Effectiveness of Exercise Interventions on Pelvic Floor Muscle Function of Pregnant and Postpartum Women: A Systematic Review of Reviews

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Abstract

Background

Dysfunctions related to pelvic floor muscles such as urinary incontinence and pelvic pain are common among pregnant and postpartum women. With properly functioning pelvic floor muscles, it is possible to prevent these dysfunctions. Still, shared understanding about effective exercise interventions is missing. The aim of this review of reviews was to form a summary of the existing evidence about effective exercise interventions on pelvic floor muscle function of pregnant and postpartum women.

Methods

Nine databases were searched by June 12, 2020. PICO was used to define the eligibility criteria. Population: pregnant or postpartum women, interventions: activity-based interventions aiming to affect the function of pelvic floor muscles, comparators: waiting list or usual care, outcomes: disorders concerning pelvic floors muscles, study design: systematic reviews and meta-analysis. Screening and quality assessment were conducted by two researchers separately. The data were extracted and analyzed narratively.

Results

Altogether 20 systematic reviews reporting findings from 147 original studies were included. The methodological quality of the included reviews was mainly good, overall scores varying from 6/11–11/11. The results showed it may be possible to reduce low-back and pelvic pain as well as the severity of pain with exercise interventions during pregnancy but no association with odds of low back and pelvic pain during the postpartum period were found. With prenatal exercise interventions, it is possible to decrease the risk of urinary incontinence during pregnancy and the postnatal period, but the differences between the control group and the intervention group seem to vanish in the late postnatal period. The results were carefully optimistic within postnatal exercise interventions that decreased pelvic pain, reduction in vaginal bulging and pelvic organ prolapse, but more research is needed.

Conclusions

Overall, the level of evidence was low. It seems that with exercise interventions it could be possible to prevent and provide care for the disorders of pelvic floor muscles to some extent. However, more high-quality research is needed to support decision making in the health care systems and to get evidence-based knowledge guiding health professionals working with pregnant and postpartum women.

Background

Pregnancy and delivery change the lives of women and can have vast effects from physical state of health to mental health[2,3], self-confidence[3,4] and quality of life[4] of women. The big changes in anatomy and physiology – and the disorders that may follow, can be one of the reasons why women experience decreased well-being during pregnancy (prenatal) or after pregnancy (postnatal). Some of the biggest anatomical changes during pregnancy and delivery happen in the pelvic area. The progressive increase in volume of the uterus causes perineal structures a major overload, which make muscle trauma, nerve injuries and connective tissue damage common.[5,6] Pelvic floor muscles support the bladder, vagina, rectum, and lower back,[7] and the reduced strength and functionality of pelvic floor muscles can cause different dysfunctions.[6,8] The most common dysfunctions of pelvic floor muscles are back and pelvic pain[9,10], urinary incontinence (UI)[11] and pelvic organ prolapses (POP)[12]. These dysfunctions are common, for example, the estimates of the prevalence of UI varies according to different estimates from 30% to over 40%.[5,11,13]

Dysfunctions of pelvic floor muscles have a significant impact on the lives of women on an individual level[2–4] and on the use of the health care system. Treating these disorders can take a long time and demand several contacts with different health professionals. The limited resources of the health care system highlight the importance of preventive health care. Pelvic floor muscle training (PFMT) and physical activity are commonly recommended and encouraged in pregnant and postpartum women[14,15] to prevent and treat these dysfunctions. Despite the recommendations, a unified, overall understanding about the effectiveness of the interventions concerning PFMT is missing. The number of systematic reviews in this field of research has increased and the aim of this review of reviews, was to form a summary of the existing evidence about the effectiveness of the exercise interventions on the pelvic floor muscle function of pregnant and postpartum women and to identify the needs for future research.

Methods

Design

This study was conducted as a review of systematic reviews,[16] which provides an opportunity to form an overall understanding related to the topic of interest and point out the needs for future research.[16,17] This review was conducted following the guidelines of the Joanna Briggs Institute (JBI) Manual for Evidence Synthesis[16] and was registered in the International prospective register of systematic reviews (PROSPERO: CRD42020191591).

Data sources

The following electronic databases were used to search for eligible articles: PubMed / MEDLINE, CINAHL, PsycINFO (EBSCO), Web of Science, Medic, Cochrane Library, ERIC (EBSCO), Embase and Academic Search Premier (EBSCO). Search dates were from June 8, 2020, to June 12, 2020. There were no restrictions on the search including language, publication period or study design, but the searches were limited to title or abstract. The used search terms for the literature search were defined using the PICO method (P = population; I= Intervention; C = comparators; O = outcomes) (Table 1.). The Boolean operators “or” and “and” were used and the search terms were customized for each database separately. The search strategy was developed in collaboration with an information specialist.

Eligibility criteria

Reviews were included if they met the following inclusion criteria: 1) systematic review or meta-analysis of randomised controlled trials (RCTs); 2) study population consisting of pregnant and/or postpartum (maximum 24 months from delivery) women; 3) interventions, including exercise, exercise guidance, physiotherapy or physiotherapeutic guidance aiming to affect the functioning of the pelvic floor muscles either delivered individually or in a group format, either face-to-face or online; 4) comparison interventions including normal care, no exercise or being on a waiting list; 5) outcomes including disorders concerning pelvic floor muscle function; 6) written in English or Finnish.

Study selection process

Records were first independently screened on title and abstract level by two authors (IR, LH) applying the established eligibility criteria, and after that, the results were discussed and checked between the two authors (IR, LH). Disagreements between reviewers were resolved through a third review author (AA). Next, the two authors (IR, LH) assessed the records independently based on full text and after that the results were checked for consistency. The decisions were recorded by using Covidence. The study selection process is described in the PRISMA flowchart (Figure 1).

Quality assessment

The quality assessment was performed by two authors (IR and LH) independently using the JBI Critical Appraisal Checklist for Systematic Reviews and Research Syntheses. If the information was not available or was unclearly stated, authors contacted the corresponding authors of these articles. Disagreements over assessments were resolved with the third author (AA). To secure the quality of the included reviews, it was determined, that for the review to be included in this review of reviews, the overall scores needed to be at least 6/11. Also, regarding item 5: the used criteria for appraising studies, needed to be addressed and rated as “low risk of bias”.

Data extraction and analysis

Data extraction was carried out by two authors (LH, IR) independently according to JBI's instructions[16] using Covidence. The data extraction table was tested before its actual use. The analysis of the included reviews was done narratively, first by summarizing the evidence from meta-analysis and then from the narrative results. The summary of evidence was synthesized to effectiveness tables with specific numbers for each outcome from those reviews where meta-analyses were conducted. The certainty of evidence was reported using the GRADE approach[19] using assessments done by the authors of the original reviews. Grading the certainty of evidence was not possible for other outcomes due to incomplete information in other reviews. For example, the risk of bias assessment for the included studies in the reviews were conducted with an alternative to the Cochrane collaboration risk of bias tool.

Ethical approval

This study was conducted in accordance with the European Code of Conduct for Research Integrity (2017).

Results

Altogether 606 records were identified through database searches. After removing duplicates (n=275), 331 records were screened at the title and abstract level. After excluding the non-relevant records (n=286), 45 full-text articles were assessed for eligibility and 21 articles were excluded for various reasons. Consequently, 24 articles were included for the methodological quality assessment and 20 articles were included in our review of reviews (Figure 1). The list of excluded studies with reasons are available from the authors via a reasonable request.

Methodological quality assessment of included reviews

Out of 24 full-text reviews included in the methodological quality assessment,[18] four reviews[20–23] were excluded after assessment. Three of the excluded reviews[20,21,23] scored 4/11 points and were excluded because of the low overall scores. One review[22] scored an acceptable 7/11 points, but item 5 was not addressed and for that reason, the review was excluded.

The quality of the included reviews (n=20) was primarily on a good level. Seven studies[24–30] scored the maximum 11/11 points. The most common items for which the risk of bias was rated as being "high", were item 3 (describing the search strategy), item 7 (describing the methods to minimize the errors in data extraction) and item 10 (describing the recommendations for policy and/or practice) (Table 2).

