

The effects of therapeutic exercise on the balance of women with knee osteoarthritis: a systematic review

Efeito de exercícios terapêuticos no equilíbrio de mulheres com osteoartrite de joelho: uma revisão sistemática

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Abstract

Objective: The objective of this review was to examine evidence regarding the effects of therapeutic exercise on the balance of women with knee osteoarthritis (OA). **Methods:** The search was conducted in Pubmed, Medline, Lilacs, SciELO, ISI web of knowledge, PEDro and the Cochrane Collaboration. We used the keywords: "knee", "balance", "women" and "rehabilitation" in combination with "osteoarthritis". We selected randomized controlled clinical trials published in English, Portuguese and Spanish over the last 10 years. To verify the methodological quality of selected clinical trials, the PEDro Scale was applied. **Results:** A total of 20 studies were found in the electronic search. Of these, only 9 met the inclusion criteria and were analyzed in full. Eight of these 9 studies were classified as having high methodological quality on the PEDro Scale. Although the methods and interventions regarding balance varied widely in these studies, most found significant improvement in the balance of women with knee OA. **Conclusion:** Since the studies included in this systematic review were of high methodological quality, we can conclude that the therapeutic exercises they used improved the balance of women with knee OA.

Keywords: osteoarthritis; therapeutic exercises; postural balance; women's health; physical therapy.

Resumo

Objetivo: Fornecer evidências relacionadas ao efeito de exercícios terapêuticos sobre o equilíbrio de mulheres com osteoartrite (OA) de joelho. **Métodos:** A busca foi realizada nas bases de dados Pubmed, Medline, Lilacs, SciELO, ISI web of knowledge, PEDro e Colaboração Cochrane. Foram utilizadas as palavras-chave: *knee*, *balance*, *women*, *rehabilitation* em combinação com *osteoarthritis*. Foram selecionados ensaios clínicos aleatórios e controlados dos últimos dez anos, em língua inglesa, portuguesa e espanhola. Para verificar a qualidade dos ensaios clínicos selecionados, aplicou-se a Escala PEDro. **Resultados:** Encontrou-se um total de 20 estudos a partir da busca eletrônica. Desses, apenas nove satisfizeram os critérios de inclusão e foram analisados integralmente. A avaliação da qualidade metodológica dos nove estudos incluídos permitiu classificar oito deles como de alta qualidade metodológica. Os métodos e as intervenções para o equilíbrio variaram amplamente, no entanto a maioria dos estudos encontrou melhora significativa no equilíbrio de mulheres com OA de joelho. **Conclusão:** Como os estudos incluídos nesta revisão sistemática têm uma alta qualidade metodológica, pode-se concluir que os exercícios terapêuticos utilizados pelos estudos melhoraram o equilíbrio de mulheres com OA de joelho.

Palavras-chave: osteoartrite; exercícios terapêuticos; equilíbrio postural; saúde da mulher; fisioterapia.

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Introduction : : : .

Osteoarthritis (OA) is a chronic and degenerative disease characterized by pain and gradual loss of joint cartilage¹⁻³. It has multifarious origins and may be present in various joints⁴, where biochemical, metabolic and morphological changes take place⁵. It is characterized by a loss of normal configuration, crackling during movement, bone deformities, the formation of bone spurs, the presence of inflammatory process^{6,7}, the accumulation of synovial fluid, weakness of the quadriceps and sensorimotor loss^{5,8-13}.

OA affects more than 80% of the population of older adults^{9,10} with women affected more often than the men¹⁴, including a 35-45% prevalence in those 65 years of age¹⁵. Srikanth et al.¹⁶ verified in a meta-analysis that women have a significantly higher risk of developing knee and hand OA than men.

Although the reasons for higher prevalence in women are not clear¹⁷, several factors can be cited: the hormonal, including post-menopausal, remodeling of cartilage¹⁸ (which occurs at around 50 years-old and is followed by decreasing levels of estrogen, a hormone that provides chondrial protection^{14,19,20}), muscle weakness and poor lower limb alignment (of the femur in relation to the tibia)²¹, obesity²² and lower volumes of joint cartilage in women than men²³.

OA affects joints that support weight unloading and, among them, the knee is the most affected¹⁶. Abnormal and excessive loads are important factors that can result in OA of the knee²⁴, a joint whose function is essential in many activities of daily living (ADL) such as ascending and descending stairs, getting up from a chair and walking²⁵.

