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Physical therapy treatment for pelvic floor strengthening in women after vaginal delivery: A systematic review

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ABSTRACT

Introduction: Pregnancy and vaginal birth are considered risk factors for pelvic floor dysfunction (PFD) development, as urinary incontinence (UI), fecal incontinence (FI), pelvic organ prolapse (POP) and sexual dysfunction. Pelvic floor muscle training (PFMT) is a physiotherapeutic resource for PFD treatment, considered UI golden standard treatment with benefits also proven in postpartum women. Though, the lack of standardization of protocols brings gaps in scientific knowledge. Objective: To answer the question "Postpartum pelvic floor muscle training affects pelvic floor muscle strength, urinary function and sexual function?". Methods: systematic review involving randomized clinical trials. Databases: PubMed, Cochrane Central Register of Controlled Trials, PEDro, LILACS, SciELO, EMBASE e MEDLINE, beyond gray literature. Two reviewers selected the studies through the Rayyan program. Were included studies conducted with primiparous women up to one year after childbirth that used the following resources: vaginal cones or balls, electric stimulation, biofeedback, and PFMT, that have compared resources to usual care, placebo, or other treatment. The risk of bias was assessed using the PEDro Scale by two reviewers. Results: 1.381 articles were found, with 508 duplicates. After titles and abstract reading 79 were included for complete reading, then only eight were included for analysis. Most articles compared PFMT and PFMT instructions. Using the PEDro Scale, three included articles scored 8, one scored 7, one scored 6, two scored 5 and only one study scored 4. The main outcomes assessed were PFM contraction strength, endurance time, UI, and sexual function. Strength was mainly assessed by manometry and Oxford Scale, UI by questionnaires and Pad Test, and sexual function by questionnaires. Five studies showed improvement in PFM strength in the intervention group, two studies showed improvement in UI in the intervention group, and two studies showed improvement in sexual function in the intervention group. Conclusion: PFMT was beneficial for primiparous women up to one year after vaginal delivery, improving PFM strength, UI, and sexual function. Nevertheless, more studies with greater quality and greater homogeneity of the protocols and populations are needed.

Keywords: Postpartum, Pelvic floor, Physiotherapy, Strength training, Systematic review.

1 INTRODUCTION

The structural integrity of the pelvic floor, composed of muscles, fascia, and ligaments, is known to be essential for the maintenance of urinary and anal continence functions, mode of delivery, and sexual activity (DESILVA *et al*, 2017). However, this integrity can be affected by several factors

such as hormonal changes, tobacco use, obesity, chronic intra-abdominal pressure factors, impact physical activity, parity and childbirth that can cause a decrease in the strength of the pelvic floor muscles (PFM). This is due to prolonged and increasing exposure to pressures, pulls, and distensions caused by increased abdominal volume containing the baby's weight, amniotic fluid, and placenta. In addition, vaginal delivery, by itself, can cause functional alteration of the pudendal nerve, responsible for both sensitivity and motor activation of PFM, in addition to increasing the chance of partial or total deinsertion of the pelvic floor muscles (ASSIS *et al*, 2013; HANDA *et al*, 2019; HAN *et al,* 2021).

Studies (KHAJEHEI *et al,* 2015; REZAEI et al, 2017) *conducted with postpartum women between six months and one year after delivery indicate a prevalence of 64 to 76% of sexual dysfunctions, 63% prevalence of stress urinary incontinence (SUI) and 39% of fecal incontinence (FI), in addition to 9% of prolapse after the first delivery (RIKARD-BELL et al, 2014*). Some of the PAD (pelvic floor dysfunctions) have a negative impact on physical, mental and social well-being, with impairment in the practice of physical exercise, daily activities, work, social participation, sexual relations and self-esteem. As a result, social isolation may gradually increase, due to fear and shame of their condition, thus increasing the risks for the development of depression, anxiety, and other diseases such as diabetes (FELDE et al 2012, HARVEY 2003, AALAIE 2021, BANKOSKI et al 201, DUMOULIN et al 2014).

