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Meta-analysis

The pilates method in the function of pelvic floor muscles: Systematic review and meta-analysis

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ABSTRACT

Background: Many Pilates instructors believe that the method can produce significant improvement in the resistance of pelvic floor muscles, but it is known that about 49% of women who can contract this muscle do not perform an adequate contraction and cannot increase urethral closure pressure.
Objectives: To evaluate the response of the Pilates method in the function of the pelvic floor muscles, compared to the control group, in healthy women.
Search methods: The following databases were searched from October to December 2016: PUBMED, SCIELO, LILACS, MEDLINE, WEB OF SCIENCE and CINAHL via PERIÓDICOS CAPES, without restriction of language and year of publication.
Selection criteria: Randomized (RCTs), quasi-randomized, and non-randomized clinical trials assessing the effectiveness of the Pilates method for the fuction of pelvic floor muscles in healthy women were included.
Data collection and analysis: Two reviewers independently selected the studies, assessed the risk of bias and performed the data extraction. Primary outcomes were the method of evaluation of strength, function, coordination, and symmetry of contraction of the pelvic floor muscles.
Results: 4434 articles were identified and 2 articles were selected to compose this review and the meta-analysis. No between-group difference was demonstrated for the pelvic floor muscle function as measured by perineometry ($p = 0.32$).
Conclusions: No evidence showed a modification of the function of pelvic floor muscles in healthy women practicing the Pilates method.

1. Background

Pelvic floor muscles (PFM) play an important role in supporting the pelvic organs, controlling urinary and fecal continence, and sexual function (Bø et al., 2015). In order to allow such functions, PFM should perform a normal or strong voluntary contraction with the presence of an involuntary contraction, resulting in a "circular closing of the vagina, the urethra, and the anus" and in a "cranioventral movement of the perineum and upward movement of the pelvic organs" (Messelink et al., 2005).

The Pilates method was developed by the German Joseph Pilates in the 1920's. This method is based on the principles of centering, concentration, control, breath, precision, fluidity (Lately, 2001), and global strengthening through low-velocity muscular actions with a high isometric component called "Power House" (Silva and Mannrich, 2009). This force center is composed of the transverse abdominal, multifidus, diaphragm, and PFM muscles, which are responsible for the static and dynamic stabilization of the body. The 34 exercises proposed in the original method can result in more than 500 exercise variations, divided into two broad categories: Exercises in the mat Pilates and

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in the apparatus (Chair, Reformer, Cadillac and Ladder Barrel) (Marés et al., 2012).

Pilates has gained popularity and has become a trend of physical and therapeutic conditioning, however, there is little evidence that the Pilates method improves women's health (Mazzarino et al., 2015). When compared to no activity, Pilates performed by 2–3 times a week for 5–12 weeks demonstrates improvement of abdominal muscular resistance for both sexes (Campos et al., 2016). In general, the method improves short term flexibility, dynamic balance, and muscular endurance in healthy individuals (Kamioka et al., 2016).

Pilates instructors believe that the method can produce significant improvements in pelvic floor muscle resistance, based on the close relationship between PFM and trunk region, which is demonstrated in different studies through the coactivation of PFM and abdomen. (Sapsford et al., 2001; Madill and McLean, 2006; Arab and Chehrehrazi, 2011). For this reason, during the exercise of the Pilates method, the instructor verbally requests the contraction of the pelvic floor muscles associated with the contraction of the transverse abdominal muscle (Lately, 2002). However, there is still no consensus on the influence of coactivation of PFM in healthy women.

In contrast, it is known that about 30% of women are unable to contract PFM in the first evaluation only with verbal command (Bø, 2012) and 49% of those who manage to contract this muscle do not perform an adequate contraction with the objective to increase urethral pressure (Bump et al., 1991). This fact may make verbal instruction of PFM contraction ineffective during Pilates exercise practice. Ineffective contraction of PFM associated with a significant increase in intra-abdominal pressure during physical activity may increase the risk of pelvic floor disorders such as pelvic organ prolapse and urinary incontinence (IU) (Eliasson et al., 2008).

Thus it is necessary to identify the influence of the Pilates method in muscle function of the pelvic floor of healthy women and to quantify the activation of the pelvic floor muscles with the activation of the abdominal muscles.

The present systematic review aims to evaluate the response of the Pilates method in the function of the pelvic floor muscles, compared to a control group, in healthy women.

2. Methods

This systematic review included randomized (RCTs), quasi-randomized, and non-randomized controlled trials that verify the influence of the Pilates method on the function of the pelvic floor muscles of healthy women. In order to carry out this review, the recommendations of the Checklist PRISMA (Moher et al., 2009) and Cochrane Handbook (Higgins and Green, 2011) were followed. This review is registered on PROSPERO (2016-CRD42016052776).