General characteristics of the reviews

The included 20 reviews, consisting of 147 original studies (online supplement 1), were published from 2003–2019. All of the included articles (n=20) were systematic reviews, of which eight performed a meta-analysis. The remaining 12 articles performed a narrative analysis. The main purpose of the reviews was to assess the effectiveness of different exercise interventions either in pregnant (n=13), postpartum (n=4) or both pregnant and postpartum women (n=3). Primary outcomes assessed were pain (n=13), incontinence (n=6) and prolapse (n=1) (Table 3.).

Exercise interventions used to improve pelvic floor muscle function

The used interventions and the level of description of the interventions in the reviews were heterogeneous. The exercise protocols varied including different kinds of stabilizing exercises, strengthening exercises with equipment or without, aerobic exercise, stretching and mobility training, body awareness, guidance, yoga, breathing exercises, relaxation, and balance exercises. The exercise interventions were initiated independently and/or in groups and/or under supervision by a physiotherapist, midwife, nurse or other educated person in hospitals, exercise classes or at home. The frequency of exercising varied from several times a day to one time per week and the duration of the intervention period was from one week to 17 months. The interventions began between gestational weeks eight and eight weeks postpartum. The interventions are described according FITT principles, which stands for frequency, intensity, time, and type. In addition, the setting of the intervention was added (Table 3).

Effectiveness of the exercise interventions

The results are divided into three different sections according to the primary outcomes: pain, urinary incontinence and pelvic organ prolapse symptoms.

Pain

Pain was the primary outcome in 13 reviews, of which four performed a meta-analysis and nine a narrative analysis (Table 3.). Interventions were initiated both during the prenatal period (n=10 reviews) and the postnatal period (n=3 reviews). The results of meta-analysis focused only on the prenatal exercise interventions. The level of evidence (GRADE) assessments are seen in Table 4. It was determined in 5 out of 13 outcomes by the authors of the original reviews.[26,29] The level of evidence was rated to be very low in two, low in two and moderate in one outcome. The main reasons to downgrade the level of evidence was risk of bias and imprecision. The specific reasoning for the level of evidence can be found in the original reviews.[26,29]

The results of the meta-analysis were contradictory. According to the analysis by Davenport et al. (2019),[26] a meta-analysis including 12 RCTs, prenatal exercise was not associated with lower odds of low back pain, pelvic girdle pain or lumbopelvic pain during pregnancy compared to no exercise (OR 0.78, 95% CI 0.6–1.02, I2 =22%). The following meta-analysis supported these results.[29,40] No significant differences were found in the number of women reporting low back pain (RR 0.97, 95% CI 0.80–1.17) or pelvic pain (RR 0.97, 95% CI 0.77–1.23) between the group who received exercise and information about managing pain, versus the control group, who received ordinary prenatal care.[29] Exercise had no protective effect on pelvic girdle pain (RR 0.99, CI 0.81–1.21, I2 = 0%) or lumbopelvic pain during pregnancy (RR 0.96, CI 0.90–1.02, I2 = 1%)[40] (Table 4).

On the contrary, positive results with the effects of prenatal exercise on pain were also compared and no exercise of usual care was found. Prenatal exercise significantly reduced low back pain (SMD -0.64, 95% CI -1.03 –-0.25, I2 = 81%) (RR 0.66, 95% CI 0.45–0.97, I2 = 88%) in pregnancy more than usual prenatal care alone.[29] Shiri et al. (2018)[40] found that exercise reduced the risk of low back pain in pregnancy by 9% (RR 0.91, 95% CI 0.83–0.99, I2 = 0%). Peng & Chao (2019)[38] found that, light-intensity (MD -2.21, 95% CI, -4.33–-0.09, I2 = 99%) and moderate-intensity (MD=-1.98, 95% CI, -3.63–-0.34; I2 = 94%) prenatal exercise could decrease lumbopelvic pain during pregnancy. In addition, Davenport et al. (2019)[26] found an inverse association between prenatal exercise and severity of low back pain, pelvic girdle pain or lumbopelvic pain during pregnancy (SMD −1.03, 95% CI −1.58–-0.48, I2 =92%) (Table 4).

Almost all the reviews with narrative analysis recommended that more high-quality research is needed in this area and highlighted that the evidence for now is very limited. Prenatal exercise may decrease low back pain,[31,32,39] pelvic girdle pain,[28,31] pelvic pain[39] or lumbopelvic pain[42] during pregnancy. In addition, prenatal exercise was associated with lower severity of low back pain, pelvic girdle pain or lumbopelvic pain during pregnancy. On the contrary, two high-quality studies showed no difference in back and pelvic pain intensity between the exercise groups and the control groups, and the evidence was low for exercise for pregnancy-related lumbopelvic pain.[34,41]

There was not found to be an association between prenatal exercise and the likelihood of low back pain, pelvic girdle pain or lumbopelvic pain during the postpartum period (OR 0.89, 95% CI 0.51–1.56, I2 =27%)[26] (Table 4). The results from one narrative analysis supported the result of the meta-analysis; the evidence for the effectiveness of exercise on postpartum lumbopelvic pain, was very limited.[34]

There was no meta-analysis regarding postnatal exercise interventions, but three reviews did lead to narrative analysis. The results according to narrative analysis was carefully optimistic. There was some limited evidence that stabilizing exercises decrease pelvic girdle pain for postpartum women.[28] In addition, an intervention in one trial involving physical therapy with specific stabilizing exercises proved to be effective in reducing the intensity of lumbopelvic pain.[30]

Urinary incontinence

UI was a primary outcome in six reviews, of which four performed a meta-analysis and two a narrative analysis (Table 3). In addition, Wu et al. (2018)[27] studied postnatal PFMT for the prevention of UI as a secondary outcome. Interventions were initiated both during the prenatal period (n=5) and the postnatal period (n=4). The level of evidence (GRADE) assessments are seen in Table 5. It was determined in 12 out of 19 outcomes by the authors of the original reviews regarding prenatal exercise interventions, and in three out of seven outcomes regarding postnatal exercise interventions.[24,25] The level of evidence was rated to be very low in two, low in four, moderate in five, high in one outcome regarding prenatal exercise interventions, low in one and moderate in two outcomes regarding postnatal exercise interventions. The main reasons to downgrade the level of evidence were inconsistency, risk of bias and imprecision. The specific reasoning for the level of evidence can be found in the original reviews.[24,25]

Prenatal exercise interventions were compared to no exercise or with usual care, decreased the risk of reporting UI during pregnancy from 22% to 62%. Heterogeneity was reported to be high.[24,25] Using prenatal PFMT for treatment of prenatal UI was not effective and there was no evidence of any difference in risk of UI (RR 0.70, 95% CI 0.44–1.13, I2 = 71%).[24] However, exercise interventions showed a moderate reduction in the severity of prenatal UI symptoms with prenatal exercise (SMD −0.54, 95%CI −0.88–-0.20, I2 = 64%).[25]

Prenatal exercise interventions had positive results for preventing postnatal UI in the early and mid-postnatal periods. Exercise interventions compared to control groups reduced the odds of developing postnatal UI from 17% to 62% during early postnatal period.[24,25,36] Prenatal PFMT in women with or without UI may reduce the risk slightly in the mid-postnatal period (RR 0.73, 95% CI 0.55–0.97, I2 = 65%) (29% less; RR 0.71, 95% CI 0.54–0.95, I2 = 0%) (RR 0.75, 95% CI 0.56–1.02).[24,35] On the contrary, in the late postnatal period (RR 0.85, 95% CI 0.63–1.14, I2 = 0%), 12 months postnatal (RR 1.20, 95% CI 0.65–2.21) and in the long term (> 5 years) (RR 1.07, 95% CI 0.77–1.48, I2 = 25%), there were no evidence of a difference between PFMT and control groups in the risk in prevalence of UI.[24] In addition, using prenatal PFMT for treatment of postnatal UI compared with usual care, there was no evidence of differences in the early (RR 0.75, 95% CI 0.37–1.53), mid-postnatal (RR 0.94, 95% CI 0.70–1.24) or late postnatal (RR 0.50, 95% CI 0.13–1.93, I2 = 24%) periods.[24] However, prenatal PFMT had a moderate role in reducing the severity of postnatal UI symptoms (SMD −0.54, 95% CI −0.87–-0.22, I2 = 24%)[25] (Table 5).