The early identification of signs of PAD in the postpartum period is important for preventive action and intervention to be carried out in order to avoid pelvic floor dysfunction and its negative consequences on the psycho-emotional impact of the affected woman, and the burden on the health system. Physical therapy plays a prominent role in conservative treatment (DUMOULIN *et al, 2014) using resources that improve contraction strength, support, coordination, speed, endurance and PFM functionality (HENDRICK* et al, 1998). Among the methods used by physiotherapy, pelvic floor muscle training (TMAP), biofeedback, electrostimulation, vaginal ball or cone stand out (CITAK *et al*, 2010; HERSCHORN *et al*, 2004).

Currently, it is already known about the important role of physiotherapy and its resources in the process of prevention or rehabilitation of PAD in women who have undergone vaginal births. However, the lack of standardization of treatment protocols leads to gaps in scientific knowledge on this topic. Therefore, it is necessary to understand the best resource to be used, as well as to standardize the protocols successfully in this population, in order to guide future treatments so that they are more assertive regarding the elaboration of the APT.

The primary objective of this review was to assess whether pelvic floor strengthening physiotherapy programmes applied after vaginal delivery affect urinary and sexual function, as well as pelvic floor muscle strength.

2 MATERIALS AND METHODS

This is a systematic review of the effectiveness of the pelvic floor muscle strengthening program of women undergoing vaginal delivery on muscle strength, urinary function, and sexual function. The guidelines of the *Preferred Reporting Items for Systematic Reviews and Meta-Analysis* (PRISMA) (Moher *et al*., 2009) guided the methodology of this study. To search the databases and select the articles, the PICO criteria described below were used:

Q: Primiparous women, who have had a vaginal birth for a maximum of one year.

I: Performing the PFMT alone or in conjunction with other physical therapy resources, such as vaginal balls or cones, electrostimulation and biofeedback after delivery.

C: Comparison will be made with usual care, placebo group, or another form of treatment for pelvic floor strengthening.

O: Pelvic floor muscle strength, sexual function, and urination.

2.1 STRATEGY FOR THE SEARCH AND SELECTION OF STUDIES

The electronic search strategy employed included the following databases: PubMed, Cochrane Central Register of Controlled Trials, PEDro, LILACS, EMBASE, as well as grey literature (Open Grey website). The following terms were synonymous, obtained through *Medical Subject Headings* (MeSH): *postpartum period, pelvic floor, pelvic floor disorders, resistance training, electric stimulation therapy, vaginal cone, sexual dysfunction, urinary incontinence, muscle strength*. There was no restriction on the date of publication of the studies. The last search was conducted in August 2021.

2.2 ELIGIBILITY CRITERIA

The study involved only Randomized Clinical Trials (RCTs) conducted with adult women, up to one year after vaginal delivery, who used as an intervention TMAP, vaginal cones or balls, electrostimulation and biofeedback, in the vaginal postpartum period. In addition, the included studies compared intervention methods to usual care, placebo or another treatment for pelvic floor strengthening.

Protocols, guidelines, abstracts, reviews, and observational studies were excluded; who assessed muscle strength only by electromyography, ultrasound, or anorectal manometry; and those who did not have muscle strength as an outcome.

2.3 DATA EXTRACTION

The studies found in the search were included in the "*Rayyan"* database, used to organize the articles (OZZANI *et al*., 2016). From this program, all abstracts were read by two different and blinded

reviewers (ILGB and MRDZ), who judged the inclusion and exclusion of the studies, following the criteria established above. Two other reviewers (MGB and RBF) were available for conflict resolution.

A standardized form was filled out systematically from the reading of each study, in spreadsheet format, for data extraction, prepared by a reviewer (ILGB) and the veracity of the information verified by a second reviewer (MRDZ) and, when necessary, by a third reviewer (MGB).

