between the intervention and control groups as measured by ICIQ-SF. Initially, the exercise group had lower average scores on ICIQ-SF (MD = -0.07 [-0.21-0.08], p=0.37). MD was higher after exercise (MD = -0.06 [-0.16-0.04], p=0.45, but there was no statistically significant difference.

Conclusion: Evidence has shown an effect of pelvic floor muscle training on urinary incontinence and quality of life in the postpartum period in primiparous women. However, high-quality randomized controlled studies are needed.

Keywords: Pregnancy, postpartum, urinary incontinence, quality of life, pelvic floor exercise.

Perinatal Dönemde Pelvik Taban Kas Egzersizleri Üriner İnkontinansı Etkiler mi? Randomize Kontrollü Çalışmaların Sistematik İncelenmesi ve Meta-Analizi

Öz

Amaç: Pelvik taban disfonksiyonu (PTD), idrar kaçırma (İK), anal inkontinans, pelvik organ prolapsusu ve cinsel işlev bozukluğundan oluşur. Bu çalışmada gebelik, doğum ve doğum sonrası dönemde kadınlara uygulanan pelvik taban kas egzersizlerinin üriner inkontinans semptom şiddeti ve yaşam kalitesini inceleyen randomize kontrollü çalışmaların sistematik derlemesi ve meta-analizinin yapılması amaçlandı.

Yöntem: PubMed, Cochrane Library ve Web of Science gibi veri tabanları, MeSH tabanlı anahtar kelimeler kullanılarak tarandı. Yalnızca randomize kontrollü çalışmalar (RKÇ) dahil edildi. Veriler Review Manager bilgisayar programı (Sürüm 5.3) kullanılarak analiz edildi.

Bulgular: Müdahale öncesi gruplar arasında inkontinans ortalamasında birleştirilmiş standartlaştırılmış farklar -0,09 idi (%95 GA: [-0,018, -0,00], p=0,04). Başlangıçta, egzersiz grubunun UDI-6'da ortalama puanları daha düşüktü (MD =-3.32 [-4.61-2.03], p<0.00001). MD egzersiz sonrasında daha yüksekti (MD = -2,85 [-3,10 -2,61], p<0,00001). ICIQ-SF ile ölçülen müdahaleler ve kontrol grupları arasında yaşam

Özgün Araştırma Makalesi (Original Research Article)
Geliş / Received: 27.07.2024 & **Kabul / Accepted:** 11.11.2024
DOI: https://doi.org/10.38079/igusabder.1523341
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kalitesinde bir fark olmadığını gösteren çok az kanıt vardı. Başlangıçta egzersiz grubunun ICIQ-SF'de ortalama puanları daha düşüktü (MD = -0,07 [-0,21-0,08], p=0,37). MD egzersiz sonrası daha yüksekti (MD = -0,06 [-0,16-0,04]; p=0,45 ancak istatistiksel olarak anlamlı bir fark yoktu.

Sonuç: Kanıtlar, ilk doğum yapan kadınlarda pelvik taban kas eğitiminin idrar kaçırma ve postpartum dönemde yaşam kalitesi üzerinde etkili olduğunu göstermiştir. Ancak yüksek kalitede randomize kontrollü çalışmalara ihtiyaç vardır.

Anahtar Sözcükler: Gebelik, doğum sonrası, idrar kaçırma, yaşam kalitesi, pelvik taban egzersizi.

Introduction

Pelvic floor dysfunction (PFD) consists of urinary incontinence (UI), anal incontinence, pelvic organ prolapse and sexual dysfunction[1]. PFD etiology is multifactorial. Age, ethnicity, multiparity, birth pattern, pelvic surgery history, pregnancy, chronic cough, obesity, family history and genetic PFD are among the risk factors that cause the development[2,3].

It is stated that childbirth plays a major role in the emergence of PFD. This condition, which will be caused by the birth process, is also affected by changes in the pregnancy process. Causes that lead to PFD during pregnancy; the baby's birth weight, body mass index, smoking, genetic predisposition, age, intraabdominal pressure and nutrition have been reported[4]. A systematic meta-analysis review of fifteen studies found that vaginal delivery increased the risk of urinary incontinence by two times compared to cesarean section[5]. Incontinence affects the lives of women physically, socially, psychologically and economically[6]. While women with incontinence experience increased feelings of shame, their self-confidence decreased significantly, they found themselves unattractive and avoided communication with other people[6,7].