2.1. Criteria for considering studies for this review

We included articles that addressed the Pilates Program, MAT Pilates, and/or Pilates apparatus (chair, reformer, cadillac and ladder barrel) for at least 8 weeks, with or without voluntary contraction of the pelvic floor muscles. Studies also had to have a control group with another form of physical exercise, a pelvic floor muscle training program (PFMT), or kegel exercises. Finally, studies were included if the subjects were healthy women or with minimal complaint, with more than 18 years of age, and were not pregnant.

2.2. Types of outcome measures

The primary endpoints of assessment in this review were any type of evaluation of strength, function, coordination, and symmetry of contraction of pelvic floor muscles using the following methods: modified Oxford scale, dynamometer, perineometer, functional evaluation of the pelvic floor (AFA), Scale of Ortiz, Amaro 5-point scale, evaluation of the pelvic floor according to the new terminology of the International Continence Society (ICS), PERFECT scheme, functional visual evaluation, or ultrasound of the pelvic floor.

2.3. Description of outcome measures

To evaluate the function of the pelvic floor muscles, some subjective methods measured by digital palpation are described. Among them, the modified Oxford scale is the most used method, in which it quantifies the muscular function of the pelvic floor in a scale of 0–5 based on digital palpation. During palpation, the therapist inserts two fingers into the vaginal canal to feel the contraction of the PFM, if the patient's vaginal introitus is narrow it can be performed unidigital (Laycock and Jerwood, 2001).

The 5-point scale of Amaro (Amaro et al., 2005) is similar to the Oxford scale. It evaluates the muscular function, subjectively, also through digital palpation. It only differs in degree, from 0 to 4°; the higher the degree, the greater the functionality. This also happens in the scale of Ortiz (Ortiz et al., 1994). While the PERFECT scheme also evaluates muscle function in the same way, the letters of the model represent characteristics of the contraction, such as where *P* represents the force measured by the scale of Oxford; *E* mentions the time of contraction support; *R* shows how many repetitions the patient can perform, with the same strength and contraction time; *F* informs how many fast contractions the patient can perform (Laycock and Jerwood, 2001).

The International Continence Society (ICS) has established a pelvic floor evaluation method that is complementary to the methods described above. In other words, it evaluates the pelvic floor function using the PERFECT scale associated with a subjective assessment of coordination, use of accessory musculature, symmetry, and painful reaction to palpation (Slieker-ten Hove et al., 2009). However, there are other instruments that are able to quantify the strength of the pelvic floor, which do not involve vaginal palpation but equipment such as the dynamometer that is a validated instrument that quantifies the anteroposterior and lateral-lateral forces, as well as the passive force of the pelvic floor (Peschers et al., 2001; Dumoulin et al., 2003).

The perineometer is used to quantify the voluntary contraction of the pelvic floor muscles through a probe in the vaginal region, which quantifies the pressure exerted by the pelvic floor muscles. The higher the value obtained, the greater the pressure exerted by the pelvic floor. There are several devices on the market with different units of quantification, as well as different probes, which makes it difficult to standardize the measurement. Moreover, there is still no consensus to determine the most adequate probe to quantify pelvic floor pressure (Isherwood and Rane, 2000).

Another instrument used is transperineal ultrasonography that allows the evaluation of the thickness of the levator hiatus through a comparison of the thickness at rest and at the time of contraction. It is also possible to evaluate the closure of the vaginal hiatus and quantify it: the smaller the gap, the better the pelvic floor function (Dietz et al., 2002).

2.4. Search methods for identification of studies

2.4.1. Electronic searches

Two researchers carried out the search for articles, independently, in the period of October to December 2016 in the databases: PUBMED, SCIELO, LILACS, MEDLINE, WEB OF SCIENCE, and CINAHL via PERIÓDICOS CAPES, without restriction of language and year of publication. To verify the ongoing studies, the following clinical

trial registration databases were consulted: Brazilian Registry of Clinical Trials (ReBEC) (http://www.ensaiosclinicos.gov.br/), Clinical Trials (clinicaltrials.gov), Physiotherapy Evidence Database (PEDro) (https://www.pedro.org.au/), and Cochrane Library (http://www.cochranelibrary.com/). Manual searching of the databases, consultation with authors, and references of articles included was also accomplished.

2.4.2. Data collection and analysis

The terms searched in the electronic databases used to obtain the articles were MeSH (*Medical Subject Headings*): exercise movement techniques and pelvic floor; Keywords: Pilates, pelvic floor muscle, and pelvic floor muscle contraction; and Decs (*Descritores em Ciências da Saúde*): pelvic diaphragm. The search strategy is detailed below (Annex 1).