Patients with knee OA show quadriceps muscle weakness as well as proprioceptive deficits^{3,5,9-11}, which can alter balance and postural control^{3,8}. The joint inflammation present in these patients contributes to pain and prevents the arrival of afferent information regarding movement and sense of joint position²⁶. Such proprioceptive deficits cause a change in the dynamic stability provided by muscles around the joint, generating a functional instability that limits the individual's ability to perform ADLs^{26,27}. A study using a force platform to measure the pressure of each portion of the foot in order to evaluate the static and dynamic balance of patients with grades I to IV knee OA demonstrated that the degree of knee OA was positively correlated with the length and width of oscillation, i.e., as the degree of OA increases, the greater the patient's difficulty in maintaining balance²⁸.

Thus, in an attempt to minimize these effects in patients with OA, various therapeutic resources have been proposed in literature^{8,15,27,29}. For most patients with OA, the recommendation is conservative treatment that helps reduce

and relieve symptoms, improve performance of functional activities, prevent loss of muscle strength and slow the progression of the disease. Among the different conservative treatments, exercise has been shown to reduce pain and improve functional performance. There is already a good level of clinical evidence for the efficacy of aerobic exercise and strength training for knee OA^{13,30-33}. However, few studies regarding the effects of exercise on the postural stability and balance of OA patients have been conducted⁸.

A significant improvement in balance has been found in a number of studies involving short-term exercise (6-16 weeks)^{34,35}. In contrast, Crilly et al.³⁶ found no significant balance improvement after a 12 week exercise program that had been specifically developed to improve balance in a group of elderly women.

Thus, since balance impairment is one of the first changes in patients with knee OA and results in compromised postural control, balance can be an important tool for monitoring OA patients and planning the most appropriate mode of therapeutic exercise for individuals with OA. This is especially true for women, since they are more affected.

In view of the need for further clarification about this issue, the purpose of this review was to provide clinical and scientific evidence on the efficacy of therapeutic exercise approaches for improving balance in women with knee OA.

Methods : : : .

Search strategy

Searches were carried out in the following electronic databases: Pubmed Medline, Lilacs, SciELO, ISI web of knowledge, PEDro and the Cochrane Collaboration.

The keywords used were: knee, balance, women, rehabilitation and osteoarthritis, linked by the boolean operator AND. The bibliographical survey was restricted to randomized and controlled clinical trials published in the last ten years (January/2000 - July/2010) in English, Portuguese or Spanish, involving individuals aged over 45 years.

Two evaluators (AS and PRMSS) independently selected the studies based on titles, excluding those that were not related to the theme of this review. After selection, the evaluators analyzed the abstracts of the selected articles to identify those that met the inclusion criteria. The included studies were analyzed in their entirety according to a structured script involving the following parameters: author/year, sample, study design, outcomes measured, intervention instruments and effects found.

Study selection

Type of study

Only randomized controlled trials (RCTs) conducting interventions involving therapeutic exercise for balance in women with knee OA were selected.

Type of participants

Only studies that reported balance results for women with knee OA were selected.

Type of interventions

Only studies that investigated or compared therapeutic exercise interventions for improving balance in women with OA were selected.

Type of outcome of interest

Only studies whose main objective was to investigate the influence of therapeutic exercise on the variable 'balance' in patients with knee OA were included.

Assessment of methodological quality

The PEDro Scale³⁷, which is based on the Delphi list³⁸ and was translated into Portuguese in 2009³⁹, was used to assess the methodological quality of the included studies. It consists of 11 items that assess the methodological quality of randomized clinical trials, and focuses on two aspects of the study: whether it has internal validity and whether it contains sufficient statistical information to make it interpretable. Only 10 of the 11 evaluated criteria were rated³⁷. Each criterion is scored according to its presence or absence in the assessed study. The final score is obtained by the sum of all positive responses.

Studies with a score equal to or greater than 5 (50%) were considered high quality, in accordance with Moseley et al.⁴⁰. However, according to Maher⁴¹, due to the impossibility of achieving certain conditions, such as the blinding of therapists or subjects in intervention studies, the maximum achievable score for this type of study would be 8/10.

So, for this review, all randomized with a score greater than or equal to 5 (5/8) were considered to be of high methodological quality.