2.4 RISK OF BIAS

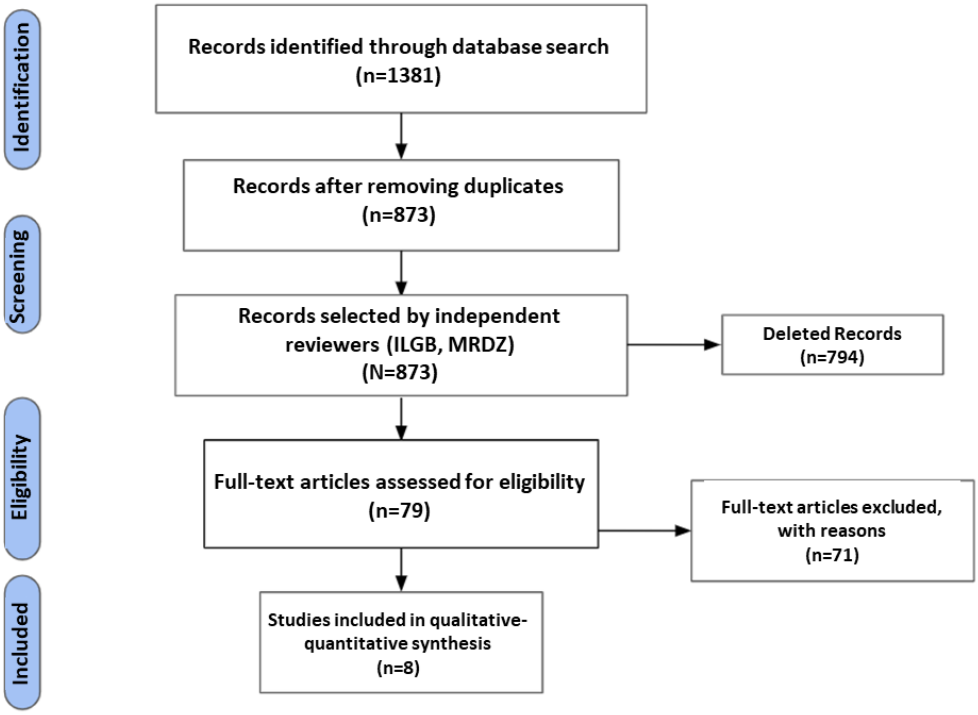
The assessment of the risk of bias was carried out using the PEDro Scale *(Physiotherapy Evidence Database*), by two evaluators (ILGB and MRDZ), independently (DE MORTON, 2009; CASHIN and MCAULEY, 2020) and (MGB) was available for conflict resolution.

3 RESULTS

3.1 SELECTION OF STUDIES

A total of 1,381 articles were identified through database searches. After reading the titles and abstracts, 794 articles were excluded because they involved a different population from the one established for this review; other types of treatments; participants more than one year postpartum; and outcomes that did not address the strength of PFM. Articles that did not present an abstract or were not found in full were also excluded. Thus, 79 studies were included for a complete reading, of which 71 were excluded. As a result, eight RCTs were included in the systematic review (CITAK *et al*., 2010; AHLUND *et al*., 2013; HILDE *et al*., 2013; BØ *et al*., 2015; GOLMAKANI *et al*., 2015; KOLBERG *et al*., 2016; LIN *et al*., 2020; YANG *et al*., 2017). Figure 1 (PRISMA flow diagram) shows the selection process of the included studies.