2.4.3. Selection of studies

After reading the titles and summaries of studies identified through the search strategy or from additional sources, two researchers evaluated each abstract independently (A.Q.L and C.A.B.) to verify compliance with the inclusion and exclusion criteria of this review.

Eligible studies were read in full and evaluated, also independently for eligibility. The studies were included in this review through identification of the population, intervention, control group, and outcomes similar to the research question. In cases of disagreements, the evaluation of a third researcher (P.L.) was requested. The description of the included studies is shown in Fig. 1.

The data were extracted separately by the researchers and recorded in a standardized data extraction form that was previously designed by the authors. In this record, the following information was recorded: study design, population, inclusion and exclusion criteria, sample calculation, recruitment of participants and their characteristics, randomization, allocation, type and protocol of the intervention group and control group, evaluated outcomes, statistical analysis, and study results.

2.5. Assessment of risk of bias in included studies

The analysis of bias risk was also performed independently by two researchers through the Cochrane Bias Risk Assessment Instrument for RCTs, as recommended by Cochrane (Carvalho et al., 2013). In this instrument the following are evaluated: randomization, secrecy of allocation, masking, follow-up, selective description of the outcome, and other sources of bias, which in this review was considered the absence of the sample size calculation.

We considered uncertain or high risk of bias if randomization or secrecy of allocation was not sufficiently reported (depending on the degree of description and whether the method described was satisfactory). Unreported sample size calculation or insufficient data were taken as uncertain or high risk of bias. In relation to the blinding item, the authors made an adaptation of the

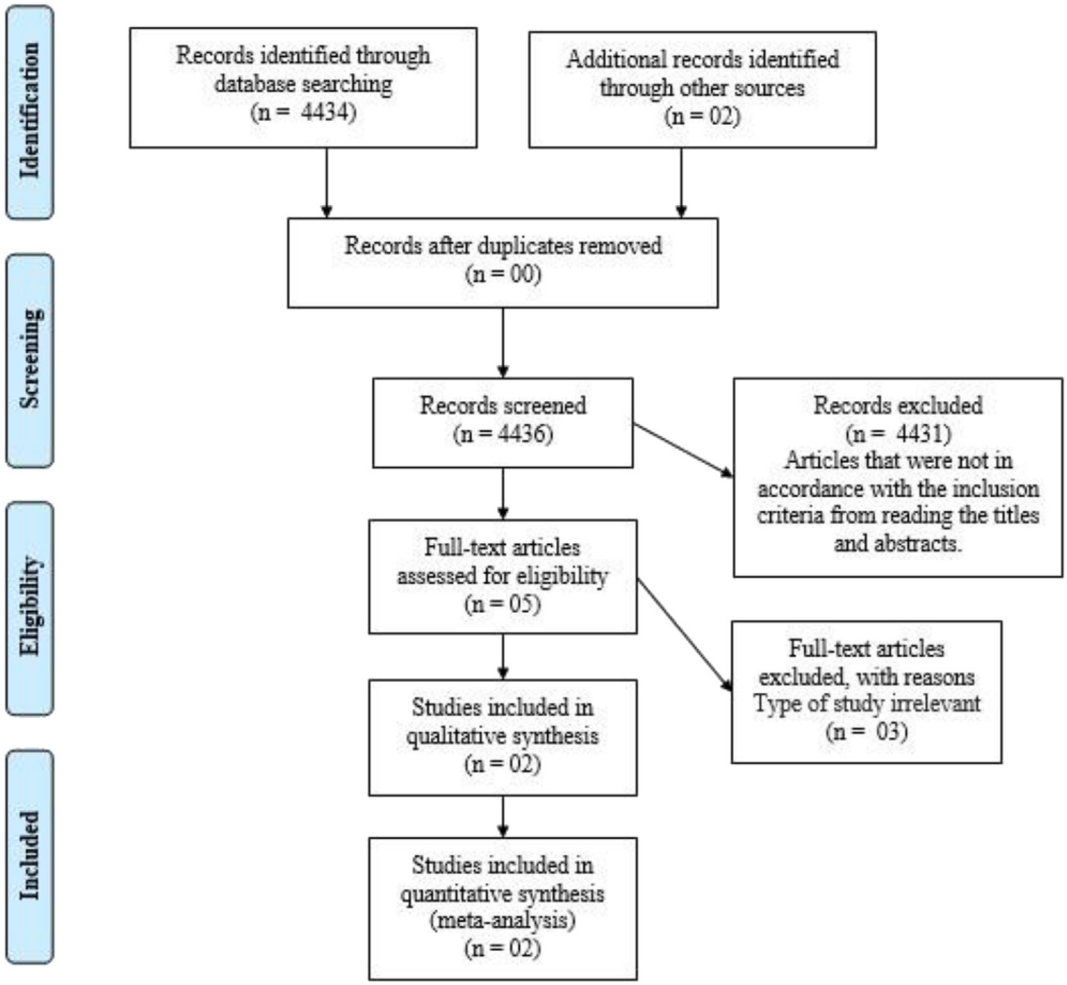

Fig. 1. Study flow diagram.

instrument considering low risk of bias the non-blinding of the participants, since in this type of study it is impossible to blind the participants.

