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Review Article

The Influence of Physical Exercises on the Flexibility of Older Individuals with Knee Osteoarthritis: A Systematic Review

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Abstract

Background: Flexibility is a component of functional capacity and is relevant in maintaining the musculature and structures adjacent to the joints. Then, the improvement of the flexibility must be a critical goal in the rehabilitation programs. By improving flexibility in knee osteoarthritis (KOA) individuals, the pain is relieved, the risk of injury is reduced, and the need for surgical interventions is delayed. We aimed to summarize the available literature on the influence of different physical exercise modalities on flexibility in older KOA individuals.

Methods: This study followed the PRISMA statement and registered in PROSPERO (CRD42020195786). Seven databases (MEDLINE/PubMed; PEDro; CINAHL; Scopus; Web of Science; Embase; and SPORTDiscus) were screened for papers published prior to Sep 6, 2022. The PEDro scale, Cochrane collaborations, and ROBINS-I tools were used to evaluate the methodological quality and risk of bias.

Results: Ten studies (including 438 participants diagnosed with KOA) fulfilled the eligibility criteria, and nine concluded that flexibility was improved after a physical exercise program.

Conclusion: Despite the modality, physical exercise improves flexibility in older KOA individuals, improving the functional capacity. Health professionals engaged in KOA rehabilitation should use physical exercise as a strategy to improve the flexibility of this population.

Keywords: Knee osteoarthritis; Aged; Range of motion; Exercise therapy; Rehabilitation

Introduction

Aging is increasing globally associated with a gradual reduction in mental and physical capacity. Consequently, there is an increased risk of chronic diseases and death (1). Throughout the life, the

accumulation of a variety of cellular and molecular damage can be observed, such as (i) degeneration of the periarticular soft tissue and extracellular matrix (2); (ii) chronic low-grade inflammation related to aging (inflamm-aging) (3); and (iii) the decrease in compliance and vascularization of connective tissues, directly impacting the functional capacity of older individuals and favoring the predisposing to the development of chronic musculoskeletal diseases (1), such as knee osteoarthritis (KOA).

KOA is a degenerative disease that affects the articular cartilage, with multiple risk factors, including trauma, overuse, and genetic predisposition (4,5). The common symptoms are pain, decreased knee flexibility, swelling, and loss of normal joint function (6). The older adults with KOA have more important functional limitations than their peers. Thus, KOA can negatively impact these individuals, considering their physical and mental health (5).

There is no cure for KOA, and the rehabilitation approaches aim to reduce pain, improve functional capacity (7), and optimize knee joint mobility. In this context, flexibility is relevant in maintaining the musculature and structures adjacent to the joint (8). The treatment of KOA includes pharmacological, non-pharmacological, and surgical procedures (5). Several physical exercise modalities have been used in managing KOA individuals (5,9), including strengthening (5,10,11), low-impact aerobics exercises (5), neuromuscular education (5), self-care management (5,9), flexibility exercises (11), whole-body vibration exercises (WBVE) (12), Tai chi (5,9), and aquatic exercises (5,9). The American Academy of Orthopaedic Surgeons (AAOS) (5), strongly recommends that individuals with symptomatic KOA participate in regular physical exercise programs.

In the pathogenesis of KOA, the malfunction of the chondrocytes affects the flexibility, and it has a tight relationship with muscle performance (13,14). The enhanced flexibility can induce sarcomerogenesis, promote an increase in calcium ions within the neuromuscular junction, and decrease muscle stiffness (14). These factors may contribute to better muscle performance after flexibility training; however, the connection between muscle performance and flexibility remains uncertain (14).

There is a clear association between disability and decreased knee joint range of motion (ROM), secondary to muscle spasms, muscle weakness, a sedentary lifestyle, and reduced flexibility (13,15). Enhanced range of motion has been associated with reduced pain and increased muscle function (15). Thus, it is expected that by improving the flexibility, the pain is decreased, the risk of injury is reduced in KOA individuals, and the need for surgical interventions might be delayed (13,15).