The narrative analysis mainly supported the results of meta-analysis. Mørkved & Bø (2014) found that prenatal exercise interventions compared with no exercise or with usual care, showed a significant reduction in symptoms, episodes of UI or a lower percentage of women with UI in late pregnancy or during the first three months after delivery. The results of using prenatal PFMT for treatment of prenatal UI were contradictory; one original study showing there was no difference between intervention and control groups and two original studies demonstrating a significant difference in the reduction of the symptoms.[37]

Women participating in postnatal exercise interventions compared with control groups were 46% to 56% less likely to report UI during early postnatal period.[24,27] On the contrary, there was no evidence of a difference in the risk of UI in women randomized to postnatal PFMT or control group in the mid-postnatal period, up to six months (RR 0.95, 95% CI 0.75–1.19, I2 = 65%), in the late postnatal period (RR 0.88, 95% CI 0.71–1.09, I2 = 50%), six years postnatally (RR 0.96, 95% CI 0.88–1.05) or 12 years after delivery (RR 1.03, 95% CI 0.94–1.12).[24] However, women randomized to PFMT were less likely to have UI after treatment compared to controls more than six and up to 12 months postdelivery (RR 0.55, 95% CI 0.29–1.07) (Table 5).

The narrative analysis mainly supported the results of meta-analysis. Clinically relevant and statistically significant effects of the interventions, with a reduction in symptoms or frequency of UI after the intervention period was found.[37,43] The results with follow-up periods were heterogeneous, but most of the original studies supported the finding from meta-analysis showing there were no differences between intervention and the control group in prevalence of UI after later follow-up.[37,43]

Pelvic organ prolapse

Based on the meta-analysis by Wu et al. (2018)[27] interventions including structured PFMT compared with watchful waiting showed reduction in bothersome vaginal bulging between 6 and 12 months postpartum (RR, 0.48, 95% CI 0.30–0.76) and reduction of stage II or greater pelvic organ prolapse within 12 months postpartum (RR 0.74, 95% CI 0.45–1.24, I2 = 47 %) (Table 6). The level of evidence was downgraded because of serious risk of bias and imprecision regarding POP symptoms, and because of imprecision regarding POP stage.

Discussion

This review of reviews summarizes the results of 20 previous systematic reviews and meta-analysis to produce knowledge about the effectiveness of the exercise interventions on pelvic floor muscle function among pregnant and postpartum women. The included reviews and meta-analysis consisted of 147 original studies that were published between 2003–2020. The methodological quality of the included reviews and meta-analysis were mainly high, however, the methodological quality of original studies included in the reviews varied greatly, and the certainty of evidence was most often very low or low. High certainty of evidence was rated only for prenatal PFMT for prevention of postnatal UI in continent women in the mid-postnatal period (>3 to 6 months).[24]

It seems that exercise interventions can be effective compared with usual care, but the results need to be considered with caution because of the variations in the quality of evidence. With prenatal exercise interventions, it may be possible to reduce low back pain,[29,31,32,39] pelvic girdle pain,[28,31] pelvic pain[39] and lumbopelvic pain,[38,42] decrease the severity of pain,[26] and decrease the risk of UI[24,25] and UI symptoms[25] during pregnancy. However, prenatal exercise interventions were not significantly associated with lower odds of lower back pain,[26,29] pelvic girdle pain,[26,40] pelvic pain[29] or lumbopelvic pain[26,40] and using PFMT for treatment of prenatal UI was not effective[24] during pregnancy.

Prenatal exercise interventions had positive results for preventing and decreasing the odds of developing postnatal UI in the early and mid-postnatal periods,[24,25,35,36] but in the late postnatal period, 12 months postnatal or in the long term (> 5 to 12 years), there was no evidence of a difference between PFMT and control groups regarding the risk on prevalence of UI.[24] In addition, no association with prenatal exercise and odds of low back pain,[26] pelvic girdle pain[26] or lumbopelvic pain during the postpartum period[26,34] were found.

The results were carefully optimistic that with postnatal exercise it could be possible to decrease pelvic girdle pain[28] and to reduce the intensity of lumbopelvic pain[30] after delivery. Postnatal PFMT compared with watchful waiting also showed reduction in bothersome vaginal bulging between six and 12 months postpartum and reduction of pelvic organ prolapse within 12 months postpartum.[27] Women participating in postnatal exercise interventions compared to control groups were 46% to 56% less likely to report UI during early postnatal period,[24,27] but there was no evidence of a difference in the risk of UI in the mid-postnatal period, up to six months, in the late postnatal period or six years postnatally.[24]

It is not a new phenomenon, that physical activity is recommended during pregnancy and the postnatal period, and, for example, PFMT has been used as treatment for UI symptoms since the 1940s. Arnold Kegel popularised PFMT as Kegels at the end of the 1940s, but later several records of the use of PFMT were found even prior that.[44] The latest physical activity recommendations,[14,15] emphasize the importance of physical activity broader than only focusing on PFMT. Canadian guidelines (2019) for physical activity throughout pregnancy[15] strongly encourages all women without contraindications to be physically active throughout pregnancy (moderate-quality evidence). An umbrella review by DiPietro et al. (2019)[14] updated the evidence from the 2018 Physical Activity Guidelines Advisory Committee Scientific Report and stated that increasing the physical activity of pregnant and postpartum women is essential for public health. In Finland, the UKK Institute (2021)[45,46] published weekly physical activity recommendations during pregnancy and after delivery. The recommendations encourage women to utilize everyday opportunities to be physically active, remember to break up sedentary behavior, get enough rest and to start PFMT right after delivery.

The recommendations highlight physical activity throughout pregnancy and after delivery because it may be possible to reach maternal health benefits like decreased risk of UI,[15] excessive gestational weight gain,[14,15,46] depression symptoms[14,15] and lumbopelvic pain.[15] Regular physical activity improves physical fitness and can speed up recovery after delivery[45]. The results of this review support the physical activity recommendations. An interesting finding was that many previous studies concentrated strictly on PFMT, although now, PFMT is only part of the exercise. The more holistic view of health and well-being seems to be the focus of the latest recommendations. Pelvic floor muscles should not be treated by only focusing on the pelvic area, instead, understanding anatomy and physiology of the body is essential. The reasons behind the disorders of pelvic floor muscles can be caused by dysfunctions in the pelvic area,[47] but the reasons can also be found elsewhere, for example in breathing.[48]

Even though the exercise interventions seemed to be effective, the differences between intervention and control groups vanished in the late postnatal period.[24] This is an interesting finding, because the evaluations of the number of women suffering from disorders related to pelvic floor muscle function in the long term are quite high.[5,11,13] Based on these results, one important aspect is to notice the population receiving the interventions. Understandably, the resources of the health care system are limited, and we need to consider which actions are effective and cost-effective for which sub-groups. A recent review[50] found that providing group-based PFMT for all women during pregnancy is more efficient than postnatal exercise for women with UI. In this review, the participants were women both with and without the symptoms of UI, pain and prolapse having interventions in groups and individually. On the contrary, like in previous research,[49] individual supervision is found to be one of the key factors for successful intervention.[28,30,32,33,37,39,41,42] Based on these findings, providing individual supervision for acknowledged risk groups could be effective and cost-effective. In addition, all women should have access to preventive care during pregnancy, for example, opportunities to participate in group-based training or have access to web-based training programs.

The main limitation of this review is the quality of the original studies included in the reviews.[16] To strengthen the quality of this review, the JBI Manual for Evidence Synthesis were followed while conducting the review and the PRISMA guidelines were used for assuring the quality of reporting the results. After defining the search terms, an information specialist confirmed the search phrases for different databases. The whole search process was documented using Covidence and was conducted independently by two authors, one phase at a time. After each phase, the decisions were checked for consistency and in the event of a disagreement, a third author was consulted. The quality assessments and data extraction were conducted independently by two researchers. The data extraction was based in the JBI Manual for Evidence Synthesis. In addition, the level of evidence was reported based on GRADE. The methodological quality of included reviews was relatively high, but according to the GRADE assessments, the quality of evidence was mainly low.