2.6. Summary measures

All the numerical data provided by the studies were taken as mean, standard deviation, confidence interval, follow-up time, as well as the omissions of data.

2.7. Synthesis of results

Meta-analysis was performed using The Cochrane Collaboration's Review Manager software, version 5.3. For the continuous variables, whose outcomes were measured by the same evaluation instrument, the mean difference (MD) was used, while for the studies that presented the same outcome evaluated by different scales, the mean of the standardized difference (SMD) was calculated. A 95% confidence interval (95% CI) was considered in both calculations. The random effects models were used, considering that the effectiveness outcome presents a wide possibility of results.

The homogeneity of the studies was verified through the heterogeneity test, from which the studies were considered homogeneous when p assumed a value greater than 0.05 and the heterogeneity index (I^2) was less than 40% (Higgins and Green, 2011). In cases where the information provided by the studies was insufficient to carry out the proposed analysis, the reviewers contacted the authors to obtain the data.

3. Results

3.1. Results of the search

In the initial search, 4434 articles were identified. Of these, five were potentially eligible and were examined in full text (Culligan et al., 2010; Ferla et al., 2016; Torelli et al., 2016). One was excluded because it was not an intervention study (Ferla et al., 2016) and two were excluded becasue they were cases studies (Diniz et al., 2014; Bertoldi et al., 2015). The complete description of the reason for the exclusion is detailed in Table 3. Two articles allowed the meta-analysis to be performed (Culligan el at., 2010; Torelli et al., 2016).

3.2. Included studies

All studies were developed in a single center. The two included studies involved 119 women. There was loss during follow-up of 19 women. The participants' age ranged from 27 (Torelli et al., 2016) to 49.5 (Culligan et al., 2010) years. The studies included healthy women with little or no pelvic floor dysfunctions. One report included only nulliparous women of reproductive age (Torelli et al., 2016). All studies excluded pregnant women (Torelli et al., 2016; Culligan et al., 2010), who already practiced the Pilates method (Culligan et al., 2010) or who had previously had some type of education on the pelvic floor (Culligan et al., 2010; Torelli et al., 2016).

The study of Culligan et al., 2010) included multiparous, women (mean parity 2.1 ± 0.9 in the Physical Therapy Group and 1.8 ± 0.9 in the Pilates group). In the study of Torelli et al. (2016) only nulliparous women were included.

Regarding the intervention, all studies (Culligan et al., 2010; Torelli et al., 2016) were RCTs with two groups, intervention and control. These studies adequately detailed the exercises of the Pilates method that are included in the intervention protocol (Culligan et al., 2010; Torelli et al., 2016). The number of sessions was 24 sessions (Culligan et al., 2010; Torelli et al., 2016). The frequency and duration of the session were twice a week with a duration of 60 min (Tables 1 and 2).

Regarding the type of intervention, the studies (Culligan et al., 2010; Torelli et al., 2016) described the evolution of the exercises each week. However, there were differences in the type of intervention; one study (Torelli et al., 2016) described an unprocessed Pilates Method Program of voluntary PFM contraction (PEP) versus Pilates method exercise program associated with voluntary PFM contraction (PEP + PFMC). While the other study (Culligan et al., 2010) consisted of an exercise program of the Pilates method versus physiotherapy exercise protocol for PFM training (PFMT groups) (Tables 1 and 2). The PFMT included education about PFM and transverse abdominal contractions, exercises, biofeedback, and home exercise program.

Regarding the primary outcomes, all the studies evaluated the strength of the PFM through perineometry (Culligan et al., 2010; Torelli et al., 2016). Vaginal palpation was classified by the Oxford Scale and pelvic floor ultrasonography (Torelli et al., 2016) (Table 1). In both articles, outcomes were assessed at baseline and at the end of the study.

3.3. Risk of bias in included studies

Regarding randomization and secrecy of allocation of the randomized trials included in this review, one study randomized through a block design of six to determine the allocation sequence, and randomization was performed using sequentially numbered opaque sealed envelopes (Culligan et al., 2010) which we considered low risk of bias. The other study did not mention the form of

Table 1
Type of study and population characteristics of the studies included in this review.