Flexibility is a component of functional capacity (14,16) and concomitantly to the muscle weakness can lead to joint pain and dysfunction (13). The reduction of the flexibility is present in KOA individuals when compared with health subjects. In consequence, it has an effect on the patellofemoral alignment that could lead to more important stress and the predisposition to the development of symptoms such as pain, stiffness, and functional limitation (13,15). Then, this improvement must be a critical goal in rehabilitation programs, and the flexibility might be considered in the elaboration of a physical exercise program (15).

Therefore, this systematic review aimed to summarize the available literature that reports the influence of different physical exercise modalities on the flexibility of older KOA individuals.

Methods

Protocol and Registration

This study screened published papers prior to Sep 6, 2022, and followed the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA) Statement (17), and the protocol was registered in the International Prospective Registry of Systematic Reviews (PROSPERO) - CRD42020195786.

Research Question

We aimed to answer the following question: What is the influence of physical exercises on the flexibility of older individuals with KOA? The PICO strategy was used to determine the components of the research question (17): Participants (P) = older individuals with KOA; Interventions (I) = physical exercise; Comparison (C) = multiple treatment comparisons; Outcome (O) = flexibility.

Inclusion and exclusion criteria

The inclusion criteria consisted of (i) original data on the flexibility of older individuals diagnosed with KOA; (ii) an investigation of the effects of physical exercises on flexibility in older individuals; (iii) to be interventionist studies with inter or intragroup comparisons; and (iv) which protocols used static or dynamic exercises. The exclusion criteria were: (i) review articles; (ii) conference abstracts; (iii) studies with animals; (iv) case reports; (v) combined therapeutic interventions; (vi) studies with individuals younger than 60 years old; (vii) studies involving pharmacology approaches; or (viii) post-surgery interventions.

Search strategy

Three independent reviewers (A.C.G.S., A.G.M., and E.M.-M.) accessed the MEDLINE/PubMed; Web of Science; Physiotherapy Evidence Database (PEDro); Scopus; Embase; Cumulative Index to Nursing and Allied Health Literature (CINAHL); and SPORTDiscus databases on Sep 6, 2022. The complete search strategy can be assessed in the Appendix section.

Study selection

After exporting all the publications found on the databases to an Excel spreadsheet, two authors (A.C.G.S. and V.S.C.) manually removed the duplicated records. Two authors (A.C.G.S. and Y.T.S.) independently examined titles and abstracts according to the inclusion criteria, and in case of uncertainty of eligibility, the full text was obtained. Researchers were blinded to each other's decisions, and a third author (E.M.-M.) solved the disagreements.

The data extracted from the articles that fulfilled the inclusion criteria were imported to an Excel spreadsheet containing: (i) study information (author, year of the publication, and country); (ii) aim of the studies; (iii) participants (sample size, mean age, sex), and groups; (iv) physical exercise programs; (v) flexibility assessment; (vi) methodological quality (PEDro scale) (18); (vii) risk of bias; and (viii) flexibility outcomes. Two researchers (A.C.G.S. and V.S.C.) independently extracted the data, and a third author (E.M.-M.) solved the disagreements.

Methodological quality, risk of bias of the selected papers

Two authors independently appraised the studies (Y.T.S. and A.C.G.S.), and a third author solved any disagreement (E.M.-M.). The issue was discussed until a consensus. The methodological quality of each randomized controlled trial (RCT) was evaluated according to the PEDro scale (18), consisting of a checklist with ten items established based on an expert consensus specific to clinical trials of physical therapy interventions (18). The publications were classified as having 'excellent' methodological quality (score of nine or ten), 'good' methodological quality (score of six to eight), 'fair' methodological quality (score of four to five), and 'poor' methodological quality (score of three or below) (19).