The studies classified with the PEDro Scale were analyzed independently by two evaluators and, when there was divergence, the disparate items were reviewed and discussed with a third evaluator until consensus was reached.

Data analyses

A five-level scoring system was used to categorize the evidence in this review. The number, methodological quality and

results of the studies involving a given variable were used to determine its level of evidence^{42,43}.

Strong evidence was indicated by consistent findings in two or more high quality RCTs;

Moderate evidence was indicated by consistent findings in a high-quality RCT as well as one or more low-quality RCTs, or by consistent findings in multiple low-quality RCTs;

Limited evidence was indicated by a single RCT or multiple low-quality RCTs;

Conflicting evidence was indicated by inconsistent findings in multiple RCTs;

Absent evidence occurred in no RCTs.

Results ::::

Identified studies

The initial search resulted in 20 articles. After the titles and abstracts, the studies appearing in more than one database or that did not meet predetermined inclusion criteria were excluded. The final selection, made by consensus, resulted in the inclusion of nine articles in the quality assessment phase.

Eleven articles were eliminated because they did not match the proposed theme, due either to the use of medications⁴⁴⁻⁴⁶, surgeries^{47,48}, proprioceptive orthoses⁴⁹ or to other exclusion criteria such as lack of a control group⁵⁰⁻⁵⁴.

Assessment of study quality

Among the nine articles evaluated on the PEDro Scale, eight scored greater than or equal to 5 and were thus considered high quality. The studies by Hinman, Heywood and Day²⁷ and Lund et al.² achieved the highest scores, with 8 points each. However, only Diracoglu et al.¹ was considered to be of low quality (Table 1). When the studies were examined together, there was strong scientific evidence from high quality studies with consistent results^{8,13,15,27,29,55,56} that the balance of women with knee OA improved.

General data about the selected articles

To better describe the articles included in this review, they were summarized using information on the following topics: author/year, sample, design, outcomes measured, interventions, instruments and effects found (Table 2).

The types of therapeutic exercise used to improve balance in the selected clinical trials were: aerobic exercise and strength training^{1,8}, Tai Chi⁵⁶, hydrotherapy²⁷, vibrating platform exercise²⁹, balance exercises⁵⁵, strength training

with controlled or uncontrolled weights¹³ and educational programs¹⁵.

The sample size of the nine studies varied from 43 to 273 individuals with OA. In most studies (n=5), patients of both sexes participated. However, the protocols of four studies involved only women^{1,2,29,56}. For the majority of the studies (n=7), the clinical diagnosis of OA, which was necessary for inclusion in the review, was according the criteria of the American College of Rheumatology (ACR).

All studies were experimental, with pre- and post-intervention assessments; long-term treatment evaluation (follow-up) occurred only in two studies^{2,27}.

Regarding the effects found in the majority of the studies, there was significant balance improvement between pre-and-post intervention evaluations, with the exception of Lund et al.².

Discussion

The analysis indicated that a variety of therapeutic exercises are used in clinical physical therapy practice with knee OA patients. Of the nine studies assessed on the PEDro Scale³⁷, eight were considering to have high methodological quality.

It was observed that the therapeutic exercises used in the reviewed literature can be considered as treatment possibilities along with other existing methods (electro-

thermo-phototherapy, cryotherapy, medications and psychotherapy) and, in order to achieve satisfactory results, should be used jointly to treat OA patients. The treatment proposals of the studies included in this systematic review were satisfactory not only regarding the therapeutic exercises used (physical exercise^{1,8,13,15} including aerobics and strength training^{2,27}, hydrotherapy, kinesiotherapy⁵⁶ and proprioceptive training^{29,55}), but also with regarding methodological quality. However, it should be pointed out that only McKnight et al.¹⁵ observed a moderate effect size in the analyzed intra-group variables; the treatment effect size in the remaining studies was small^{2,13,27}.

In the reviewed studies, only one found no balance improvement² in OA patients treated for eight weeks. Holden et al.⁵⁷ reported that a time exceeding eight weeks is necessary for satisfactory balance results.

The methodological guidelines of the evaluated studies were properly prepared and described, allowing clinical reproducibility.

Regarding the assessed outcomes, it is important to note that the use of reliable validated instruments increases the consistency of the results found. The Knee Injury and Osteoarthritis Outcome Score (KOOS) questionnaire was the most widely used assessment tool in the studies included in this review⁵⁸⁻⁶⁰. The KOOS has been validated and is based on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire⁶¹.