Studies	Methods	Objective	Participants	Age (intervention group)	Age (control group)	BMI (intervention group)	BMI (control group)
Culligan et al., 2010	RCT	Compare the change in pelvic muscle strength achieved by women after completing either a standardized 12-week Pilates exercise program or a "traditional" 12-week pelvic muscle-training program	62 women ≥ 18 years	51.1 ± 10.6	48.8 ± 12.1	24.7 ± 5.0	25.1 ± 4.6
Torelli et, al 2016	RCT	Evaluate the effectiveness of adding voluntary PFMC to a Pilates exercise program in sedentary nulliparous women	57 women nulliparous and sedentary	27.98 ± 5.4	27.41 ± 4.8	23.01 ± 2.8	23.60 ± 3.1

BMI= Body mass index (Kg/cm^2); RCT = Randomized Clinical Trials; PFMC= Pelvic Floor Muscle Contraction.

Table 2
Description of intervention and results of studies included in this review.

Studies	Outcomes	Interventions	Results
Culligan et al., 2010	PFM strength (perineometry)	Control group: 24 sessions of training the pelvic floor muscles (twice a week lasting one hour) Intervention Group: 24 sessions of Pilates exercises (twice a week lasting one hour)	Mean improvement in the Pilates group was 6.2 ± 7.5 cmH2O (p = 0.0002) and in the PFMT group of 6.6 ± 7.4 cmH2O (p = 0.0002). When compared between groups, these improvements in muscle strength were not significantly different (p = 0.85).
Torelli et, al 2016	PFM strength (Perineometry)	Control group: 24 individual sessions of the Pilates Method (twice a week with a duration of 60 min) NO instruction of voluntary contraction of PFM	Mean differences peak of pressure (cm H2O) PEP + PFMC 6,95 ± 11,50 and PEP 2,12 ± 7,99 (p = 0,049). Average pressure (cm H2O) PEP + PFMC 4,69 ± 9,17 and PEP 1,00 ± 5,60 (p = 0,050).
	Function of PFM (Vaginal palpation classified by the Oxford Scale) Function of PFM by Ultrasound	Intervention group: 24 individual sessions of the Pilates Method (twice a week for 60 min) WITH instruction of voluntary contraction of PFM	Mean Oxford scale differences PEP + PFMC 4,29 ± 0,62 and of group PEP 3,58 ± 0,65 (p = 0,000). PM thickness at rest (cm) PEP + PFMC 0,10 ± 0,26 and PEP 0,08 ± 0,25 (p = 0,398); PM thickness at contraction (cm) PEP + PFMC 0,16 ± 0,25 and PEP 0,02 ± 0,32 (p = 0,046); levator hiatos area at rest (cm^2) PEP + PFMC 0,61 ± 2,47 and PEP 0,32 ± 2,03 (p = 0,326); Levator hiatos area at contraction (cm^2) PEP + PFMC -0,58 ± 2,42 and PEP -0,01 ± 1,82 (p = 0,182).

PFM= Pelvic Floor Muscle; PEP + PFMC= Pilates exercises program with voluntary pelvic floor muscle contraction; PEP= Pilates exercise program.

allocation, it only reported the form of randomization, which also happened through opaque envelopes (Torelli et al., 2016). This study was classified as low risk of bias according to the randomization question, however the secrecy of allocation was considered as risk of uncertain bias. (Fig. 2 e 3).

We considered blinding as a low risk of bias for the two RCTs included (Culligan et al., 2010; Torelli et al., 2016). With regard to incomplete results and selective description of outcomes, all studies included in this review were considered low risk of bias (Culligan et al., 2010; Torelli et al., 2016). Other risk of bias was low