The aim of pelvic floor muscle training (PFMT) in urinary incontinence is to increase the muscle strength of the pelvic floor, to provide symmetrical muscle contraction at the right time and to improve urethral sphincter function. During pelvic floor muscle contraction, the urethra openings are closed by the movement of the perinee in the ventral and cranial direction and the urinary leakage is prevented[8]. PFMT is widely recommended during pregnancy and after birth for both prevention and treatment of incontinence[9]. Although there were randomized controlled studies on the severity and quality of life of PFME in the literature, no systematic review meta-analysis studies were found. This study aimed to conduct a systematic compilation and meta-analysis of randomized controlled studies examining urinary incontinence symptom severity and quality of life of pelvic floor muscle exercises performed on women during pregnancy, birth, and postpartum period.

Material and Methods

This study was aimed to conduct a systematic compilation and meta-analysis of randomized controlled studies examining urinary incontinence symptom severity and quality of life of pelvic floor muscle exercises performed on women during the pregnancy, birth, and postpartum period. In the preparation of the systematic review and meta-analysis, the criteria in the PRISMA checklist and Cochrane Handbook[10,11].

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Search strategy

A comprehensive, systematic search of PubMed, Web of Science, the Cochrane Library databases was completed from the earliest date available until May 2024. The database was searched using the following keywords: "pelvic floor muscle exercise" AND "incontinence" OR "stress urinary incontinence" AND "pregnancy" OR “birth” OR "postpartum." The search strategy was changed according to the characteristics of each database. During the study, literature review, article selection, data extraction, and quality evaluation of the included articles were independently performed by two researchers to keep the risk of bias under control.

Inclusion and exclusion criteria

The criteria used were: (1) Using pelvic floor muscle exercise in the intervention group; (2) the intervention included pregnancy; (3) childbirth and postpartum periods; and (4) published only in English were included, (5) Articles including Women who were not pregnant or performed cesarean postpartum pelvic floor muscle exercise (6) if studies only mention fecal incontinence and prolapse and (7) studies prior to the last 5 years were excluded from the study. The following criteria (PICOS) were considered in the selection of the studies to be included in the study:

Participant (P): Pregnant women,

Intervention (I): Pelvic floor muscle exercise,

Comparison (C): Control or use different exercise,

Outcome (O): start time-incontinence, incontinence, quality life,

Study design (S): Randomized controlled experimental studies published in English and Turkish between 2013 and 2024.

Study selection and data extraction

The titles and abstracts of the articles to be included were scanned by two independent researchers. The full texts of the articles that could not be identified according to the inclusion criteria were reviewed by the same independent researchers. Disputes between researchers were settled by including another researcher. Data were obtained using standard data extraction forms, including study characteristics, PICOS approach, age, gender, and follow-up time. Where necessary, the authors of the original studies were contacted for missing information. We also reviewed the references of all relevant studies and reviews for any potentially relevant study we may have missed.

Risk of bias assessment

The quality of the selected articles was evaluated by researchers with the Quality Assessment Tool (The Effective Public Health Practice Project-EPHPP) checklist. This study utilized Version 2 of the Cochrane Risk-of-Bias tool for randomized trials (RoB-2) to assess the quality of articles in randomized controlled trials.

Quantitative data synthesis and analysis

Data analysis for this meta-analysis was conducted using Review Manager 5.4 (The Nordic Cochrane Center, Copenhagen, Denmark). Heterogeneity among studies was assessed using Cochran’s Q test and Higgins’ I^2, with an I^2 greater than 50% signifying

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significant heterogeneity. Consequently, random effect results were considered when I^2 exceeded 50%, while fixed effect results were employed if it was below this threshold. For categorical variables, odds ratios (OR) were calculated, and for continuous variables, mean difference (MD) and standardized mean difference (SMD) were determined. MD or SMD were appropriately pooled for continuous variables, along with their corresponding 95% confidence intervals (CI), provided the results were measured on the same scales. All p-values were calculated from two-tailed tests, with statistical significance at $p<0.05$. Coherence between researchers for independent article selection and bias scores was evaluated using the Cohen kappa statistic. Effect size was accepted 0.2 as small, 0.5 as moderate, and 0.8 as large using Cohen's criteria for pooled estimates. Only 62.5% (n=5) of the studies were graded 1 according to the EPHPP tool. Coherence between the observers was excellent both in the selection of articles and in the scoring of selected articles in terms of bias [Cohen kappa 0.95 for article selection, 0.97 for bias scoring].