Two authors (A.C.G.S and V.S.C) independently assessed the risk of bias in the selected studies, and if there were disagreements, a third author (E.M.-M) was consulted. The RCT studies were evaluated using the Cochrane Collaboration's tool (20), and each domain was qualified as low risk, unclear risk, or high risk of bias. Each judgment was represented by the colors: green, yellow, and red, respectively (20). The non-RCT studies were evaluated using the Risk Of Bias In Non-randomized Studies of Interventions tool (ROBINS-I) (21), which classifies each domain as low risk, moderate risk, serious risk, critical risk of bias, or no information, and each judgment was represented by the colors green, yellow, red, dark red and blue, respectively (21).

Data synthesis

Due to the different characteristics of the studies, exercise protocols, and outcomes assessment, statistical pooling of the data was not appropriate.

Results

All the publications found in the databases were preliminarily considered to be included in this systematic review. Overall, 1978 papers were initially screened (MEDLINE/PubMed = 440, PEDro = 9, Scopus = 341, CINAHL = 110, Web of Science = 199; EMBASE = 861 and SPORTDiscus = 18). After removing duplicates, 1368 records remained. Of these, ten articles fulfilled the inclusion criteria. The PRISMA flowchart schematizes the selection process (17) (Fig. 1).

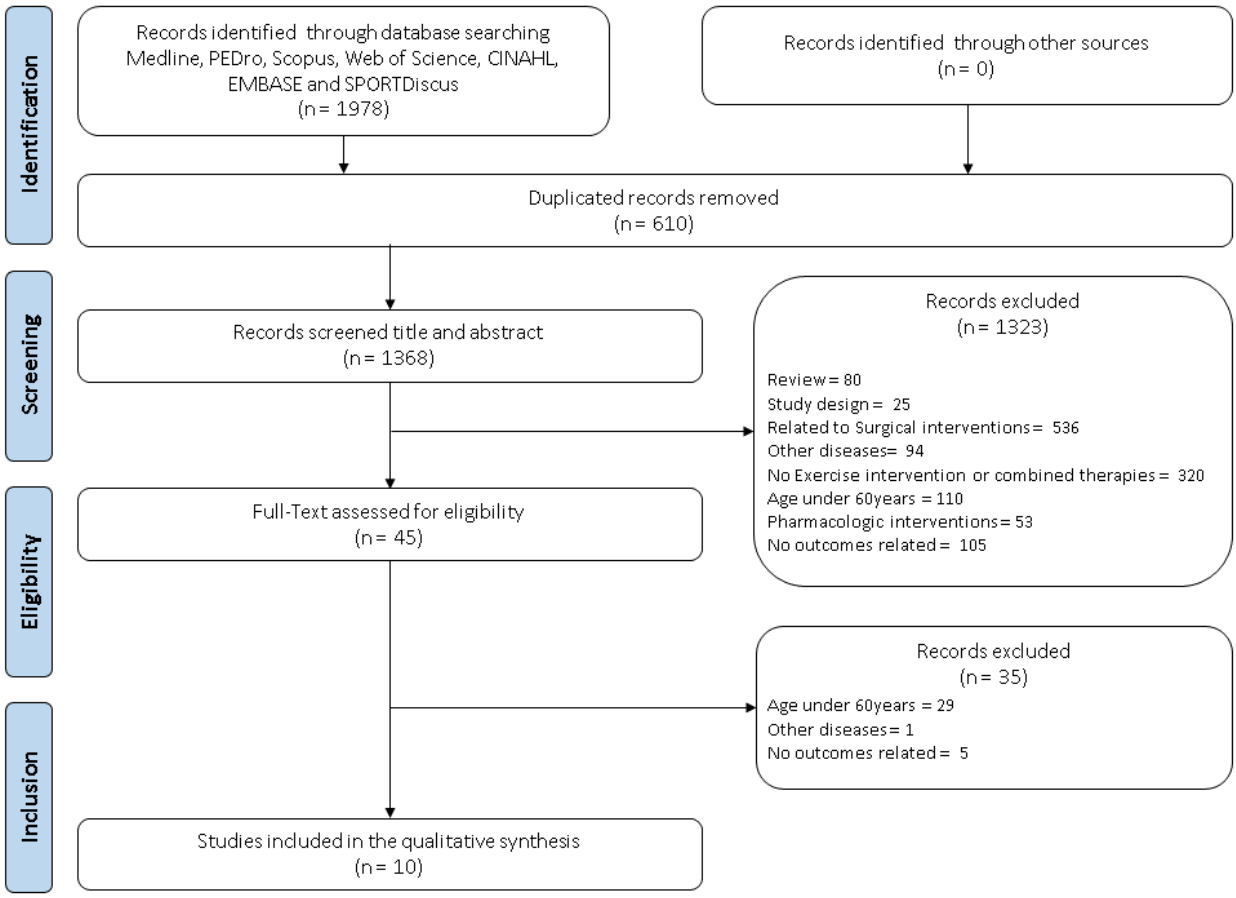

Fig. 1: PRISMA flow diagram of the literature selection process

Table 1 summarizes the characteristics of each selected publication, including study information, the aim of the study, characteristics of the participants and groups, physical exercise programs, flexibility assessment, methodological quality, and flexibility outcomes.

Table 1: Characteristics of the publications included

Author Year Country	*Participants Mean Age Groups*	*Physical exercise programs*	*Flexibility assessment*	*PEDro scale*	*Flexibility outcomes*