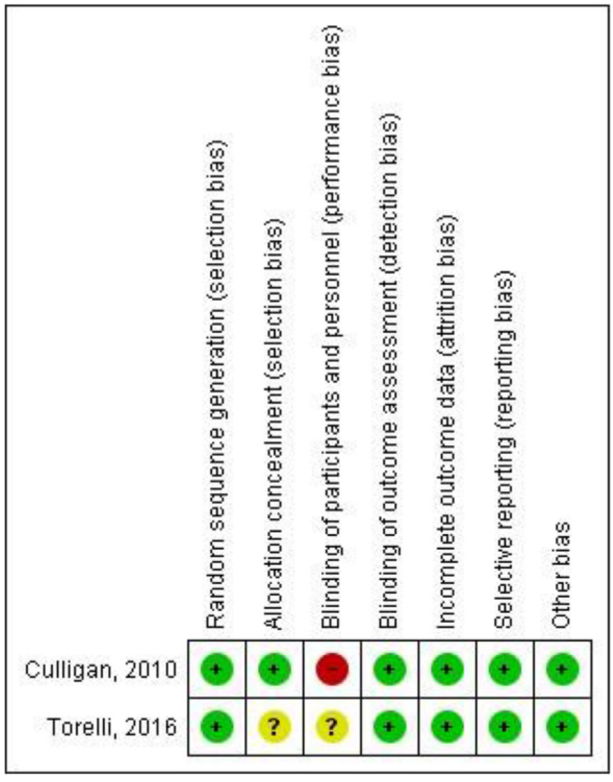

Fig. 2. 'Risk of bias' summary: review authors' judgements about each methodological quality item for each included study.

including the presentation of the replicable sample size calculation. An overview of the risk of bias is given in Figs. 2 and 3.

Culligan et al. (2010) reported losses during follow-up; 62 women agreed to participate in the study (30 and 32), but only 52 completed the study protocol (28 and 24 in the Pilates and Training of the pelvic floor muscles, respectively). While, Torelli et al. (2016), stated that 57 participants were initially recruited, but only 48 (24 for each group) completed the research protocol (see reasons for loss in Table 4).

The study by Culligan et al. (2010) presented a mean difference through the final muscle strength assessed by perineometry in the Pilates group of 6.2 ± 7.5 cmH2O (p = 0.0002) and in the pelvic floor muscle training group of 6.6 ± 7.4 cmH2O (p = 0.0002). When compared between groups, they were not significantly different (p = 0.850) (Table 2).

While, Torelli et al. (2016), evaluated only three outcomes. The Oxford scale presented mean PEP + PFMC difference of 4.29 ± 0.62 and PEP group of 3.58 ± 0.65 (p = 0.000). When evaluating perineometry, the mean difference in PEP + PFMC pressure was 6.95 ± 11.50 and PEP group 2.12 ± 7.99 (p = 0.049). While the mean pressure for the PEP + PFMC group was 4.69 ± 9.17 and in the PEP group 1.00 ± 5.60 (p = 0.050), both measurements had no statistical difference. The variables pubovisceral muscle thickness and genital hiatus area (both at rest and during contraction) did not indicate any sign of improvement when comparing data collected before and after the protocol (Table 2).

The results of the meta-analysis indicated that the pelvic floor muscle function mentioned by the perineometer did not present a difference between the groups, in which a mean difference of −2.18 (−6.43,2.08) (p = 0.32) was found (Fig. 4).

4. Discussion

This review shows that the Pilates method does not modify the PFM function measured by perineometry in healthy women. However, more RCTs with a satisfactory sample size and low risk of bias would be required to provide stronger evidence for this finding.

Among the RCTs that evaluate the Pilates method for training the pelvic floor muscles, Culligan et al. (2010) compared the changes in pelvic floor muscle strength and pelvic floor symptoms in 62 women undergoing a Pilates exercise program or pelvic floor

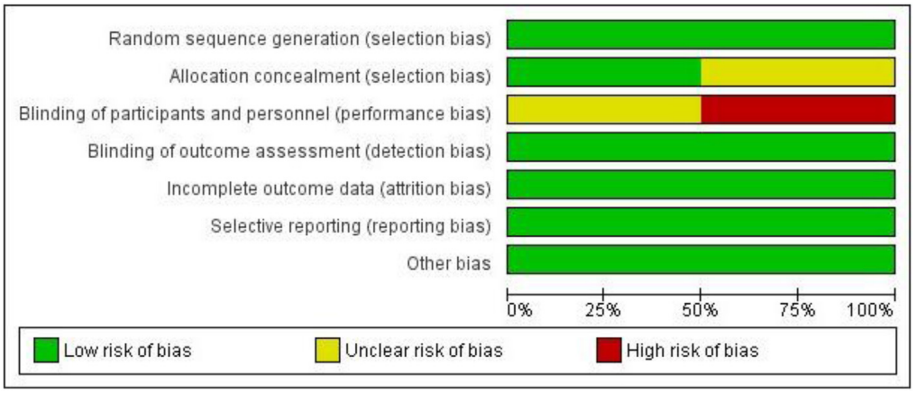

Fig. 3. 'Risk of bias' graph: review authors' judgments about each methodological quality item presented as percentages across all included studies.

Table 3
Characteristics of excluded study.