Ethical consideration

Since the research was a meta-analysis study, ethics committee approval was not obtained. The Helsinki Declaration was complied with at all stages of the research.

Results

The PRISMA flow chart for searching and selecting literature is summarized in Figure 1. The electronic database search and hand-search yielded 460 potentially relevant studies. After removing duplicates, we screened 233 articles based on title or abstract. The remaining 25 full texts were assessed for eligibility. For the full-text screening, a third reviewer was needed to resolve disagreements, all regarding the blinding of the studies. Eight trials met all eligibility criteria and were included in qualitative synthesis (Figure 1).

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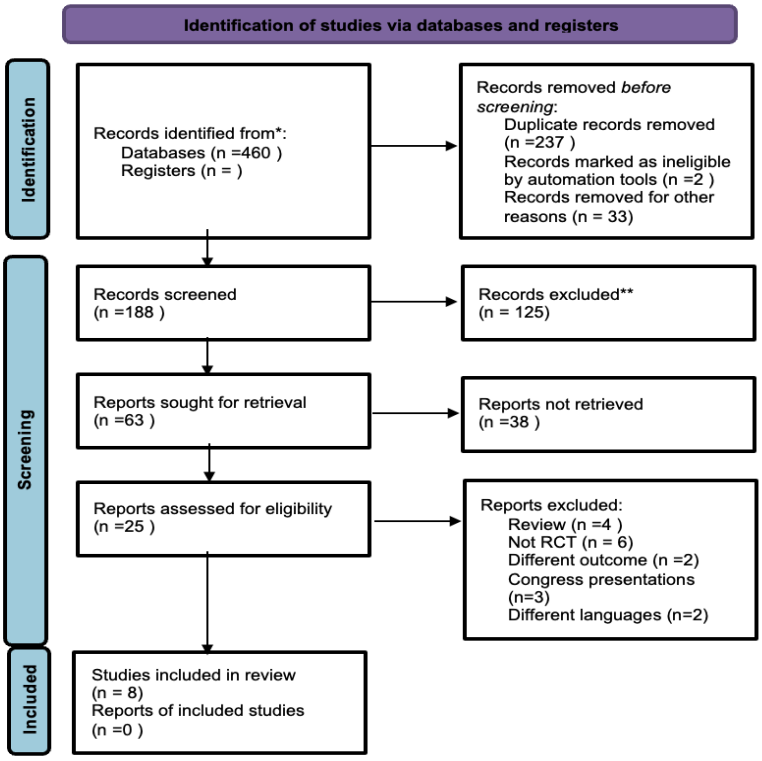
Figure 1. PRISMA 2020 flow diagram



* Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases / registers).

** If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

Eight trials (1643 participants in total) were included in these reviews and meta-analysis. The features of the studies are summarized in Table 1. All other studies started in the postpartum period except for the two study studies (started during pregnancy)[12-19]. Three studies included in the study[15,17,19]. and all studies started in the postpartum period[12-14,16,18]. The duration of the experiments varies from four weeks to 12 months. In most of the articles, while women in the control group received routine postpartum care, in one study the control group received kegel exercise[19] and in one study, pelvic floor intervention with a vibrating tool was performed for four weeks[14]. Women in the intervention group received the following treatments: Jaffar et al.[19] behavioral change intervention with a newly developed Kegel Exercise Pregnancy Training application (KEPT); Piernichka et al.[18] aerobics application; Wang et al.[17] audio guidance training; Artymuk et al.[14] pelvic floor exercises with electrical signals with EmbaGYN device; Yang et al.[12] kegel exercise; Singordardottir et al.[16] pelvic floor exercise with a physiotherapist; Johannessen et al.[15] joined the PFMT class; Sacomori et al.[13] received PFME. The entire patient population included primiparous women. In most studies, incontinence was evaluated as the primary result. All studies except one study[19] in meta-analysis evaluated incontinence during the postpartum period (Table 1).

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Most of the meta-analysis studies used internationally valid assessment tools to assess the effect of PFME on incontinence. The evaluation tools used by the researchers to evaluate the incontinence in the studies were given in Table 1.