Table 1. Methodological classification assessed by PEDro scale.

	Messier et al. ⁸	Song et al. ⁵⁶	Diracoglu et al. ¹	Hinman, Heywood and Day ²⁷	Lund et al. ²	Trans et al. ²⁹	Chaipinyo and Karoonsupcharoen ⁵⁵	Jan et al. ¹³	McKnight et al. ¹⁵
Question 1*	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Question 2	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Question 3	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Question 4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Question 5	No	No	No	No	No	No	No	No	No
Question 6	No	No	No	No	No	No	No	No	No
Question 7	No	No	Yes	Yes	Yes	No	Yes	Yes	No
Question 8	No	No	Yes	Yes	Yes	No	No	Yes	No
Question 9	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Question 10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Question 11	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Total	5	5	4	8	8	6	7	7	6

* Since the score for the first item is on external validity, it is not considered the in the final score (Moseley et al.⁴⁰). Question 1: The eligibility criteria were specified; Question 2: The subjects were randomly distributed per group; Question 3: The distribution of the subjects was blind; Question 4: Initially, the groups were similar with respect to prognostic indicators more important; Question 5: All subjects participated in a blind fashion in study; Question 6: All physical therapists who administered the therapy did so in a blinded fashion; Question 7: All evaluators who measured at least one key outcome, they did it blindly; Question 8: Measurements of at least one key outcome was obtained by more than 85% of the subjects initially distributed by the groups; Question 9: All subjects from which they presented measurements of results received the treatment or the condition of control according to distribution or, became an analysis of the data for at least one of the key outcomes of "intention to treat"; Question 10: The results of statistical comparisons between groups were described for at least one key outcome; Question 11: The study presents both measures of accuracy as measures of variability for at least one key outcome.

Table 2. General data of the selected articles.

Study	Volunteers	Outcomes assessed	Lineation	Intervention	Instrumentals	Effects found
Messier et al. ⁸	Diagnostic: RX and Clinical examination Inclusion: OA with pain Age: ≥60 years (n=25 ♂/78 ♀) Group: EG1= Aerobic (n=33) EG2=Strength (n=34) CG=Control (n=36)	- Single-leg stance - Double-leg stance (eyes open and closed)	Randomized controlled trial. Evaluations: pre, 3, 9 and 18 months of intervention.	EG1=warm-up and walk with intensity of 50 to 85% of HR and cool. EG2=exercises to upper and lower limbs with dumbbells, performed 2 sets of 10 to 12 repetitions. CG=educational meetings on OA - 3x/week. - 18 months (3 months at the center for rehabilitation and 15 months at home).	Force Platform (AMTI)	- Significant improvement in EG1 and EG2 in bipodal position with eyes closed in relation to the CG. - The EG1 and EG2 had better balance than the CG in unipodal position with eyes open, after 18 months of intervention. - No difference was found between the groups for the single leg stance and closed eyes.
Song et al. ⁵⁶	Diagnostic: ACR Inclusion: RX degree ≥2 and sedentary Age: ≥55 years Group: EG= Tai Chi (n=22 ♀) CG=Control (n=21 ♀)	- Pain - Stiffness - Balance - Muscular strength - Fitness	Randomized controlled trial. Evaluations: pre and post intervention.	EG=exercises of Tai Chi, composed by warm-up, 12 movements, stretching global and relaxation. - 3x/week. - 12 weeks. CG=routine treatment of the clinic. After the end of the study the Tai Chi program was offered.	- K-WOMAC - Likert Scale - Cybex 770 - Cycle ergometer	- The EG showed significant improvement in pain, stiffness and fitness compared to the CG. - The EG showed improvements in balance and in strength compared to the CG.
Diracoglu et al. ¹	Diagnostic: ACR Inclusion: RX degree 1 and 2 Age: 35 to 65 years Group: EG1=Kinesia (n=30 ♀) EG2= Strength (n=30 ♀)	- Physical Function - Quality of Life - Muscular strength - Fitness - Position Sense	Randomized controlled trial. Evaluations: pre and post intervention.	EG1=program of balance and strengthening. EG2=strengthening. - 3x/week. - 8 weeks. - 24 sessions. - groups of 5 people.	- WOMAC - SF-36 - Biodex System - Walking time - Time to climb stairs	- In the WOMAC and SF-36 Questionnaires, and in walking time no difference was found between the experimental groups. - Both groups showed significant improvement in WOMAC and SF-36 Questionnaires, walking time, time to climb stairs and in strength when compared to the baseline.
Hinman, Heywood and Day ²⁷	Diagnostic: ACR Inclusion: RX (osteophytes and reduction of intra-articular space) and pain Age: ≥50 years Group: EG=Hydrotherapy (n=33, 24 ♀) CG=Control (n=35, 24 ♀)	- Pain - Physical function - Physical activity level - Quality of life - Muscular strength	Randomized controlled trial. Evaluations: pre and post intervention, and follow-up of 6 weeks.	EG=strengthening exercises and balance exercise in the heated pool (34 °C). - 2x/week (45 to 60 min). - 6 weeks. CG=no intervention during the study period, however an aquatic therapy was offered after the end of the study.	- VAS - Likert Scale - WOMAC - Muscular Test of Nicolas - Get Up and Go Test - Walking Test - Step test	- There were no differences in the test of rung and in the Test "Time Up and Go" when compared between the groups, and the assessments pre and post intervention.