Figure 1 PRISMA Flow Diagram of the Study Selection Process



3.2 CHARACTERISTICS OF THE STUDIES

The included articles were published between 2010 and 2020 (CITAK *et al*., 2010; AHLUND *et al*., 2013; HILDE *et al*., 2013; BØ *et al*., 2015; GOLMAKANI *et al*., 2015; KOLBERG *et al*., 2016; LIN *et al*., 2020; YANG *et al*., 2017), involving a total of 1,115 participants, with sample sizes ranging from 48 to 189. The duration of the intervention ranged from 8 weeks to 6 months. Five studies compared PFMT with PFMT instructions alone (AHLUND *et al*., 2013; HILDE *et al*., 2013; BØ *et al*., 2015; GOLMAKANI *et al*., 2015; KOLBERG *et al., 2016*) one made the comparison between PFMT and no treatment (CITAK *et al*., 2010); one compared APMT, electrostimulation associated with APMT, and instruction on postpartum routine (YANG *et al*., 2017); and one study compared TMAP, in conjunction with biofeedback and electrostimulation, with instruction on postpartum routine (LIN *et al*., 2020). Chart 1 summarizes the characteristics of the included studies.

Table 1. Characteristics of the included studies

Author, year	Purpose of the study	Participants and population	Intervention and comparison	Initiation of treatment	Handling time	Treatment	Main results
Citak *et al*, 2010	To assess the effect of PFMT on sexual function	Total:118 GC:60 GI:58 Primiparous women, who have not undergone	GI: TMAP GC: No treatment	4th month postpartum	3 months	TMAP: performed at home with 3-second contractions; 10 times a day for 15 days. Progression to	There was a significant difference between the groups in sexual function

		PFMT before or during pregnancy. Age: 19 to 26 years old				up to 10 seconds of contraction, 15 times a day until the end of the study.	and PFM strength in favor of IG.
Ahlund *et al*, 2013	Evaluate the effect of TMAP on PFM strength and UI	Total: 82 GI:40 GC:42 Primiparous women with UI. Age: 29 to 37 years	GI: TMAP GC: Package leaflet	3rd month postpartum	6 months	TMAP: performed at home, in sitting or standing, performing 3 rapid contractions, followed by 3 sets of 8 to 12 slow contractions, held for 6 seconds, daily.	Both groups showed significant improvement in strength, endurance, and UI symptoms.
Hilde *et al,* 2013	Evaluate whether the TMAP decreases the prevalence of UI	Total: 175 GI: 87 GC: 88 Primiparous women. Age: -IG mean 29.8 (SD 4.1) - CG mean: 30.1 (SD 4.0)	GI: TMAP GC: Information leaflet on TMAP, encouraging the performance of the exercise	6th week postpartum	4 months	TMAP: conducted by a physiotherapist, in a group, 1 time a week, for 45 min; and, daily, at home, from 2 to 3 p/day, with 3 sets of 8 to 12 maximal contractions, sustaining for 6 and 8s and, at the end of each contraction, + 3 to 4 rapid contractions, in standing, sitting, lying down, and kneeling positions.	There was no significant difference between the groups.
Bø *et al*, 2014	To evaluate the effect of MAPHT on prevention and treatment of POP	Total: 175 GI: 87 GC: 88 Primiparous women. Age: - IG mean: 29.8 (SD 4.1) - CG mean: 30.1 (SD 4.0)	GI: TMAP GC: Written recommendation to perform PFMT	6th week postpartum	4 months	MPTM conducted by a physiotherapist, in a group, 1 time a week, for 45 min; and daily, at home, 2 to 3 times a day, with 3 sets of 8 to 12 maximal contractions, holding for 6 to 8s and, at the end of each contraction,	There was a significant difference in PFM strength between the groups in favor of IG.