Table 1. Characteristics of eight studies included in the systematic review

Reference/ Country	Study type	Population	The inclusion and exclusions criteria	Training protocol	Comparisons	Drop out
Jaffar et al.[19] 2022, Malaysia	RCT	IG: 16 CG: 10	**The include criteria included 1)** Malaysian citizen 2) Mobile phone (Android) and internet access Mobile phone (iPhone) 3) Pregnant woman 4) Age more than 18 years 5) Any parity at 26–27 weeks gestation 6) Stress UI or Mixed UI (International Consultation on Incontinence Questionnaire- UI- Short Form **The exclude criteria included 1)** Non-Malaysian citizen (due to Non-Malay speaking) 2) Mobile phone (iPhone) 3) Planning to be pregnant or post-partum woman 4) Age less than 18 years (Teenage pregnancy) 5) Chronic medical problem (s) before pregnancy 6) Urge UI Complicated pregnancy (not advisable to perform PFMT)	Participants allocated to the intervention group were provided 8-weeks behavioural change intervention (pelvic floor muscle training) via a newly developed mHealth app (KEPT app).	Routine Care	IG:3 CG:0
Piernichka et al.[18] 2021, Poland	RCT	IG: 24 CG: 24	**The include criteria included** 1) Only women without diagnosed urinary tract problems **The exclude criteria included** 1) Women in pregnancy, 2) with past births or 3) contraindications to physical activity or 4) allergy to materials	Participants allocated to the intervention group werw participated in a high-impact aerobics programme, 3 times a week for 6 weeks.	Routine care	IG:11 CG:5
Wang et al.[17] 2020, China	RCT	IG: 54 CG: 54	**The inclusion criteria:** 1) nulliparous women with a singleton pregnancy and cephalic presentation at 30 to 32 gestational age; 2) 20-34 years old; 3) having a stress urinary incontinence symptom with an episode frequency ≥1 per month during the last 3 months (stress urinary incontinence was defined as urine leakage on coughing, sneezing, laughing or physical activities); 4) being continent before pregnancy; 5) understanding the study procedure and willing to participate in the study. **The exclude criteria:** 1) severe comorbidities like placenta previa, threatened premature labor or pregnancy-induced hypertension; 2) a history of chronic cough, constipation, pelvic surgery, spinal surgery, urinary system disease (e.g. active urinary tract infection) or diabetes mellitus; 3) indications of cesarean section or contraindications of vaginal birth.	Participants in the intervention group received audio guidance training.	Routine care	IG:6 CG:4
Singordardottir et al.[16] 2020, Iceland	RCT	IG: 41 CG: 43	**The inclusion criteria:** 1) generally healthy, 2) aged ≥18 years, 3) able to understand Icelandic and 4) to attend the treatment sessions. **The exclusion criteria:** 1) multiple birth, 2) gestational length 3) <32 weeks, 4) unwell newborn or stillbirth and 5) conditions that could interfere with women´s ability to participate (inability to contract their PFMs, neurological conditions, previous urogynecological and/or bowel surgery or cognitive disorders)	Participants allocated to the intervention group physical therapist -	Routine Care	IG:3 CG:1

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Johannessen et al.[15] 2020, Norway	RCT	IG:429 CG: 426	**The inclusion criteria:**-1) healthy pregnant women 2) aged 18 years or older with a singleton live fetus. **The exclude criteria: 1)** high-risk pregnancies 2) women who lived more than a 30-minute drive from the hospital.	The training group attended a weekly PFMT class for 4 months, starting 6 weeks postpartum. Also they did daily three sets of 8–12 PFM contractions at home. At 6 weeks (baseline) and 6 months postpartum women answered an electronic questionnaire.	Routine care	IG:45 CG:82
Artymuk et al.[14] 2020, Russia	RCT	IG: 40 CG: 40	**The include criteria:** 1) undergone delivery in the preceding 12 weeks, 2) aged 18–45 years, and 3) with a negative pregnancy test. **The exclude criteria: 1)** Women after assisted delivery (forceps or ventouse), 2) cesarean delivery, 3) third- and fourthdegree perineal tears, 4) urinary and/or gastrointestinal infections or inflammatory diseases, 5) severe comorbidities, and 6) cognitive and mental disorders	Participants allocated to the intervention group were provided EmbaGYN device.	Kegel exercise	IG:6 CG:4
Sacomori et al.[13] 2019, Brasil	RCT	IG: 98 CG: 104	**The include criteria:** Eligible participants consisted of 1) women > 18 years of age, 2) able to understand Portuguese, and 3) immediately postpartum after having given birth to a live child. **The exclude criteria:** 1) had previous UI due to neurological disorders, 2) had a history of cancer in the genitourinary tract, 3) had a previous diagnosis of a neurological disease, 4) were blind, 5) were illiterate, 6) had drug addiction problems, or 7) mentioned not having a telephone/mobile phone number.	In the 4th postpartum month women were trained to do PFM contraction. 2–3 s contraction and relaxation, ten times a day in the first 15 days. Thereafter, the duration of contraction and relaxation was changed to five seconds. Then increase the durations to 10 s and the number of workouts to 15 sessions/ day up to the end of the study. The results of both groups, obtained in the 4th and 7th postpartum months, were compared	Routine care	IG:31 CG:39
Yang et al.[12] China	RCT	IG: 80 CG: 80	**The include criteria:** 1) be primiparas with a single surviving baby, 2) be between 20 and 35 years old, 3) have an episiotomy or second degree episiotomy tear during spontaneous vaginal delivery (bulbocavernosus superficial transverse perineal muscle, deep transverse perineal muscle, levator) and 4) have an episiotomy as a result of instrument midwifery (vacuum extraction or forceps). **The exclusion criteria:** 1) participants with heart diseases, diabetes, high blood pressure, SUI or POP, 2) participants with rubra, serosa, or lochia alba, 3) participants with a heart pacemaker, 4) participants who had a laparotomy, 5) cancer patients, and 6) participants with a nervous system disease.	3 months postpartum, beginning at the sixth week postpartum in addition to performing rehabilitation exercises.	Routine care	IG: 17 CG: 20