Table 2. Continuation.

Study	Volunteers	Outcomes assessed	Lineation	Intervention	Instrumentals	Effects found
Lund et al. ²	<p>Diagnostic: ACR</p> <p>Inclusion: primary OA</p> <p>Age: 40 to 89 years</p> <p>Groups:</p> <p>EG1=Hydrotherapy (n=27♀)</p> <p>EG2=Land (n=25♀)</p> <p>CG=Control (n=27♀)</p>	<p>- Pain</p> <p>- Physical function</p> <p>- Balance</p> <p>- Muscular strength</p>	<p>Randomized controlled trial.</p> <p>Evaluations: pre and post intervention, and follow-up of 3 months.</p>	<p>EG1=warm-up, strength, balance and stretching with the water temperature to 33.5 °C.</p> <p>EG2=warm up, strengthening exercise, balance exercise and stretching exercise. The resistance was the patient's own body weight, a rubber band, or weight resistance.</p> <p>- 2x/week.</p> <p>- 8 weeks.</p> <p>- group attendance.</p> <p>CG=no intervention.</p>	<p>- VAS</p> <p>- KOOS</p> <p>- Balance Master Pro®</p> <p>- Biodex System</p>	<p>- No difference was found for pain and to the KOOS Questionnaire between the 3 groups, after 8 weeks.</p> <p>- The EG2 had improvement in pain compared with the CG, after 3 months of follow-up.</p> <p>- Improvement of muscle strength on the EG2 when compared with the CG.</p> <p>- No difference was found for the balance.</p>
Trans et al. ²⁹	<p>Diagnostic: ACR</p> <p>Inclusion: RX and clinical examination</p> <p>Age: mean 60.4 years</p> <p>Group:</p> <p>EG1= Stable Vibration platform (n=17♀)</p> <p>EG2= Balance board with built-in vibration (n=18♀)</p> <p>CG=Control (n=18♀)</p>	<p>- Pain</p> <p>- Stiffness</p> <p>- Physical function</p> <p>- Muscle strength</p> <p>- Balance</p>	<p>Randomized controlled trial.</p> <p>Evaluations: pre and post intervention.</p>	<p>EG1=training in stable vibration platform</p> <p>EG2=training in dynamics vibration platform.</p> <p>- 2x/week</p> <p>- 8 weeks</p> <p>CG=did not participate in any training.</p>	<p>- WOMAC</p> <p>- Biodex System</p> <p>- TDPM Test</p>	<p>- Improvement of muscular strength in EG1 compared with the CG.</p> <p>- Improvement of proprioception in the EG2 compared with the CG.</p> <p>- There were no differences between the groups was observed for the pain, stiffness and physical function.</p>
Chapinyo and Karoon-supcharoen ⁵⁵	<p>Diagnostic: ACR</p> <p>Inclusion: knee pain and morning stiffness</p> <p>Age: ≥50 years</p> <p>Group:</p> <p>EG1=Balance (n=24, 15♀)</p> <p>EG2=Strength (n=24, 22♀)</p>	<p>- Pain</p> <p>- Physical function</p> <p>- Muscular strength</p> <p>- Mobility</p>	<p>Randomized controlled trial.</p> <p>Evaluations: pre and post intervention.</p>	<p>EG1=program of balance with mini-squatting, anterior and posterior displacement, both sides.</p> <p>EG2=the volunteers performed isometric extension in both lower limbs.</p> <p>- A program of exercises performed at home.</p> <p>- 30 repetitions.</p> <p>- 5x/week.</p> <p>- 4 weeks.</p>	<p>- KOOS</p> <p>- Isokinetic Dynamometer</p>	<p>- Not found differences between the groups for pain, and strength.</p> <p>- The EG2 showed a better quality of life compared with the EG1.</p> <p>- Both groups (EG1 and EG2) had an improvement in pain, strength, balance and mobility when compared with the baseline.</p>