Conclusions

The results showed that with exercise interventions it might be possible to reduce low back[29,31,32] and pelvic pain[28,31,38,39,42] as well as the severity of pain[26] during pregnancy. However, no association with prenatal exercise and probability of low back[26] and pelvic[26,34] pain during the postpartum period were found. With prenatal exercise interventions, it is possible to decrease the risk of UI during pregnancy[24,25] and postnatally[24,25,35,36] but the differences between the control and the intervention group seems to vanish in the late postnatal period[24] and the same phenomenon was found with postnatal exercise interventions.[24,27] The results were carefully optimistic within postnatal exercise interventions decreasing pelvic pain,[28,30] reduction of vaginal bulging and pelvic organ prolapse,[27] but more research is needed on postnatal exercise interventions.

There is a need for high quality RCT studies for gaining more information to support decision making in health care systems and for guiding health professionals working with pregnant and postpartum women. In the future, it would be beneficial to study the topic broadly, focusing on a more holistic view of health and well-being by including PFMT in only one part of exercise. Also, the use of e-health interventions should be studied. eHealth has increased during the past few years and is needed if the pandemic and limitations to meet pregnant and postpartum women face-to-face are considered.

Abbreviations

UI: urinary incontinence

POP: pelvic organ prolapse

PFMT: pelvic floor muscle training

JBI: Joanna Briggs Institute

RCT: randomized controlled trial

GRADE: Grading of Recommendations, Assessment, Development and Evaluations

OR: odds ration

CI: confidence interval

RR: risk ration

SMD: standardized mean difference

MD: mean difference

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request. The dataset (data extraction table) is based on the systematic reviews listed in the manuscript and described in table 3. The list of the reviews included can be find as an attachment below “related files”.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

IR: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Resources, Project Administration, Visualization, Writing – Original Draft Preparation; LH: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Resources, Supervision, Visualization, Writing – Original Draft Preparation, AA: Conceptualization, Methodology, Supervision, Writing – Review & Editing. All authors read and approved the final manuscript.

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Tables

Table 1. The search terms.

Population	pregnancy, pregnant, nulliparous, prenatal, maternal, antenatal, pregnancy, pregnant, nulliparous, prenatal, maternal, postpartum, postnatal, after delivery, after cesarean section, cesarean section, labor, delivery
Intervention	physical activity, exercise, movement, motor activity, physiotherapy, rehabilitation, pelvic muscle exercises, yoga, pelvic floor muscle training, guidance, guidelines, health promotion, counseling, exercise, therapy, support, education, patient education, prevention, management
Comparison	usual care, no-intervention
Outcome	pelvic floor dysfunction, pelvic floor muscle syndrome, overactive pelvic floor, myofascial pelvic pain, levator tension myalgia, hypertonic pelvic floor muscles, pelvic health, pelvic floor disorder, pelvic girdle pain, pelvic girdle function, pelvic girdle dysfunction, cystocele, urethrocele, rectocele, cystourethrocele, enterocele, anterior vaginal wall prolapse, pelvic organ prolapse, posterior vaginal wall prolapse, pelvic fullness, pubocervical vesical fascia weakness, pelvic pressure, vaginal fullness, vaginal pressure, urinary incontinence

Table 2. Methodological quality of systematic reviews (n=24).

Review (n=24)	Items											Overall score
	1	2	3	4	5	6	7	8	9	10	11	
Almousa 2018[28]	x	x	x	x	x	x	x	x	x	x	x	11/11
Belogolovsky 2015(E)[22]	x	x		x				x	x	x	x	7/11
Boissonnault 2012[31]	x	x		x	x	x			x	x	x	8/11
Colla 2017[32]	x	x	x	x	x		x	x		x	x	9/11
Davenport 2019a[25]	x	x	x	x	x	x	x	x	x	x	x	11/11
Davenport 2019b[26]	x	x	x	x	x	x	x	x	x	x	x	11/11
Dumoulin 2006 (E)[23]				x	x					x	x	4/11
Ferreira 2012[33]	x			x	x	x	x			x	x	7/11
Gutke 2015[34]	x			x	x	x			x		x	6/11
Harvey 2003[35]				x	x		x	x		x	x	6/11
Lemos 2008[36]	x	x	x	x	x	x		x		x	x	9/11
Mørkved 2014[37]	x	x	x	x	x	x		x		x	x	9/11
Peng 2019[38]	x	x	x	x	x	x	x	x		x	x	10/11
Pennick 2015[29]	x	x	x	x	x	x	x	x	x	x	x	11/11
Richards 2012[39]	x	x	x	x	x	x	x		x	x	x	10/11
Saboia 2018 (E)[21]				x	x		x		x			4/11
Shiri 2017[40]	x	x	x	x	x	x		x	x	x		9/11
Soave 2019 (E)[20]				x				x		x	x	4/11
Stuge 2003[41]	x	x		x	x	x		x		x	x	8/11
Tseng 2015[30]	x	x	x	x	x	x	x	x	x	x	x	11/11
van Benten 2014[42]	x	x	x	x	x	x	x		x	x	x	10/11
Wagg 2007[43]				x	x	x	x	x		x	x	7/11

Woodley 2020[24]	x	x	x	x	x	x	x	x	x	x	x	11/11
Wu 2018[27]	x	x	x	x	x	x	x	x	x	x	x	11/11
Abbreviations: (E), excluded based on the methodological quality												

Table 3. Characteristics of included reviews and the used interventions (n=20)

Review, year, country	Primary outcome	Interventions used	Total number/ sample size, participants	Number of original studies in review	Methodological quality, appraisal tool	Method of analysis
Almousa et al. 2018 [28] (UK)	Pain (PGP)	F: ranged from 1 to 3 times per week I: ranged from light to heavy T: duration of interventions varied from 6 to 20 weeks. Interventions were conducted from 8 GWs to 5 months postpartum. T: stabilizing and strengthening exercises using different equipment and/or with bodyweight S: both home exercise and at clinics, instructions provided in video tape	719/44-330, pregnant & postpartum women	N=6 RCTs	Good quality (n=5), moderate quality (n=1), PEDro scale	Narrative synthesis
Boissonnault et al. 2012 [31] (USA)	Pain (PGP, LBP)	F: ranged from 1 to 3 times per week I: not reported T: duration of interventions varied from 1 to 28 weeks. Interventions were initiated during the second and third trimesters. T: pelvic and trunk stabilization protocols, stretching, water gymnastics/ aerobics, land-based aerobics, abdominal strengthening, strengthening exercises, pelvic floor muscle strengthening exercises	1819/15-407, pregnant women	N=11 (n=7 RCTs, n=4 quasi-experimental studies)	Good quality (n=3), moderate quality (n=6), poor quality (n=2), PEDro scale	Narrative synthesis

		S: at home and in clinics, both supervised and individually				
Colla et al. 2017 [32] (Brazil)	Pain intensity (LBP, PP), functionality	F: ranged from 1 or 2 times per week to 3 times a day I: not reported T: duration of interventions varied from 1 to 20 weeks. Interventions were initiated between 12 to 32 GWs. T: stretching, muscle strengthening, pelvic stabilization, PFMT, stationary bicycle, aerobics, body awareness, posture, yoga-type exercises (warm-up, breathing, relaxation) S: at homes and in the clinics, individually or in groups.	1781/34-855, pregnant women	N=8 RCTs	High quality (n=7), low quality (n=1), PEDro scale	Narrative synthesis
Davenport et al. 2019 [25] (Canada)	Prevalence and severity of UI	F: ranged from 1 to 7 times per week I: ranged from light to moderate T: duration of interventions was not reported. Interventions were initiated between 9 to 30 GWs. T: aerobic exercise and PFMT S: at clinics and home, both independently and/or supervised	15 982/, 64-10098, pregnant women	N=24 (n=18 RCTs, n=2 quasi-experimental studies, n= 4 cohort studies)	the Cochrane Risk of Bias tool	Meta-analysis and narrative synthesis
Davenport et al. 2019[26] (Canada)	Odds of LBP, PGP and LBPP and severity of symptoms	F: ranged from 1 to 14 times per week I: ranged from low to vigorous	52 297/15-5304, pregnant women	N=32 (n=23 RCTs: n=5 quasi-experimental studies, n=3	the Cochrane Risk of Bias tool	Meta-analysis and narrative synthesis