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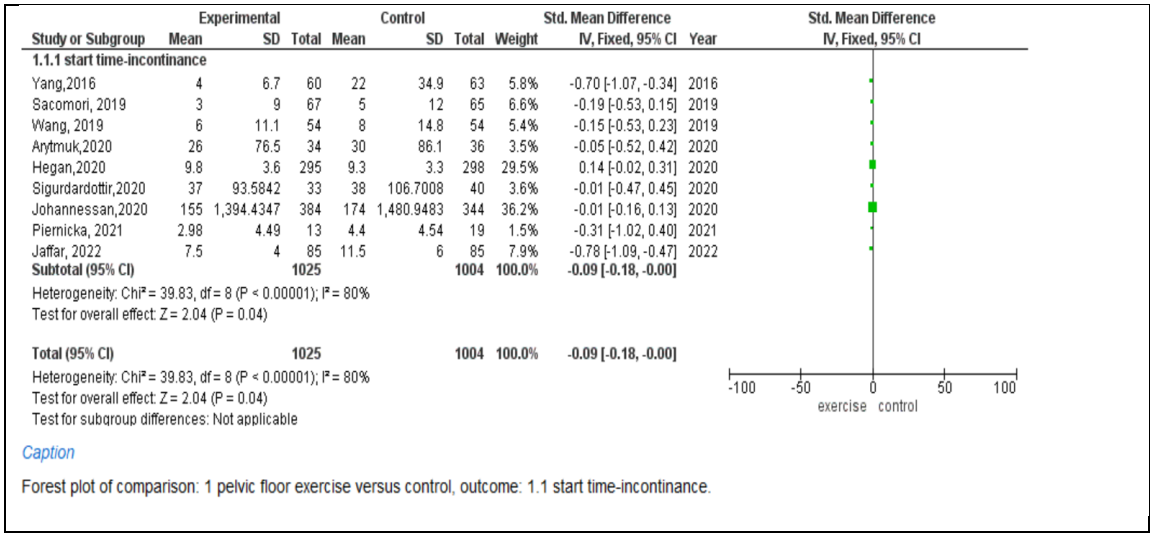
All studies on incontinence have been reported in meta-analysis and included in statistics. Only one study evaluated incontinence results in the prenatal period[19]. Figure 2 shows the effects of pelvic floor exercises on incontinence during the postpartum period. A total of 8 studies involving a total of 1643 participants examined the effects of PFME on incontinence. Pooled standardized differences in incontinence mean (SMD) between pre-intervention groups were -0.09 (95% CI: [-0.018, -0.00], p=0.04, Figure 2).