Jan et al. ¹³	<p>Diagnostic: ACR</p> <p>Inclusion: RX degree ≤3, physical examination, pain and bilateral OA</p> <p>Age: ≥50 years</p> <p>Group:</p> <p>EG1=Weight-bearing exercise (n=36, 24♀)</p> <p>EG2=Nonweight-bearing exercise (n=35, 25♀)</p> <p>CG=Control (n=35, 24♀)</p>	<p>- Physical function</p> <p>- Speed walk - Position sense</p> <p>- Muscular strength</p>	<p>Randomized controlled trial.</p> <p>Evaluations: pre and post intervention.</p>	<p>EG1=the participants performed the exercise in a sitting position, with knee at 90° of flexion with 1 foot fixed on the center of the pedal.</p> <p>EG2=the participants were positioned with knee in 90° of flexion, with a free distal extremity.</p> <p>- 3x/week.</p> <p>- 8 weeks.</p> <p>CG=no intervention.</p>	<p>- WOMAC</p> <p>- Cybex 6000</p> <p>- Electrogoniometer</p>	<p>- Improvement of the WOMAC Questionnaire for both intervention groups compared with the baseline and with the CG.</p> <p>- The EG1 had better position sense of the knee compared to the EG2 and CG.</p> <p>- Improvement of the peak torque in both intervention groups.</p>
McKnight et al. ¹⁵	<p>Diagnostic: RX and clinical examination</p> <p>Inclusion: OA degree 3 and 4</p> <p>Age: 35 to 64 years</p> <p>Group:</p> <p>EG1=Streight (n=91, 80%♀)</p> <p>EG2=Educational program (n=87, 74%♀)</p> <p>EG3=Combined (n=95, 76%♀)</p>	<p>- Pain</p> <p>- Physical function</p>	<p>Randomized controlled trial.</p> <p>Evaluations: pre and post intervention.</p>	<p>EG1=stretching exercises, balance, strength and flexibility.</p> <p>- 3X/week.</p> <p>- 24 months.</p> <p>EG2=educational program and interactive.</p> <p>- 90 minutes with health professionals. EG3=received the two speeches together.</p>	<p>- WOMAC</p> <p>- FOCUS</p> <p>- ERGO</p> <p>- Get Up and Go Test</p>	<p>- All three groups showed decreased self-reported pain and large increase in physical function.</p> <p>- Men gained significantly more large muscle mass strength, but also tended to report more pain than women.</p>

In most of the studies, the OA diagnosis was based on ACR criteria, which consists of clinical and radiographic evaluations, in accordance with the Kellgren and Lawrence Scale⁶² (grades 1 through 4). In clinical trials and observational studies, OA is commonly diagnosed according to¹⁵ these criteria. However, it should be pointed out that, of the nine included studies, only four reported the OA degree of the subjects included in the sample^{1,13,15,56}.

The representativeness of samples may be considered appropriate, averaging 30 subjects per group; one study used 90 subjects per group¹⁵. The sample size in most of the studies was calculated to determine the minimum number of subjects necessary for each group^{2,8,15,27,29,55}.

All selected studies involved women with OA, and five^{8,13,15,27,55} contained men in the sample. However, the percentage of women in the groups was always higher, which is compatible with epidemiological data since OA is more prevalent in women^{14,16}.

Regarding therapeutic exercise, strength training and aerobic^{30,63} modalities stood out. The aerobic and strength training exercises proposed in Messier et al.⁸, are widely used in patients with knee OA to improve physical conditioning, especially to strengthen the quadriceps, since its weakness may be responsible for complaints of imbalance and pain^{54,64}.