Aoki and colleagues (2009), Japan. (22)	N: 36 Female Age*: 72.3±5.2 years (stretching); 74.4±6.4 years (CG) Groups: Stretching and CG	Every day at home until admission for surgery. Exercise protocol: knee flexion assisted by hand while sitting on the floor and knee flexion assisted by hand in a prone position. Each position was repeated ten times for 30 s.	Goniometer (supine position)	4/10 (fair)	↑ knee ROM in the stretching group. No significant relationship between the number of days (25–146) and the percentage change in knee ROM. Registration x Admission*: CG: 109.9±23.5° x 109.1±20.4° Stretching Group: 110.0±25.6° x 117.6±20.2° *P*= 0.007
Marconcin and colleagues (2018), Portugal (23)	N: 80 Male and Female Age*: 69.1±5.8 years Groups: SMEG and EG	Twelve weeks Twice a Week Exercise protocol: 5 min warm-up, 15 to 20 min of recreation activity and balance exercise, 30 to 40 min of strengthening exercises (upper and lower limbs), and 10 to 15 min of stretching and relaxation exercises at the end. Home exercises were performed in the last two weeks (24).	CSR test	6/10 (good)	No significant changes in the CSR test. Before x After MPK*: EG: −7.1±12.0 cm x −5.6±12.8 cm SMEG: −13.6±16.5 cm x −6.6±14.4 cm *P*= 0.145 Before x After LPK*: EG: −6.6±9.9 cm x −6.5±11.53 cm SMEG: −11.8±14.9 cm x −7.6±14.1 cm *P* = 0.208
Moura-Fernandes and colleagues (2020), Brazil (25)	N: 37 Male and Female Age*: 68.06±2.02 years (CG) and 62.32±2.52 years (WBVE) Groups: WBVE and CG	Single session 11 min Exercise protocol: Participants were instructed to sit at an ancillary chair in front of a side-alternating VP, bare feet, with arms extended and hands on the knees. Frequency of 5 Hz, feet placed 3 min in each PPD (2.5, 5.0, and 7.5 mm) and 1 min rest between the bouts.	ATF	7/10 (good)	↓ ATF Before x After*: CG: 17.53±2.54 cm x 16.3±12.53 cm WBVE: 18.81±2.08 cm x 14.64±2.05 cm *P* < 0.05