Figure 2. Forest plot of comparison: 2 pelvic floor exercise versus control, outcome: 2.1 start time-incontinence

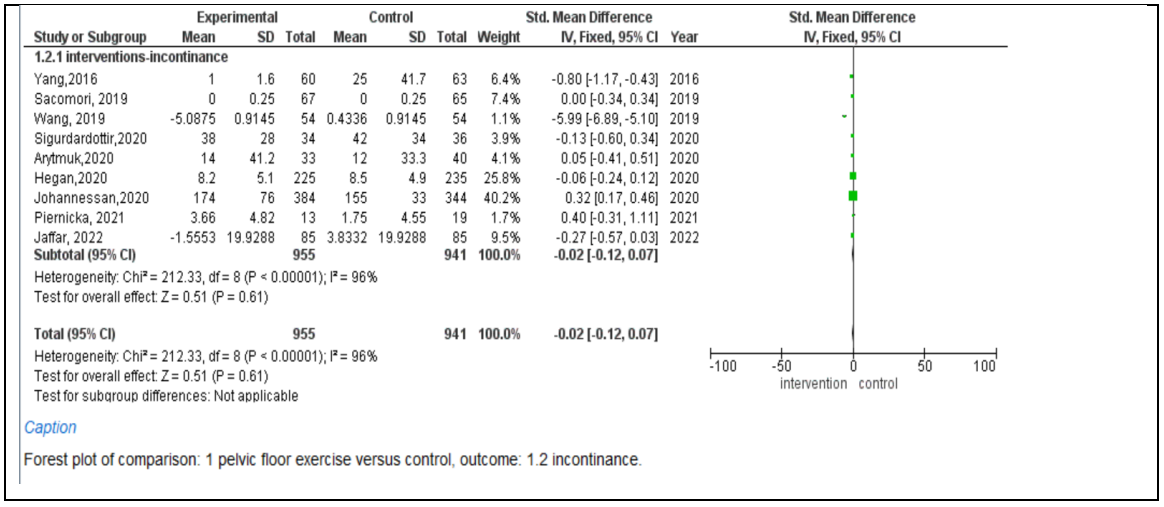


Caption

Forest plot of comparison: 1 pelvic floor exercise versus control, outcome: 1.1 start time-incontinance.

When we looked at the evaluation of PFME according to pooled standardized differences in incontinence mean (SMD) after intervention, incontinence SMDs in both intervention and control group were -0.02 (95% CI:[-0.12 –0.07], p<0.00001, Figure 3).

Figure 3. Forest plot of comparison: pelvic floor exercise versus control, outcome: 3.1. interventions- incontinence.



Caption

Forest plot of comparison: 1 pelvic floor exercise versus control, outcome: 1.2 incontinance.

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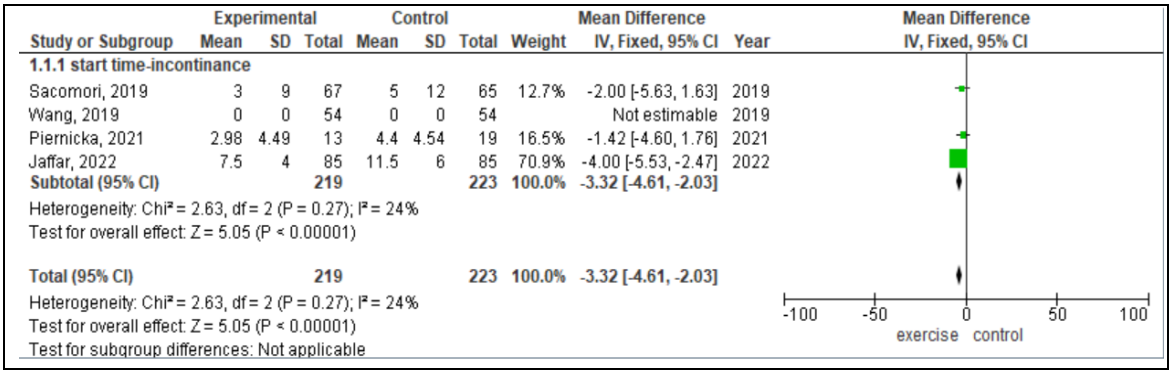
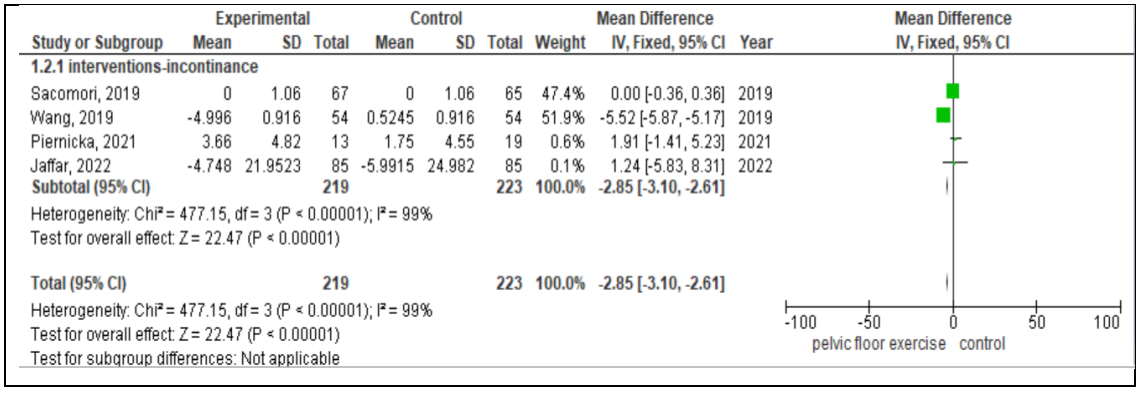
Meta-analysis of these studies has shown that PME can improve incontinence in the postpartum period. The included studies had high heterogeneity (I^2 = 96%; p = 0.00001). The forest chart is shown in Figures 2-3. There was evidence of a difference when incontinence was evaluated between interventions and control groups measured by UDI-6. Initially, the exercise group had lower average scores in UDI-6 (MD =-3.32 [-4.61-2.03], p<0.00001; Figure 4).