Quadriceps strengthening has been shown in several studies to be the key point for controlling pain, physical functioning and quality of life in this population. In addition, this therapeutic approach contributes to improvement in postural sway control, thus improving balance⁶⁴. This has also been demonstrated by Messier et al.⁸, who, using a force platform evaluation after 18 months of intervention, found significant balance improvement compared to controls in groups involved in aerobic and strength exercise in the bipedal position with eyes closed and in the unipedal position with eyes open. However, the appropriate treatment time and session frequency still seem inconclusive in literature due to wide variation among studies.

In a systematic review on knee OA exercise³⁰ whose objective was to determine whether therapeutic exercise would be beneficial in terms of joint pain reduction and improvement in physical functioning, it was reported that studies must describe the procedures used in detail, as well as the length of intervention time and the frequency and intensity of training. The lack of a full procedural description prevents the reproduction of clinical findings in new studies.

The results of the studies in this systematic review that used aerobic and strength training exercises demonstrated positive effects for some of the evaluated outcomes, such as pain and stiffness^{1,2,13} and balance^{1,8}. However, for the outcome balance, Lund et al.² found no difference. In contrast, in the study by

Diracoglu et al.¹, in which three times a week for eight weeks one group performed strength training exercises and the other balance exercises associated with strength training, both groups showed significant improvement on the WOMAC, the SF-36, in walking time, time ascending and descending stairs and strength, thus demonstrating the effectiveness of strength and balance exercises for women with knee OA.

Chaipinyo and Karoonsupcharoen⁵⁵ conducted a study comparing a strengthening exercise program with a balance exercise program with a frequency of five times a week for four weeks in women with knee OA and found better quality of life and mobility in the strengthening exercise group than the balance program group.

A survey conducted recently by McKnight et al.¹⁵, in which a 24-month strength training program, an educational program and an association of both were compared, it was reported that the three groups benefitted with respect to pain and improved physical function, with the men improving in muscular strength more than the women, which demonstrates that an educational program about the dysfunction is also beneficial for patients with knee OA. Similar results have also been reported in other studies⁶⁵⁻⁶⁷.

However, conclusions regarding time and frequency of optimal intervention, instruments to be used and adverse effects would be precipitous, since in the evaluated studies, intervention times ranging from four weeks to 18 months were assessed and a variety of instruments were used to assess pain and balance.

Another therapeutic intervention found in this systematic review was hydrotherapy, which provided physiological benefits from both its mechanical and thermal effects. Among these effects, relaxation, analgesia and reduced joint impact should be highlighted, since in this modality muscle spasms, pain and fatigue are reduced and muscle strength and balance are improved due to lack of support points. Thus, the patient is obliged to undergo postural changes that reduce impact and weight unloading on the joints⁶⁸⁻⁷⁰.

Two studies analyzed in this systematic review^{2,27} used hydrotherapy as a therapeutic resource. Hinman, Heywood and Day²⁷ conducted strengthening and balance exercises twice a week for six weeks and observed significant improvement in physical function, pain, muscle strength and quality of life, but no differences in the Timed Up and Go test. In contrast, Lund et al.², using strengthening, endurance, balance and stretching exercises in groups that exercised in and out of water twice a week for eight weeks, found no difference for pain or balance between groups. Nevertheless, the authors observed that hydrotherapy would provide more benefits to patients with knee OA than to those who performed the protocol out of the water.

Vibrating platform exercise was used for muscle strengthening^{71,72}. Trans et al.²⁹ compared three groups: exercise on a stable vibrating platform, exercise on a balance platform with vibration and a control group. Training was administered twice a week for eight weeks, and it was demonstrated that training on a stable platform improved muscular strength, while the training on vibrating balance platform improved proprioception compared to controls.

Thus, studies in this review showed some variation regarding the benefits of therapeutic exercises in relation to time and frequency of treatment. However, in clinical practice, these therapeutic exercises are already used by physical therapists, even without scientific evidence attesting to their effectiveness

for this disease. However, based on the results of this review, in which the studies presented high methodological quality, it can be concluded that the involved therapeutic exercises improved the balance of women with knee OA, suggesting that they can lead to safe clinical decisions and provide effective results in the interventions in women with knee OA.

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