						+ 3 to 4 rapid contractions, in standing, sitting, lying down, and kneeling positions.	
Golmakani *et al*, 2015	To evaluate the effect of MPT on sexual self-efficacy	Total: 104 GI: 52 GC: 52 Primiparous women, who live with their husbands, resuming activity at 8 weeks after vaginal delivery and hassle-free. Age: - CG average: 25.19 (SD3.78) - IG mean: 26.57 (SD 3.92)	GI: TMAP GC: No treatment	8th week postpartum	8 weeks	APT: performed at home, 2 times a day, in the supine position and bent knees, with 4 sets, from 15 to 20 repetitions, sustaining for 5 to 10 seconds and relaxing for 5 to 10 seconds, with an interval 2 min between each set.	There was a significant difference in PFM strength between the groups in favor of IG. There was a significant increase in the mean sexual self-efficacy in both groups, being more significant in the IG.
Kolberg *et al*, 2015	Evaluate the effect of ABPM in vaginal and sexual symptoms, dyspareunia and coital incontinence	Total: 175 GI: 87 GC: 88 Primiparous women. Including I also give birth instrumentalized Age: GI mean: 29.8 (SD 4.1) - CG mean: 30.1 (SD 4.0)	GI: TMAP GC: Package leaflet	6th week postpartum	4 months	APMT, conducted by a physiotherapist, in a group, 1 time a week, for 45 min; and, daily, at home, 2 to 3 times a day, with 3 sets of 8 to 12 maximal contractions, sustaining for 6 and 8s and, at the end of each contraction, + 3 to 4 rapid contractions, in standing, sitting, lying down, and kneeling positions.	Among women with vaginal symptoms, there was a significant increase in the strength and endurance of the PFM, in the IG. There was no significant difference in resting vaginal pressure between the groups.
Yang *et al*, 2017	To evaluate the effect of TMAP	Total: 189 GI1: 63 GI2: 66	GI1: TMAP GI2: PFMT and	2nd day postpartum	3 months	TMAP: performed at home, in the	There was a significant

	combined with electrostimulation on pelvic nerve electrophysiology and tissue function	GC: 60 Primiparous women, with episiotomy or 2nd degree laceration, and who had Episiotomy due to delivery forceps. Age: 20 to 35 years	electrostimulation tion GC: Postpartum routine orientation	(TMAP) and 6th week postpartum (electrostyling) mulation)		supine position, with extended knees, performing the contraction of the hypogastric, perineum and anus muscles, for 5s during inhalation, and relaxing for 5 seconds during expiration, for 20 minutes, 2 to 3 times a day, Electrostimulation: Intravaginal stimulation of low intensity and low frequency, for 30 minutes, 3 times a week.	improvement in UI and PFM strength in IG2
Lin *et al*, 2020	To study the feasibility of PFM rehabilitation after childbirth, as well as its influence on the incidence of SUI	Total: 97 GC:48 GI:49 Primiparous women. Age: 20 to 35 years old	GI: TMAP, intermittent urination exercise, biofeedback, electrostimulation and vaginal cone. GC: Health education	The information was not clear throughout the study	6 months	APT: performed at home, in the supine position, sedation and orthostatism, contracting the anus 6 to 8 seconds during inhalation and relaxing during exhalation, for 30 minutes, 3 times a day. Intermittent urination exercise: stopping or slowing the flow of urine when urinating. Biofeedback and electrostimulation: with high frequency and high intensity, for 30 min2 times a weekVaginal cone: in orthostatism, for 20 min, 1 time a day.	There was a significant improvement in UI in favor of IG.

3.3 ASSESSMENT OF RISK OF BIAS

The results of the risk of bias assessment according to the PEDro Scale (DE MORTON, 2009; CASHIN and MCAULEY, 2020). The scores of the included studies ranged from 4 to 8, and 62.5% of the studies were classified as having good methodological quality (AHLUND *et al*., 2013, HILDE *et al*., 2013, BØ *et al*., 2015, KOLBERG *et al*., 2016, YANG *et al*., 2017).

3.4 OUTCOMES

The main outcomes assessed in the RCTs included in this review were strength and sustaining time of PFM contraction, UI, and sexual function. The evaluation of PFM strength was performed through manometry, with *Camtech devices* (HILDE *et al*., 2013; BØ *et al*., 2015; KOLBERG et al., 2016*), EPI-NO* (CITAK *et al., 2010) and* Peritron *(AHLUND* et al., 2013); and digital palpation, using the Modified Oxford Scale (*CITAK et al*., *2010*; AHLUND *et al*., 2013; YANG et al., 2017*) and the Brink Scale (*GOLMAKANI et al., 2015).