Table 1: Continued…

Oida and colleagues (2008), Japan (26)	N: 88 Age*: 77.8±5.4 years (male) and 73.2±5.3 years (female) Male and Female Groups: Exercise and CG	Three months Eight classes of 90 min + daily home exercises Exercise protocol: stretching of knee and ankle joints; strengthening of quadriceps, extension, and flexion of the knee joint and movement exercises (turning over, getting up, standing up)	Digital angle meter	5/10 (fair)	↑ Knee ROM in the exercise group. Before x After*: EG: 118±15° x 126±16° CG: 121±15° x 125±15° *P*= 0.037
Reid and McNair (2011), New Zealand (27)	N: 20 KOA N: 19 Non-KOA Male and Female Age*: 69.0±5.8 years (KOA Stretch), 67.4±5.0 years (KOA CG), 67.9±4.0 years (Non-KOA Stretch), and 69.6±4.3 years (Non-KOA CG)	Six Weeks Five times per week. Once a day at home. Exercise protocol: 3 bouts of 60 s stretching the hip flexors, quadriceps, hamstrings, and upper and lower calf muscles. Gymnasium (twice a week): Stretching and warm-up (walking on a treadmill or cycling on a stationary bicycle).	Kincom Dynamometer	7/10 (good)	↑ Knee extension ROM in the stretch group (considering 80° of knee flexion as the start position). Before x After*: Stretch: 69.5±15.4° x 77.2±13.7° CG: 71.1±10.3° x 69.3±11.1° *P* < 0.05
Yennan and colleagues (2010), Thailand (28)	N: 50 Age*: 65.6±4.9 years (AG) and 66.4±4.4 years (LBG) Female Groups: AG and LBG	Six weeks 10 min of warm-up, 45 min of exercise, and 10 min of cool-down. Exercise protocol: Double-leg squat, double-leg calf raise, stand stretch, and bend the knee, standing kick leg-to-side, standing kick leg-to-front, sitting stretch knee, sit spin bike, and fast walking forward-backward.	Sit-and-reach test	5/10 (fair)	↑ muscle flexibility in both groups. No statistical differences were observed between groups. Before x After*: AG: 6.98±8.10 cm x 10.96±7.68 cm LBG: 7.90±11.47 cm x 10.54±9.32 cm *P*= 0.399
Lau and colleagues (2013), China (29)	N: 20 Male and Female Age*: 72.0±2.0 years Group: AG	Ten weeks Twice a week Exercise protocol: stepping with arm movement; slow stepping; alternate hip and knee flexion and extension; bilateral hip abduction, adduction, flexion,	Goniometer (lying position)	N/A	↑Total knee ROM. Before x After‡: 120° (110-120°) x 125° (115-126°) *P*= 0.012

Table 1: Continued…

		and extension; semi-squatting with arm movement; stepping and gentle jumping in multiple directions.			
Lee and Lee (2008), Korea (30)	N: 46 Male and Female Age*: 75.46±6.28 years Group: Tai-Chi and CG	Twelve weeks Twice a week 60 min Exercise protocol: 24 forms of Sun-style Tai Chi.	Goniometer	N/A	↑ Knee ROM Mean differences pre and post-test* (Tai-Chi x CG): Right: 8.31±23.39° x -5.62±14.69° *P*= 0.019 Left: 7.04±27.10° x -7.91±16.08° *P*= 0.026
Lee and colleagues (2016), China (31)	N: 33 Male and Female Age*: 75.03±7.26 years Group: Exercise	Twelve weeks Seven days/week and twice a day (home program). Once a week at the community center. Exercise protocol: Two knee ROM exercises, two stretching exercises, and three muscle-strengthening exercises.	Goniometer	N/A	↑ Knee ROM Before x After*: 93.27±13.27° x 105.91±11.19° *P* = 0.000
Reid and McNair (2010), New Zealand (32)	N: 28 (KOA) and 27 (healthy) Male and Female Age*: 67.8±5.0 years (KOA) and 68.7±5.5 years (healthy) Groups: KOA individuals and healthy	One session Exercise protocol: Hamstring stretching at Kincom dynamometer in a seated position (three bouts of 60 s of stretching and 60 s of rest)	Kincom Dynamometer	N/A	↑ Knee extension ROM in both groups. Before x After*: KOA: 75.6±17.2° x 80.5±22.3° *P* < 0.05 Healthy: 77.5±15.5° x 81.9±18.2° *P* < 0.05