		T: duration of interventions varied between 4 to 20 weeks. Most of the interventions were initiated during second trimester. T: yoga, aerobic exercise, muscle strengthening, combination of aerobic and resistance training S: at clinics and home, both independently and/or supervised, alone or in groups		cohort studies, n=1 case control study)		
Ferreira & Alburquerque-Sendi'n 2012[33] (Brazil)	Limitations in activities, disability, pain intensity	F: ranged from 1 to 7 times per week I: not reported T: duration of interventions varied from 8 to 20 weeks. T: stabilizing exercises for trunk muscles S: at homes and in the clinics, individually or under guidance of physiotherapist. One study used videotapes for giving instructions.	341/44-128, postpartum women	N=6 RCTs	Low risk of bias (PEDro scores 5-8/10), PEDro scale	Narrative synthesis
Gutke et al. 2015[34] (Sweden)	Pain	F: not reported I: not reported T: not reported T: stabilizing exercise, pelvic floor exercises, water exercise, yoga, progressive muscle relaxation S: both at homes and in the clinics, both in group and individually.	Not reported/ 30-855, pregnant & postpartum women	N=56 (n=34 RCTs, n=22 other designs)	Moderate to high quality (scores 3-8/10), PEDro scale	Narrative synthesis

Harvey 2003 (Canada)	Incontinence, prolapse, pelvic floor strength	F: not reported in all studies, ranged from 3 to 7 times per week I: not reported in all studies, one study reported training intensity being 60% to 70% maximal heart rate. T: one study reported duration of intervention being 12 weeks T: pelvic floor training, Kegel contractions, aerobic exercise S: at home and in clinics, direct teaching and supervision of the technique by experienced physiotherapists, both individually and in groups	3573/45-1169, pregnant & postpartum women	N=9 RCTs	Between poor and good quality (n=7) good quality (n=2), Jadad scale	Meta-analysis and narrative synthesis
Lemos et al. 2008[36] (Brazil)	Prevalence of UI	F: ranged from 1 to 10 times a day I: varied T: duration of interventions varied from 16 to 20 weeks. Interventions were initiated in the 20 GW. T: PFMT S: at home	675/72-301, pregnant women	N=4 RCTs	High quality (n=4), Jadad scale	Meta-analysis
Mørkved & Bø 2014[37] (Norway)	UI	F: varied I: varied; strong (near maximal) contractions T: duration of interventions varied from 12 to 20 weeks. Interventions were initiated between 11 to 24 GWs. T: PFMT with few up to 30 contractions/day S: both regular home training and follow-up	3731/not reported, pregnant & postpartum women	N=22 (n=10 RCTs, n=2 quasi-experimental studies)	Scores between 3-8/10, mainly good quality, PEDro scale	Narrative synthesis

		(monthly and weekly) by a physical therapist				
Peng & Chou 2019[38] (Taiwan)	Pain (LPP)	F: ranged from once per week to twice per day I: light-intensity exercise (< 3 METs) or moderate-intensity exercise (3-6 METs) T: duration of interventions varied from three to 12 weeks. Interventions were initiated 12 to 35 GWs. T: progressive muscle relaxation, stabilizing exercises, pelvic tilt exercises, PFMT, aerobic activity, water exercise, hatha yoga S: both at homes, clinics, or public indoor spaces, either individually or in groups	2148/40-762, pregnant women	N=12 RCTs	Low quality, the Cochrane Risk of Bias tool	Meta-analysis
Liddle & Pennick 2015[29] (UK)	Pain intensity, Back- or pelvic-related functional disability/functional status	F: ranged from once per week to twice per day I: not reported in all studies, one study max. heart rate > 140/minute, one study aerobic activity of at least 64 to 76% of their maximum heart rate, one study cycling in the range of 55% to 65% of the maximal heart rate T: duration of interventions varied from 8 to 16 weeks; one study had 5 x 20 min workshops T: training in land or in water; progressive	5121/not reported, pregnant women	N=34 RCTs	Low to moderate quality, the Cochrane Risk of Bias tool	Meta-analysis

		muscle relaxation, exercises as part of a yoga program, hatha yoga, breathing exercise, strengthening the abdominal and back muscles, stretching, stabilization exercises, cycling, balance exercise S: at home, individually and in groups, led or supervised by an expert midwife and a physiotherapist.				
Richards et al. 2012[39] (Australia)	Pain (LBPP)	F: varied I: not reported T: duration of interventions varied from 1 to 12 weeks. Interventions were initiated between 18-36 GWs and in one study at any point during pregnancy. T: posture correction, physical exercises, water gymnastics, muscle strengthening exercises, aerobic, pelvic floor exercises, stretching S: at home and at clinics, both individually and in groups	566/60-301, pregnant women	N=4 RCTs	Low to moderate risk of bias (n=3), moderate to high risk of bias (n=1), the Clinical Appraisal Skills Program (CASP) tool	Narrative synthesis
Shiri et al. 2017[40] (Finland)	Pain (LBP, PGP, LPP)	F: ranged from 30 minutes per day to 1 hour once a week I: not reported T: duration of interventions varied from 7 to 24 weeks. Interventions were initiated during the second trimester	2347/42-762, pregnant women	N=11 RCTs	the Cochrane Risk of Bias tool	Meta-analysis

		and in one trial in the third trimester. T: water gymnastics, sitting pelvic tilt exercise, an energy expenditure exercise, strengthening exercises for abdominal, hamstrings and spinal muscles, low impact gymnastics and strengthening exercises or a combination of at least three of aerobic, strengthening, stretching and relaxation, flexibility and endurance, resistance exercises, PFMT, balance exercises. S: at home and/or in exercise classes, both individually and in groups.				
Stuge et al. 2003[41] (Norway)	Pain (back and pelvic), functional status, sick leave	F: not reported I: not reported T: duration of interventions varied from 2 to 24 sessions. Interventions were given between 11 to 36 GWs. T: water gymnastics, stretching and strength training. S: at home or in the clinics	1350/26-407, pregnant & postpartum women	N=9 (n=4 RCTs, n=5 quasi-experimental studies)	High quality (n=3), moderate to low quality (n=6), a quality assessment form	Narrative synthesis
Tseng et al. 2015[30] (UK)	Pain intensity (LPP)	F: ranged from 3 times per week to ≥ 2 times per day I: not reported T: duration of interventions ranged from 8 to 20 weeks.	251/40-86, postpartum women	N=4 RCTs	Good quality (n=3), Fair quality (n=1), PEDro scale	Narrative synthesis

		T: stabilizing exercises either specific or core and one study used diagonal trunk muscle systems training program S: without supervision to instructed				
van Benten et al. 2014[42] (Netherlands)	Pain (LPP); disability	F: ranged from 1 to 7 times per week I: moderate intensity T: duration of interventions varied from 8 to 12 weeks. T: aerobic, strength training, balance exercises, PFMT, water gymnastics, hatha yoga and mobility training S: at home or in the exercise class, without supervision to instructed	3826/30-761, pregnant women	N=22 RCTs	Scores between 2-10/11, overall moderate quality, the CBRG Internal Validity Checklist	Narrative synthesis
Wagg & Bunn 2007 [43] (UK)	UI	F: not reported I: not reported T: not reported T: pelvic floor muscle exercises S: interventions were led by nurses, midwives, or physiotherapists. and conducted individually or in groups	4380/72-1800, postpartum women	N=6 RCTs	Quality varied	Narrative synthesis
Woodley et al. 2020 [24] (New Zealand)	UI, FI, incontinence specific QoL	F: ranged from 1-3 times per week to >2 times per day to I: mainly not reported, one study reported progressive PFMT with increased intensity every week	10832/20-1800, pregnant & postpartum women	N=46 (RCTs and quasi-experimental studies)	Low to moderate quality, the Cochrane Risk of Bias tool	Meta-analysis