Studies	Methods	Objective	Participants	Groups	Outcomes
Diniz et al., 2014	Interventional, observational and descriptive	Verify the effects of Mat Pilates in pelvic floor muscle activity, noting which type of fiber is longer worked for practicing the method	Six women practicing the Pilates method (MAT Pilates)	Six women in a single group	PFM strength (perineometry)
Bertoldi et al., 2015	Semi experimental type time series	To evaluate the influence of the Pilates method on the contraction force of PFM and the quality of life of women during the climacteric period	Two women in the climacteric period, 50 and 48 years	Two women in a single group	Function of PFM (Visual Functional Evaluation and Functional Classification of Ortiz's AP) and PFM strength (perineometry)
Ferla et al., 2016	Observational, cross-sectional design	Verifying the existence of differences in the functioning of the PFM between women who practice the Pilates method and sedentary women and among women who practice the Pilates method and are instructed to contract the PFM during the exercises, women who practice the Pilates method, but are not instructed to contract the PFM, and sedentary women	Women, age between 20 and 40 years old; BMI less than 25 kg/m2; nulliparous; no clinical diagnosis of PF dysfunctions; has had sexual intercourse; and never had gynecological surgery. Practicing the Pilates method for at least 6 months, or have been sedentary.	The Pilates method group (PMG) comprised students from a Pilates studio, and the sedentary group (SG) consisted of university students.	Perineometry and vaginal palpation, using the PERFECT.

PFM= Pelvic Floor Muscle; BMI= Body mass index (Kg/cm^2); PMG= Pilates method group; SG = sedentary group.

muscle training, in which during the Pilates training the women were requested to contract the PFM (Culligan et al., 2010). Both groups modified the pelvic floor function and did not find an intergroup difference. However, another study compared the Pilates method without requesting the contraction of the PFM and did not find a modification (Torelli et al., 2016). This suggests the hypothesis that for this modification to occur a verbal indication is necessary for the contraction of the PFM during the exercises, regardless of the method applied, in addition to the previous evaluation of contraction capacity.

Table 4
Description of the justification for losses during ECR follow-up.

Studies	Participants (initial moment)	Participants who completed trial	Description
Culligan et al., 2010	62 participants Pilates group (n = 30) PFMT group (n = 32)	52 participants Pilates group (n = 28) PFMT group (n = 24)	The two participants who left the Pilates arm of the trial reported doing so reluctantly due to circumstances out of their control. One injured her wrist rendering her unable to continue the program, and the other had a very sick child and could no longer afford the time for study participation. In contrast, seven of the eight participants who dropped out of the PMFT arm reported doing so because they found the treatments unpleasant in some way.
Torelli et al., 2016	57 participants enrolled in randomized PEP + PFMC group (n = 29) PEP group (n = 28)	48 participants completed PEP + PFMC group (n = 24) PEP group (n = 24)	Five participants dropped out of the PEP + PFMC group stating that they lived very far from the Pilates studio, and another left because she moved to another city. Two participants exited the PEP group as they disliked Pilates exercises and 2 more left the group as they did not have time to do the exercise session twice a week.

PFMT = pelvic floor muscle-training; PFM= Pelvic Floor Muscle; PEP + PFMC= Pilates exercises program with voluntary pelvic floor muscle contraction; PEP= Pilates exercise program.

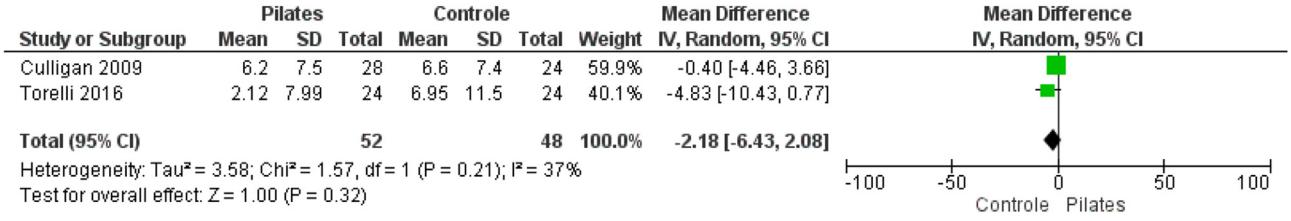

Fig. 4. Forest plot of comparison. Outcome: Perineometria.

Among the possibilities for conservative treatment, pelvic floor muscle training (PFMT) should be recommended as the first option for the treatment of women with symptoms of stress urinary incontinence (SUI) (Dumoulin et al., 2015; Paiva et al., 2017). In a review, exercise programs were evaluated such as Paula method, abdominal training, and Pilates method for the treatment and prevention of dysfunction of pelvic floor muscles. However, there is no strong evidence that exercise regimens, including Pilates, can reduce stress urinary incontinence in women by assessing outcomes such as urine leakage, pad test, or urinary incontinence identified through pelvic floor dysfunction questionnaires (Bø and Herbert, 2013).