AG: aquatic group; ATF: anterior trunk flexion; CG: control group; CSR: chair sit and reach; EG: educational group; KOA: knee osteoarthritis; LBG: land-based group; LPK: less painful knee; MPK: most painful knee; N/A: not applicable; PPD: peak-to-peak displacement; ROM: range of motion; SMEG: self-management educational group; VP: vibrating platform; WBVE: whole-body vibration exercise; *: expressed as mean ± standard deviation; ǂ: expressed as median (interquartile range); ↑: increase; ↓: decrease

Study population

The selected studies included 438 older adults with unilateral or bilateral primary KOA. Nine studies evaluated individuals regardless of the severity of KOA (23,25–32). One study investigated individuals with severe KOA awaiting knee arthroplasty (22). One study analyzed obese individuals (25).

Interventions

The selected studies carried out different protocols. Regarding the duration of treatment, most

protocols lasted from six weeks to three months. Two studies (25,32) evaluated the acute effects of physical exercises, and one (22) evaluated the effects of physical exercises from registration to admission to surgery. Regarding the type of physical exercise: one study (25) analyzed the effects of a single session of WBVE, two studies (28,29) used aquatic exercises as a treatment protocol, one study (30) investigated the effect of 24 Sun-style forms of Tai Chi, three studies (22,27,32) used only stretching as exercise approach, and five studies (22,23,26,27,31) included a home-based exercise program including strengthening, stretching or both types of physical exercise.

Flexibility assessments

The quantitative results of flexibility and statistical values mentioned in each study are shown in Table 1. Six different types of measurements were used to assess the flexibility.

The goniometry measures the knee joints' ROM and can be manually performed using a goniometer with the individual in a lying position (22,29).

The chair sit-and-reach (CSR) test is an alternative test to the traditional floor sit-and-reach test and measures the flexibility of the hamstrings. Participants were instructed to sit near the front edge of a folding chair placed against a wall, extend one leg in front of them while maintaining the other foot flat on the floor, and reach down the extended leg to touch the toes (24,33).

The anterior trunk flexion (ATF) is performed in the standing position. Individuals were asked to do maximum trunk flexion without flexing the knees and extending their necks. The distance between the middle finger and the floor was obtained. Lower distance values between the middle finger and the floor were considered the better flexibility performance (25,34).

The digital angle meter measures the combined ROM, including the passive knee extension and flexion angle (26).

The Kincom dynamometer measures the passive knee extension ROM, and the point of maximal was determined by the moment the individuals activated the emergency stop switch when they perceived the maximum tolerable stretch at the hamstrings (27,32).

The sit-and-reach test was performed in a sitting position with both legs extended. The individuals were asked to bend the waist and stretch both hands toward the feet without flexing the knees. Lower distance values between the middle finger and the floor were considered the better flexibility performance (28).

Methodological quality

The methodological quality of the RCTs involving physiotherapy, assessed by the PEDro scale, is presented in Table 1. Three studies (23,25,27) were classified as having 'good' methodological quality (≥6), and three (22,26,28) had 'fair' methodological quality (4 or 5) (19). The PEDro scale could not evaluate four studies (29–32) because they were not RCTs.

Risk of bias

A detailed assessment of the risk of bias is presented in Fig. 2. The risk of bias of the RCTs (Fig. 2A) was carried out according to the Cochrane Collaboration tool (20). Two publications (22,28) were classified as having an unclear risk of bias, and four publications (23,25–27) as having a high risk of bias. The risk of bias for the non-RCTs (Fig. 2B) was carried out using the ROBINS-I tool (21). Two publications (30,32) were classified as having a low risk of bias, comparable to a well-performed RCT (21), and two publications (29,31) were classified as having a serious risk of bias.