Figure 4. Plot of comparison: pelvic floor exercise versus control, outcome: 1.2 start time- incontinence (MD)



MD was higher after exercise (MD =-2.85 [-3.10 -2.61], p<0.00001; Figure 5) and was statistically significant.

Figure 5. Forest plot of comparison: pelvic floor exercise versus control, outcome: 1.2 interventions- incontinence (MD)



Urinary incontinence status or symptom-specific quality of life

There was little evidence to show no difference in quality of life between interventions and control groups measured by ICIQ-SF. Initially, the exercise group had lower average scores on ICIQ-SF (MD = -0.07 [-0.21-0.08], p=0.37; Figure 6). MD was higher after exercise (MD = -0.06 [-0.16-0.04], p=0.45; Figure 6), but there was no statistically significant difference. The included studies had low heterogeneity (I^2=0.54 p=0.05). The forest chart of meta-analysis is shown in Figure 6.

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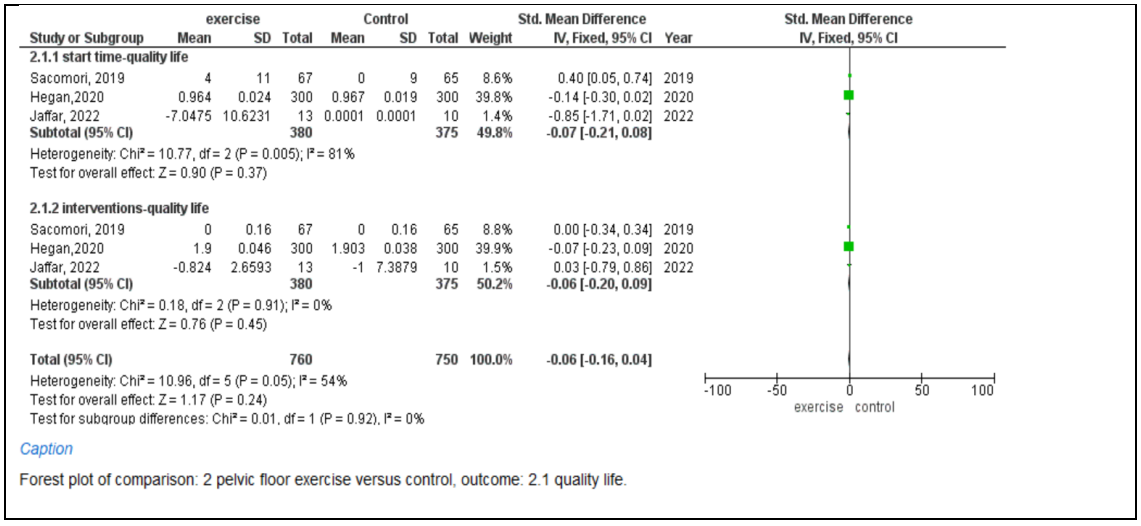
Figure 6. Forest plot of comparison: pelvic floor exercise versus control, outcome: 1.2 quality life (MD)



Caption

Forest plot of comparison: 2 pelvic floor exercise versus control, outcome: 2.1 quality life.