		T: duration of interventions ranged from 8 weeks to 17 months. T: strength training, physical conditioning program, aerobic fitness, stretching, stabilization exercisers, Kegel exercises, pelvic floor muscle training S: at home and/or in exercise class, independently and/or under supervision by a physiotherapist, midwife, nurse, or other educated person in hospitals				
Wu et al. 2018[27] (Canada)	POP symptoms	F: not reported I: not reported T: duration of interventions varied from 4 weeks to 9 months. Interventions were initiated between 1 week postpartum to 12 months after delivery, but most interventions were initiated at 6 to 8 weeks after delivery. T: structured pelvic floor muscle exercises. S: taught and supervised by trained personnel	3845/not reported, postpartum women	N=15 RCTs	Low to moderate quality, the Cochrane Risk of Bias tool	Meta-analysis

Abbreviations: F, frequency; I, intensity; T, time; T, type; S, setting; PGP, pelvic girdle pain; GW, gestational week; RCT, randomized controlled trial; LBP, low back pain; PP, pelvic pain; UI, urinary incontinence; PFMT, pelvic floor muscle exercise; LBPP, low-back pain and pelvic pain; LPP, lumbopelvic pain; FI, fecal incontinence; QoL, quality of life; POP, pelvic organ prolapse; MET, metabolic equivalents of task

Table 4. Effectiveness of the exercise interventions for preventing and treating pain.

PRENATAL INTERVENTIONS					
Outcome	**Author year**	**Number of studies / participants**	**Results / findings**	**Hetero-geneity**	**The level of evidence (GRADE)***
Prenatal exercise for prevention of prenatal LBP, PGP and LPP	Davenport et al. 2019	12 RCTs / n=1987	- Prenatal exercise was not associated with lower odds of pain during pregnancy (OR 0.78, 95% CI 0.6–1.02)	I2 =22%	⊕⊝⊝⊝ very low [a,b,c]
Prenatal group exercise + education for prevention of prenatal LBP	Liddle & Pennick 2015	2 RCTs/ n=374	- No significant differences in the number of women reporting LBP between group exercise, added to information about managing pain were found (RR 0.97, 95% CI 0.80–1.17)	I2 = 0%	not reported
Prenatal group exercise + education for prevention of prenatal PP	Liddle & Pennick 2015	2 RCTs/ n=374	- No significant difference in the number of women reporting PP between group exercise, added to information about managing pain, were found (RR 0.97, 95% CI 0.77–1.23)	-	not reported
Prenatal exercise for prevention of prenatal PGP	Shiri et al. 2018	4 RCTs / n=565	- Exercise had no protective effect on PGP during pregnancy (RR 0.99, CI 0.81–1.21)	I2 = 0%	not reported
Prenatal exercise for prevention of prenatal LPP	Shiri et al. 2018	8 RCTs / n=1737	- Exercise had no protective effect on LPP during pregnancy (RR 0.96, CI 0.90–1.02)	I2 = 1%	not reported
Prenatal exercise for treatment of prenatal LBP	Liddle & Pennick 2015	7 RCTs/ n=645	+ Any land-based exercise significantly reduced pain during pregnancy (SMD -0.64, 95% CI -1.03–-0.25)	I2 = 81%	⊕⊕⊝⊝ low [d,e]
Prenatal exercise for prevention of prenatal LBP and PP	Liddle & Pennick 2015	4 RCTs / n=1176	+ An eight- to 12-week exercise program reduced the number of women who reported LBP and PP during pregnancy (RR 0.66, 95% CI 0.45–0.97)	I2 = 88%	⊕⊕⊕⊝ moderate [f]
Prenatal exercise for prevention of prenatal LBP	Shiri et al. 2018	7 RCTs / n=1175	+ Exercise reduced the risk of LBP in pregnancy by 9% (RR 0.91, 95% CI 0.83–0.99)	I2 = 0%	not reported
Prenatal light-intensity exercise for prevention of prenatal LPP	Peng & Chao 2019	5 RCTs / n=683	+ VAS indicators showed significant differences (MD -2.21, 95% CI, -4.33–-0.09). Light-intensity exercise could decrease LPP by 2.21 VAS points during pregnancy.	I2 = 99%	not reported
Prenatal moderate-intensity exercise for prevention of prenatal LPP	Peng & Chao 2019	4 RCTs / n=965	+ VAS indicators showed significant differences (MD -1.98, 95% CI, -3.63 –-0.34). Moderate-intensity exercise could reduce LPP by 1.98 VAS points during pregnancy.	I2 = 94%	not reported
Prenatal moderate-intensity exercise	Peng & Chao	2 RCTs / n=558	-	I2 = 77%	not reported

for treatment of prenatal LPP	2019		No statistically significant differences in NRS indicators were found (MD -1.02, 95% CI -2.58–0.53)		
Prenatal exercise and severity of prenatal LBP, PGP and LPP symptoms	Davenport et al. 2019	10 RCTs / n=784	+ Indicating an inverse association between prenatal exercise and severity of any type of pain (LBP, PGP or LPP) during pregnancy (SMD −1.03, 95%CI −1.58–-0.48)	I2 =92%	⊕⊖⊖⊖ very low [g,h]
Prenatal exercise for prevention of postnatal LBP, PGP and LPP	Davenport et al. 2019	3 RCTs / n=491	- No association between prenatal exercise and odds of any type of pain (LBP, PGP or LPP) during the postpartum period were found (OR 0.89, 95% CI 0.51–1.56)	I2 =27%	⊕⊕⊖⊖ low [i]

Abbreviations: -, negative findings; +, positive findings; LBP, low back pain; PGP, pelvic girdle pain; LPP, lumbopelvic pain; RCT, randomized controlled trial; SMD, standardized mean difference; CI, confidence interval; RR, risk ration; PP, pelvic pain; VAS, visual analogue scale; MD, mean difference; NRS, numeric rating scale

*The level of evidence assessed by the authors of the original reviews:

[a] Serious risk of bias. High risk of performance bias.

[b] Serious indirectness because exercise was combined to a co-intervention.

[c] Serious risk of imprecision. The 95% CI crosses the line of no effect, and is wide, such that interpretation of the data would be different if the true effect were at one end of the CI or the other.

[d] Poor or no description of randomization process, allocation concealment, or blinding of research personnel in most of the studies in the meta-analyses.

[e] One study reported results in the opposite direction.

[f] There was a mix of potential biases among the four studies: no allocation concealment (1); no blinding of research personnel (all); poor/no description of dropouts, co-interventions, and baseline inequality (mixed).

[g] Serious inconsistency due to high heterogeneity (I2≥50%).

[h] Very serious risk of bias. High risk of selection bias (either unclear or inappropriate randomization and/or concealment procedure); detection bias (potentially flawed measurement of outcome); attrition bias and performance bias. Reporting bias was an issue in two studies (incomplete reporting of data such that it could not be included in the meta-analysis; results are reported narratively.

[i] Serious risk of imprecision. The 95% CI crosses the line of no effect, and is wide, such that interpretation of the data would be different if the true effect were at one end of the CI or the other.

Table 5. Effectiveness of the exercise interventions for preventing and treating urinary incontinence.