During exercise programs, the pelvic floor muscles are not specifically trained. There is an opinion that the co-contraction of these muscles will counteract the negative effect of increased intra-abdominal pressure, preventing urine leakage and thus strengthening the muscles of the pelvis (Bø, 2012). However, it is known that 30% of women cannot effectively contract the pelvic floor muscles during the first evaluation (Bump et al., 1991). This means that without previous training of the muscles the Pilates method does not modify the functionality of the PFMs. ECR is required to test whether pelvic floor contraction ability interferes with Pilates training response.

Regarding the duration of the intervention, according to ICS recommendations initial training of pelvic floor muscles should last 8–12 weeks prior to reevaluation (Abrams et al., 2010). Among the studies selected for this review, both (Culligan et al., 2010; Torelli et al., 2016) exhibited a 12-week Pilates exercise program. This makes it necessary to develop ECRs with this minimum time for the function to change the PFM.

Evidence suggests that the practice of strenuous physical activity associated with increased intra-abdominal pressure (IAP) becomes a risk factor for pelvic floor disorders, such as pelvic organ prolapse and urinary incontinence (Eliasson et al., 2008). Of the 22 introductory exercises of the Pilates method (reformer and mat Pilates), based on the teachings of The Pilates Method Alliance, which were prescribed for healthy women, only five mat and six reformer exercises were established with low IAP exercises (Coleman et al., 2015). However, the long-term effect of increased intra-abdominal pressure on pelvic floor muscles through the Pilates method has not yet been described.

A study was conducted with instructors of different sports modalities (yoga, Pilates, strength training, and resistance) and UI presented a high prevalence in all these modalities, emphasizing Pilates instructors with 25.9% (Bø et al., 2011). This data shows that, even in low impact activities such as yoga and Pilates, there is a high prevalence of UI. Another study evaluated the functionality of PFM in young women who practice the Pilates method and verified that there is no difference when compared to young sedentary women (Ferla et al., 2016).

In this way Baeßler and Junginger 2017 evaluated the movements of the bladder neck during Pilates exercises through ultrasonography in women contained and with voluntary ability of contraction of the pelvic floor muscles, and it is possible to emphasize that women who did not perform the pre-contraction of the PFM had a greater descent of the bladder neck. Therefore, intra-abdominal pressure should be performed with pre-contraction of the pelvic floor muscles, because such pressure can have an impact on the pelvic floor and future dysfunctions.

5. Limitations

The main limitations of the evidence were that most comparisons were investigated by single trials, the trials were small, and there were different protocols of intervention with the Pilates method.

6. Perspective

The scarce knowledge by health professionals about the pelvic floor and women about their own body makes the disturbances involving the pelvic floor even more prevalent. These disorders have a high prevalence in female athletes and among the various sports modalities (Bø and Borgen, 2001; Almeida et al., 2016).

The Pilates method is considered low impact when compared to other modalities of physical conditioning, however, it has a high isometric component (Kamioka et al., 2016) and for this reason, a large part of the exercises of the method increases the intra-abdominal pressure (Coleman et al., 2015). And in this context, there may be inefficient coordination between contraction of the abdominal muscles and PFM (Bø et al., 2009).

These findings point to the need for awareness or training of the pelvic floor muscles of healthy women before initiating any activity that exerts influence on intra-abdominal pressure. For this reason, during the practice of the Pilates method, the woman should be instructed to perform the contraction of the PFM during the exercises, associated with contraction of the abdominal muscles. The pilates method did not demonstrate a modification in the function of the pelvic floor of healthy women. Future studies on the influence of the Pilates method in women with dysfunctions are encouraged.

7. Conclusions

There was no modification of the function of the pelvic floor muscles of healthy women with the use of the Pilates method.

Search strategy

((((((((((((((((Exercise Movement Techniques[Title]) OR Movement Techniques, Exercise[Title]) OR Exercise Movement Technics [Title]) OR Pilates-Based Exercises[Title]) OR Exercises, Pilates-Based[Title]) OR Pilates Based Exercises[Title]) OR Pilates Training [Title]) OR Training, Pilates[Title]) OR Pilates[Title]) AND Pelvic floor[Title]) OR Floor, Pelvic[Title]) OR Pelvic Diaphragm[Title]) OR Diaphragm, Pelvic[Title]) OR Diaphragms, Pelvic[Title]) OR Pelvic Diaphragms[Title]) OR Pelvic floor muscle[Title]) OR Pelvic floor muscle contraction[Title].

Declarations of interest

There are no conflicts of interest.

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