The sustaining time of the contraction was assessed using Camtech devices (HILDE *et al*., 2013; BØ *et al*., 2015; KOLBERG et al., 2016*) and Peritron (*AHLUND et al., 2013). The frequency of UI was assessed using the ICIQ-FLUTS questionnaire (AHLUND et al., 2013) and *ICIQ-UI Short Form questionnaire* (HILDE et al., 2013) and the Pad Test (HILDE et al., 2013; YANG *et al*., 2017).

To assess sexual function, the studies used the ICIQ-VS, ICIQ-FLUTSsex (KOLBERG et al., 2016*), FSFI (*CITAK et al., 2010) questionnaires and the Bailes sexual self-efficacy questionnaire (*GOLMAKANI* et al*., 2015).*

The intervention groups (IG) showed a significant increase in PFM strength when compared to the control groups (CG) in five studies (CITAK *et al*., 2010; BØ *et al*., 2015; GOLMAKANI *et al*., 2015; KOLBERG *et al*., 2016; YANG *et al*., 2017)

Regarding the sustaining of contraction, only one study obtained a result in favor of IG (KOLBERG *et al., 2016); two studies showed a significant improvement in UI in IG (*LIN et al*.,* 2020; YANG *et al*., 2017); and among the three studies that evaluated sexual function, two showed significant improvement in sexual function in IG (CITAK *et al*., 2010; GOLMAKANI *et al*., 2015).

The study conducted by Yang et al (*2017) showed a significant difference between the groups in the outcomes of UI, assessed through the Pad Test (P=0.029) and an unidentified questionnaire (P<0.0001), and PFM strength, assessed through the Modified Oxford Scale, (P<0.0001), in favor of the group associating MAPT and electrotherapy (*YANG et al., 2017).

Citak *et al*. (2010) when assessing the strength of PFM, it was found that the score in both evaluations was higher in the IG (P=0.012; P=0.002, respectively). In the FSFI (Female Sexual Function Index) questionnaire, it was found that the scores of the arousal, lubrication, orgasm and final total domains were significantly higher in the IG, compared to the CG (CITAK *et al*., 2010).

Ahlund *et al (2013) evaluated PFM strength and self-reported UI symptoms and found no significant difference between the groups, although both showed significant improvement comparing the beginning and end of the study (*AHLUND et al*., 2013*).

Kolberg *et al* (2016) used the ICIQ-VS (International Consultation on Incontinence Modular Questionnaire—Vaginal symptoms) and ICIQ-FLUTSsex as methods to assess vaginal symptoms and sexuality; and manometry, through the device *Camtech*, to evaluate the resting pressure, strength and resistance of the PFM. Among women with lesions in the levator ani muscle and vaginal symptoms, there was a significant increase in PFM strength and endurance in favor of IG. There was no significant difference between the groups in sexual function (KOLBERG *et al*., 2016).

The study by Hilde et al (2013*) showed that there was no significant difference between the groups, however, there was a significant improvement in PFM strength and endurance, comparing pre- and post-intervention, in both groups (*HILDE et al*., 2013*). In addition to this study, Bo *et al (2015) found a statistically significant difference in PFM strength in favor of IG (P=0.02) (*BØ et al*., 2015).*

Golmakani *et al* (2015) evaluated the strength of PFM and resulted in a statistically significant difference between the groups in favor of the IG, and, when comparing pre- and post-treatment, the mean sexual self-efficacy increased significantly in both groups. On the other hand, at 8 weeks after the beginning of the study, only the IG showed a significant increase in all aspects of sexual self-efficacy.