PRENATAL EXERCISE INTERVENTIONS					
Outcome	**Author/ year**	**Number of studies / participants**	**Results / findings**	**Hetero-geneity**	**The level of evidence (GRADE)***
Prenatal PFMT for mixed prevention and treatment of prenatal UI	Woodley et al. 2020	11 RCTs/ n=3307	+ Prenatal PFMT in incontinent / continent women probably decreases UI risk in late pregnancy (22% less; RR 0.78, 95% CI 0.64–0.94)	I2 = 79%	⊕⊕⊕⊝ moderate [a]
Prenatal exercise for prevention of prenatal UI	Davenport et al. 2018	15 RCTs / n=2764	+ Prenatal exercise resulted in a 50% reduction in the odds of developing prenatal UI (OR 0.50, 95% CI 0.37−0.68).	I2 =60%	⊕⊕⊝⊝ low [b,c]
Prenatal PFMT for prevention of prenatal UI	Woodley et al. 2020	6 RCTs / n=624	+ Continent women performing prenatal PFMT probably have a lower risk of reporting UI in late pregnancy (62% less, RR 0.38, 95% CI 0.20–0.72)	I2 = 78%	⊕⊕⊕⊝ moderate [d]
Prenatal PFMT for treatment of UI	Woodley et al. 2020	3 RCTs / n=345	- No evidence of a difference in the risk of UI in incontinent women randomized to PFMT or control group in late pregnancy were found (RR 0.70, 95% CI 0.44–1.13)	I2 = 71%	⊕⊝⊝⊝ very low [e,f,g]
Prenatal exercise and severity of prenatal UI symptoms	Davenport et al. 2018	5 RCTs / n=465	+ Exercise-only interventions showed a moderate reduction in the severity of prenatal UI symptoms with prenatal exercise (SMD −0.54, 95%CI -0.88−-0.20)	I2 = 64%	not reported
Prenatal PFMT for mixed prevention and treatment of postnatal UI	Woodley et al. 2020	6 RCTs / n=806	+ There was a difference in the risk of UI between prenatal PFMT and control groups in the early postnatal period (RR 0.83, 95% CI 0.71–0.99)	I2 = 0%	not reported
Prenatal exercise for the prevention of postnatal UI	Davenport et al. 2018	10 RCTs / n=1632	+ Exercise-only interventions reduced the odds of developing postpartum UI by 37% (OR 0.63, 95% CI 0.51−0.79)	I2 = 0%	⊕⊕⊕⊝ moderate [h]
Prenatal exercise for prevention of postnatal UI	Lemos et al. 2008	3 RCTs / n=515	+ Perineal exercise had a protective effect on the development of postpartum UI (OR 0.45, CI 0.31−0.66, p < 0,0001)	I2 = 7%	not reported
Prenatal PFMT for prevention of postnatal UI	Woodley et al. 2020	5 RCTS / n=439	+ Continent women performing prenatal PFMT were about 62% less likely to report UI in the early postnatal period (RR 0.38, 95% CI 0.17–0.83)	I2 = 74%	not reported
Prenatal PFMT for mixed prevention and	Woodley et al. 2020	5 RCTs / n=1921	+ Prenatal PFMT in incontinent or continent women may reduce the risk of UI slightly in the	I2 = 65%	⊕⊝⊝⊝ low [i,j]

treatment of postnatal UI			mid-postnatal period (> 3 to 6 months) (RR 0.73, 95% CI 0.55–0.97)		
Prenatal PFMT for prevention of postnatal UI	Woodley et al. 2020	5 RCTs / n=673	+ Prenatal PFMT in continent women slightly decreased the risk of UI in the mid-postnatal period (>3 to 6 months) (29% less, RR 0.71, 95% CI 0.54–0.95)	I2 = 0%	⊕⊕⊕⊕ high
Prenatal PFMT for prevention of postnatal UI	Harvey 2003	3 RCTs / n=1688	+ Compared to controls, PFMT groups were 25 % less likely to report in the mid-postnatal period (>3 to 6 months) (RR 0.75, 95% CI 0.56–1.02)	P= 0.028)	not reported
Prenatal PFMT for mixed prevention and treatment of postnatal UI	Woodley et al. 2020	2 RCTs / n=244	- No evidence of a difference in the risk of UI in incontinent / continent women randomized to PFMT or control group in the late postnatal period (> 6 to 12 months) were found (RR 0.85, 95% CI 0.63–1.14)	I2 = 0%	⊕⊕⊕⊖ moderate [k]
Prenatal PFMT for prevention of postnatal UI	Woodley et al. 2020	1 RCT / n=44	- No evidence of a difference in the risk of UI in continent women randomized to PFMT or control group at 12 months' postnatal were found (RR 1.20, 95% CI 0.65–2.21)	n/a	⊕⊖⊖⊖ low [l]
Prenatal PFMT for prevention of postnatal UI	Woodley et al. 2020	2 RCTs / n=352	- No evidence that the earlier effectiveness of PFMT persisted in the long term (> 5 years) were found (RR 1.07, 95% CI 0.77–1.48)	I2 = 25%	not reported
Prenatal PFMT for treatment of postnatal UI	Woodley et al. 2020	2 RCTs / n=292	- No evidence of a difference in the risk of UI in the early postnatal period were found (RR 0.75, 95% CI 0.37–1.53)	I2 = 65%	nor reported
Prenatal PFMT for treatment of postnatal UI	Woodley et al. 2020	1 RCT / n=187	- No evidence of a difference in the risk of UI in incontinent women randomized to PFMT or control group in mid-postnatal period (>3-6 months) were found (RR 0.94, 95% CI 0.70–1.24)	I2 = 65%	⊕⊕⊖⊖ low [m,n]
Prenatal PFMT for treatment of postnatal UI	Woodley et al. 2020	2 RCTs / 869	- No evidence of a difference in the risk of UI in incontinent women randomized to PFMT or control group in late postnatal period were found (RR 0.50, 95% CI 0.13–1.93)	I2 = 94%	⊕⊖⊖⊖ very low [o,p,q]
Prenatal exercise and severity of postnatal UI symptoms	Davenport et al. 2018	3 RCTs / n=284	+ Prenatal PFMT had a moderate effect in reducing the severity of postpartum UI symptoms (SMD −0.54, 95% CI -0.87 to −-0.22)	I2 = 24%	⊕⊕⊕⊖ moderate [r]
POSTNATAL EXERCISE INTERVENTIONS					
Outcome	**Author** **year**	**Number of studies / participants**	**Results / findings**	**Hetero-geneity**	**The level of evidence**

					(GRADE)*
Postnatal PFMT for mixed prevention and treatment of incontinence	Woodley et al. 2020	2 RCTs / n= 321	+ Women randomized to PFMT were about 46% less likely to report UI early postnatal period (RR 0.54, 95% CI 0.44–0.66)	I2 = 0%	not reported
Postnatal PFMT for prevention of UI	Wu et al. 2018	7 RCTs / n=2692	+ Women receiving structured PFMT showed a significant reduction in UI 12 months postnatal waiting (RR, 0.44, 0.25–0.75)	I2 = 91%; P < 0.001	⊕⊕⊕⊝ moderate [s]
Postnatal PFMT for mixed prevention and treatment of incontinence	Woodley et al. 2020	5 RCTs / n=2800	- No evidence of a difference in the risk of UI in women randomized to postnatal PFMT or control group in the mid-postnatal period (<6 months) were found (RR 0.95, 95% CI 0.75–1.19)	I2 = 65%	not reported
Postnatal PFMT for mixed prevention and treatment of UI	Woodley et al. 2020	3 RCTs / n= 826	- No evidence of a difference in the risk in UI in incontinent/ continent women randomized to postnatal PFMT or control group the late postnatal period (>6 to 12 months) were found (RR 0.88, 95% CI 0.71–1.09)	I2 = 50%	⊕⊕⊕⊝ moderate [t]
Postnatal PFMT for treatment of UI	Woodley et al. 2020	1 RCT / n= 516	- No evidence of a difference in the prevalence of UI in PFMT and control group six years after delivery were found (RR 0.96, 95% CI 0.88–1.05)	n/a	not reported
Postnatal PFMT for treatment of UI	Woodley et al. 2020	1 RCT / n=471	- No evidence of a difference in the prevalence of UI in PFMT and control group 12 years after the delivery were found (RR 1.03, 95% CI 0.94–1.12)	n/a	not reported
Postnatal PFMT for treatment of UI	Woodley et al. 2020	3 RCTs / n=696	+ Incontinent women randomized to PFMT were less likely to have UI after treatment compared to controls in the late postnatal period (>6 to 12 months) (RR 0.55, 95% CI 0.29–1.07)	I2 = 90%	⊕⊕⊝⊝ low [u,v]

Abbreviations: -, negative findings; +, positive findings; PFMT, pelvic floor muscle training; UI, urinary incontinence; RCT, randomized controlled trial; RR, risk ration; CI, confidence interval; OR, odds ration

*The level of evidence assessed by the authors of the original reviews:

[a] Downgraded one level due to serious inconsistency (substantial statistically significant heterogeneity; I2 = 79%).