All studies have identified an adequate method for random assignment of participants to exercise groups. Four studies reported adequate allocation confidentiality using opaque envelopes numbered and sealed sequentially and assessed them with a low risk of prejudice[12-14,19]. In all studies except for the work of Jaffar et al.[19] and Sigurdardottir et al.[16] which was included in the meta-analysis, it was not possible for the participants and researchers involved in the experiment to be blind to the study. Jaffar et al.[19] and Sigurdardottir et al.[16] researchers blinded participants, and these two studies were at low risk for blindness outcomes. Other studies have also evaluated the results assessment without blinding it and because it carries a high risk of bias. In the four studies, those who stopped working were balanced between control and intervention groups, and there were few abandonments between control groups and experimental groups[14,17,19]. In all methods of study, they discussed the significant reported results, including negative results, and matched those reported in their records or protocols, so they were assessed at risk of reporting low bias. Specifically, we sought a conflict-of-interest statement and a source of funding. None of the studies included reported any other risk of bias.

Discussion

The purpose of this meta-analysis is to evaluate the effectiveness of PFMEs on incontinence in women during pregnancy and the postpartum period. In the included studies, it was examined whether there is evidence that PFMEs applied to women during pregnancy or postpartum improve incontinence and improve quality of life.

One of the most common and inevitable complications of pregnancy is its negative effect on pelvic muscle structure[20]. Seven studies[12,14-19] reported improvement in the frequency and symptoms of urinary incontinence through pregnancy and postpartum exercise, and a study reported no improvement[13]. Davenport et al.[21] the 24 studies reported that exercise and PFMTs in pregnancy and postpartum in meta-analysis reduced the likelihood of UI and symptom severity. Soave et al.[22] in their systematic review, 24 studies examining the effect on the urinary system and supporting structures evaluated

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by pelvic floor muscle training and objective measurement techniques for the prevention and treatment of pregnancy and postpartum incontinence and reported to be effective in preventing and treating, but poor quality of paper.

Zarawski et al.[23] found that pelvic floor training improves the quality of life of women with both pregnancy and postpartum incontinence. Pizzol et al.[24] was found to negatively affect women's quality of life at a strong level of evidence in their meta- analysis, including studies examining the impact of on quality of life. In the literature, studies examining the effectiveness of on quality of life have reported that I negatively affects the quality of life and that the quality of life deteriorates as the duration and severity of symptoms increases[25,26]. In this meta-analysis, the quality of life is determined as poor quality of evidence due to the risk of uncertainty and more studies are needed as there are few studies in this field. In addition, urinary or fecal incontinence occurs in the postpartum period due to trauma, episiotomy or tearing caused by childbirth. Incontinence is a problem that affects the quality of life of the woman, including her social status.

Conclusion

One of the strengths of this review is that it assesses the likelihood that PFME will improve incontinence and quality of life factors during pregnancy and postpartum. There were no studies during pregnancy on the effect of PFME (alone or in combination with adjuvant therapy) on incontinence, but few studies were found during the postpartum period. Another strength is that meta-analysis is limited to RCT's to reduce the impact of confusion. The two researchers tried to reduce bias in the vetting process by assessing the suitability of individual studies, extracting data, and assessing the risk of bias. However, this study, like other studies, has some limitations. One of the limitations of the study is heterogeneity in the study design. In addition, different experimental methods, starting points, durations, and exercises were included in the studies included in meta-analysis. Therefore, the interpretation of the results should be carried out carefully. Studies evaluating the effect of PFME on incontinence, especially in pregnancy, are almost nonexistent, and high-quality studies on the effect of PFME on incontinence were carried out during the postpartum period. In addition, since there are large differences between PFME programs in studies ranging from individual and home exercises to different exercise classes, the same and specific exercise protocol should be designed to teach the strengthening of the pelvic floor muscles.

There is growing evidence of the efficacy of traditional and complementary therapies for different pelvic floor disorders. However, most studies have a non-blind design and small sample size that limits the level of evidence. Despite these limitations, their traditional and complementary therapies should be considered as the initial management of treatment interventions for patients with pelvic floor disorder since they are not relatively invasive. By generating evidence on nonpharmacological interventions in coping with UI, which is an important women's health problem, it is recommended that midwives and women's health nurses use these interventions as part of care.

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