Lin et al (2020) *evaluated the strength of PFM and showed no significant difference between the groups, while in relation to UI, there was a significant difference (P<0.001) in favor of IG (LIN et al., 2020).*

4 DISCUSSION

The present study aimed to investigate the physical therapy programs for pelvic floor strengthening applied after vaginal delivery affect urinary and sexual functions, as well as the pelvic floor muscle strength.

Among the RCTs analyzed qualitatively in the present review, most (five) showed statistically significant differences in favor of the intervention group (TMAP) when compared to the control group. Only the study by Ahlund *et al* (2013) found a significant improvement in strength in both groups, with no significant difference between them. The authors explained that the IG's adherence to the treatment, which was performed at home, was not recorded and, therefore, it was not possible to verify whether the participants performed the treatment according to the established exercise protocol. This difference to the other ECAs may have been the control of the performance of the exercises by means of a diary and telephone calls. In addition, the authors also point out that the results may have been influenced by the high level of education and socioeconomic status of the participants in both groups

(AHLUND *et al*., 2013). These two factors should be considered, since they allow easy access to health information and, consequently, to the importance of treatment, favoring women to adhere to the proposed exercises, even when they are in the CG.

Of the three studies that assessed sexual function, only Kolberg *et al* (2016) found no significant difference between the groups after treatment. However, the authors reported that the questionnaires used had not been validated for postpartum women, which is extremely relevant information, as it may have influenced the result (KOLBERG *et al*., 2016).

The systematic review by Hadizadeh-Talasaz *et al* (2019) aimed to verify the effect of PFMT on female sexual function and quality of life after childbirth. The included RCTs had pregnant or postpartum women as participants, with no parity restriction. In total, five RCTs were included in the meta-analysis, which resulted in a statistically significant improvement in sexual function in the groups that underwent APMT. Of the five RCTs, only three were also included in our study (CITAK *et al*., 2010; GOLMAKANI *et al*., 2015; KOLBERG *et al*., 2016), as we chose to include only studies conducted with primiparous women. It is already well known in the literature that, with each pregnancy and delivery, a woman's pelvic floor undergoes extremely relevant overloads and changes (GAO et al, 2022). Thus, when evaluating the effect of MPT in women with different parities, the results could not be considered reliable.

The systematic review by Woodley *et al.* (2020) aimed to evaluate the effects of MPT on the prevention and treatment of UI and FI in pregnant or postpartum women (46 studies). Five articles studied the effect of PFMT with the aim of treating postpartum (GI) UI. Of these, three evaluated UI by means of specific and validated questionnaires (II-Q, UDI; BFLUTS; ICIQ-FLUTS), and one of them also used the tampon test. Among them, two reported improved UI in the IG. The other two studies evaluated UI using a non-specific and validated questionnaire, but both showed improvement in UI in IG. Regarding strength, only four studies evaluated it by manometry or perineometry and only one found a statistically significant improvement in IG compared to CG. Fourteen articles performed PFMT with the aim of preventing and treating UI, of which eleven assessed UI by means of questionnaires, but only two reported improvement in IG. Of these, only four evaluated the strength of PFM using the Oxford Scale, with improvement in favor of IG. The quality of the studies included in the review by Woodley *et al (2020*) ranged from moderate to very low, according to the GRADE system (WOODLEY *et al*., 2020). Two such studies were also included in the present review (HILDE *et al*., 2013; YANG *et al*., 2017). However, all the articles included have moderate to good methodological quality.

The systematic review by Zhu *et al* (2022) aimed to evaluate the efficacy and safety of combined MPT (with biofeedback, electrostimulation, or both) for urinary tract symptoms after childbirth. Through the meta-analysis of five RCTs, they found a significant improvement in PFM

strength, UI, and quality of life in favor of the IG that used combined PFT, compared to the CG, which performed only APT. Unlike this review, Zhu *et al* (2022) included studies that had participants after cesarean delivery, with urinary tract dysfunction and multiparous, which makes it difficult to compare the two studies.