[b] Serious inconsistency. High heterogeneity (I2≥50%).

[c] Serious indirectness. Exercise-only interventions and exercise + co-interventions were combined for analysis.

[d] Downgraded one level for serious inconsistency (substantial statistically significant heterogeneity; I2 = 78%).

[e] Downgraded one level due to serious risk of bias (one trial with heavy weighting in the pooled estimate at high risk).

[f] Downgraded one level for inconsistency (substantial statistically significant heterogeneity; I2 = 71%).

[g] Downgraded one level for imprecision (fewer than 400 participants, wide confidence interval).

[h] Risk of bias: serious (b. Serious risk of bias. High risk of other bias (2/3rds of the control group performed PFMT; the control group received information on pelvic floor exercise, but pelvic floor exercise completion was not recorded for the control group; "n" for control and intervention groups in table did not match with what was in the text). Unclear risk of selection bias; it was unknown if allocation was adequately concealed. Reporting bias was an issue in one study (incomplete reporting of data such that it could not be included in the meta-analysis; results were reported narratively); inconsistency: not serious, imprecision: not serious.

[i] Downgraded one level due to serious risk of selection bias (no information about random allocation concealment in three trials carrying more than 50% of weighting in the pooled estimate).

[j] Downgraded one level for serious imprecision (substantial statistically significant heterogeneity; I2 = 65%).

[k] Downgraded one level due to serious imprecision (fewer than 400 participants, wide CI).

[l] Downgraded two levels for very serious imprecision (single, small trial with wide confidence interval, including benefit no effect, and possible harm).

[m] Downgraded one level due to serious risk of bias.

[n] Downgraded one level for imprecision (single trial, fewer than 400 participants)

[o] Downgraded one level due to very serious risk of bias.

[p] Downgraded one level for inconsistency (considerable statistically significant heterogeneity; I2 = 94%).

[q] Downgraded one level for imprecision (wide confidence interval)

[r] Risk of bias: serious (Serious risk of bias. High risk of attrition bias and other bias ("n" for control and intervention groups in table did not match with what was in the text), inconsistency not serious, imprecision not serious.

[s] There is high heterogeneity between studies reporting UI outcomes. Not all heterogeneity was explained by prespecified subgroups, including less than 6 months versus 6 to 12 months, SUI versus mixed UI, and with versus without baseline UI symptoms. One point is therefore taken off for inconsistency.

[t] Downgraded one level due to inconsistency (substantial statistically significant heterogeneity; I2 = 75%).

[u] Downgraded one level due to very serious risk of bias (two trials with 90% of weighting in pooled estimate at high risk).

[v] Downgraded one level for inconsistency (considerable statistically significant heterogeneity; I2 = 90%).

Table 6. Effectiveness of the exercise interventions for preventing pelvic organ prolapse.

POSTNATAL INTERVENTIONS					
Outcome	**Author/year**	**Number of studies / participants**	**Results / findings**	**Hetero-geneity**	**The level of evidence (GRADE)***
POP symptoms	Wu et al. 2018	3 RCTs / n=609	+ showed a reduction in bothersome vaginal bulging between 6 and 12 months postpartum in participants who received structured PFMT (RR, 0.48, 95% CI 0.30–0.76).	I2 = 47%	⨁⊝⊝⊝ very low [a,b]
POP stage	Wu et al. 2018	6 RCTs / n=1275	+ showed an overall trend toward reduction of stage II or greater POP within 12 months postpartum in participants who received structured PFMT (RR 0.74, 95% CI 0.45-1.24)	I2 = 47%	⨁⨁⨁⊝ Moderate [c]

Abbreviations: +, positive findings; POP, pelvic organ prolapse; RCT, randomized controlled trial; PFMT, pelvic floor muscle training; RR, risk ration; CI, confidence interval

*The level of evidence assessed by the authors of the original reviews:

[a] 2 of the 3 eligible studies are at high risk of bias, with significant baseline imbalances.

[b] Total number of events (symptomatic POP) is 158 (less than the optimal information size of 300 for dichotomous outcomes).

[c] Total number of events (POP stage II+) is 185 (less than the optimal information size of 300 for dichotomous outcomes).

Figures

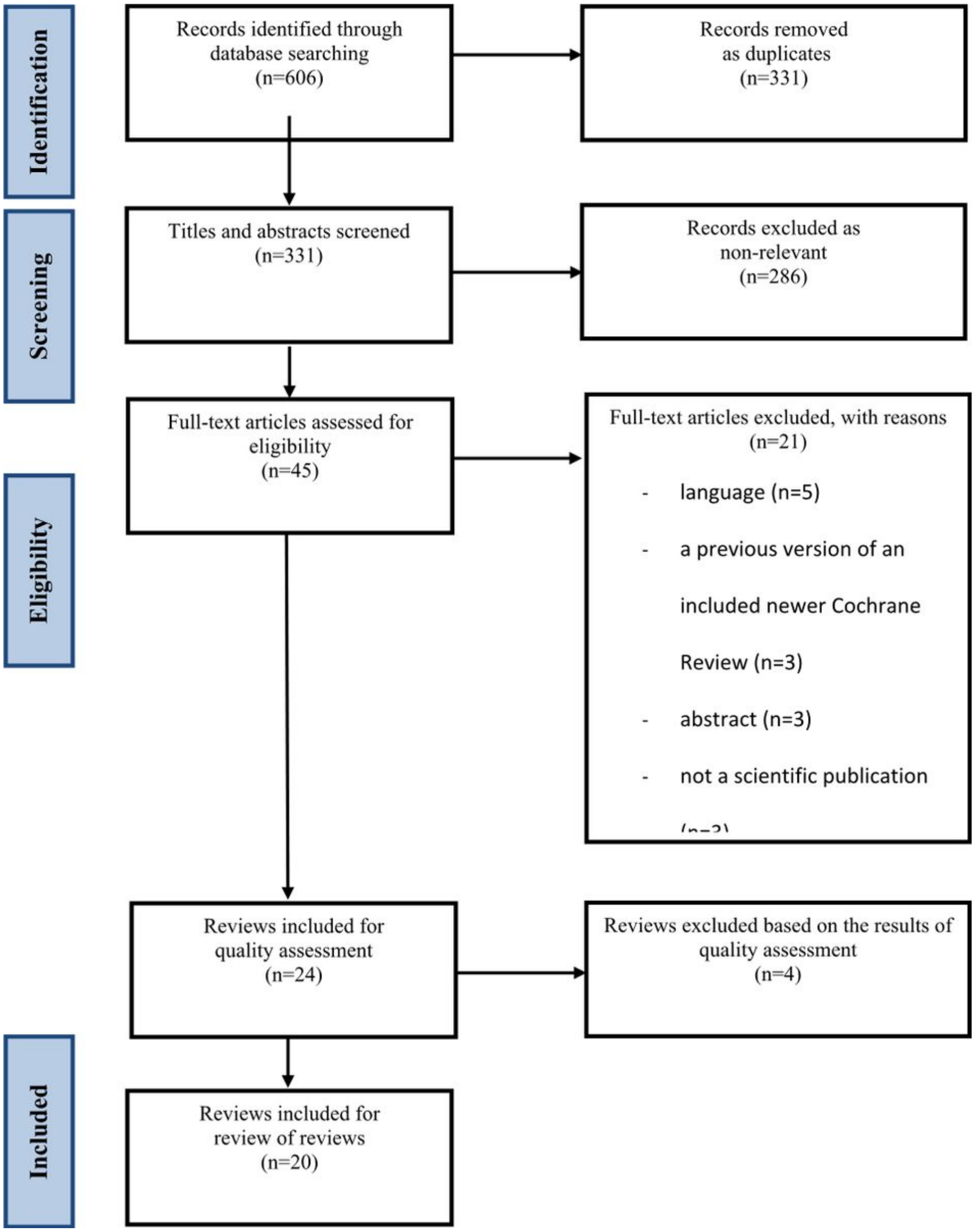

Figure 1

Prisma flow chart of the study selection process.

Supplementary Files

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