The clinical trials of WANG *et al*. (2020) and ASSIS *et al*. (2013) showed a significant improvement in PFM strength in the intervention group. WANG *et al*. (2020) treated primiparous women with PFMT through an app, and the CG received instruction to perform PFMT at home. In addition to strength, there was also an improvement in sexual function in the IG. In the study by ASSIS *et al*. (2013) the IG performed PFMT and the CG did not receive guidance on exercises. There was also an improvement in UI in the IG.

Both studies could not be included in this review because the first included women who had undergone cesarean section and the second because it was conducted with multiparous women. Cesarean section can be protective of the pelvic floor (SENKAYA *et al*, 2023), which would affect the final result of this musculature positively after exercise, which justifies the importance of involving only women who have undergone the same type of delivery. Although there is a clear definition that the pelvic floor is usually more damaged after the first vaginal delivery (KAMISAN ATAN *et al*, 2018; HORAK *et al*, 2014), it is not known for sure whether the functionality of this musculature can be progressively affected related to the number of vaginal deliveries. However, despite the differences in the populations studied, they also found that PFMT provided increased muscle strength in the GI.

When comparing the duration of PFM strengthening treatment in the studies included in this review, it ranged from 8 weeks to 6 months, i.e., there was no consensus among the authors regarding the appropriate duration for better results. It should be noted that, according to the American College of Sports Medicine (2002), there is a considerable increase in muscle strength between 4 and 8 weeks of a strengthening treatment, considered short-term. On the other hand, in relation to long-term treatments, above 4 months, a periodization of training is necessary, such as a decrease in volume and an increase in intensity, so that it continues to result in muscle strength gain (KRAEMER *et al*., 2002).

In the studies included in this review, we observed that they carried out a long-term treatment program (AHLUND *et al*., 2013; LIN *et al*., 2020), that there was no change in the periodization of training, which probably may have impacted the results, which could have been even better. The heterogeneity of treatments, in relation to frequency, volume, duration, and time after delivery, has a great impact on treatment outcomes and makes it difficult to analyze and compare outcomes (WOODLEY *et al*., 2020; YANG *et al*., 2021).

The studies by Yang et al (2017) and Lin et al (*2020) addressed in the treatment protocol the performance of inspiration associated with PFM contraction and expiration associated with relaxation of this musculature (YANG et al*., *2017*; LIN *et al*., 2020). However, it is known that, physiologically,

PFM presents a greater need for contraction during the exhalation phase, especially when there is a significant increase in intra-abdominal pressure, such as in cases of sneezing, coughing and physical exertion. Thus, the most appropriate and functional for the treatment would be to perform PFM contraction associated with expiration, (TALASZ *et al*., 2010; TALASZ et al*., 2011)* the opposite of what was done in the studies by Yang et al (2017) and Lin et al *(2020).*

Regarding the number of sets and repetitions stipulated for the treatment of GI, Yang *et al (2017), Lin et al (2020) and Citak et al (2010) did not specify (CITAK* et al., 2010 ; YANG *et al*., 2017; LIN *et al*., 2020). The other studies stipulated 2 to 3 sets, with 8 to 12 repetitions, 2 to 3 times a day, with the exception of the study by Golmakani *et al (2015) with 4 sets, 15 to 20 repetitions, 2 times a day (GOLMAKANI* et al., 2015). Among the studies that presented these data, none performed more than 9 sets per day, which is in agreement with the literature, which delimited this number of sets as a safety margin, so that there is no PFM fatigue (GARCÍA-SÁNCHEZ *et al*., 2019).

The major limitation of this review was the absence of data in the results of some studies. In these cases (twelve studies), there was an attempt to contact the authors via e-mail, more than once, to request the data, however, there was no response.

5 CONCLUSION

The PFMT applied to primiparous women up to one year after delivery has been shown to be beneficial in improving the function of the pelvic floor muscles, improving urinary incontinence symptoms and sexual function.

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