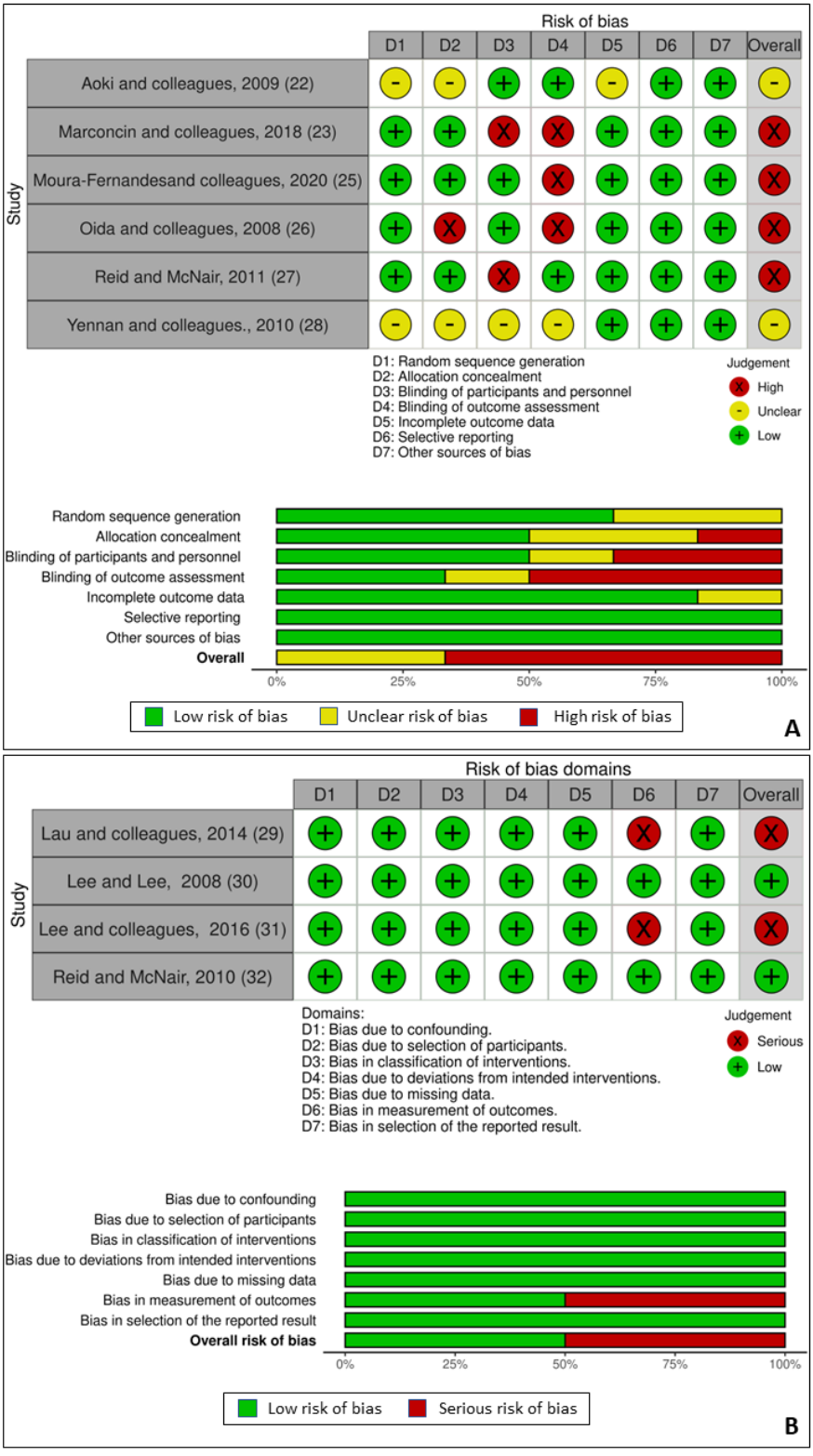

Fig. 2: (A)—Risk of bias of the randomized controlled trials; (B)—Risk of bias of the non-randomized trials

Discussion

The current systematic review presents scientific evidence about the effects of physical exercises on the flexibility of older KOA individuals. The search was conducted to find the highest number of studies focused on physical exercise interventions, and ten studies met the inclusion criteria. It is essential to highlight that, regardless of the modality of physical exercise performed in all studies, most studies reported significant values ($P<0.05$) on the improvement of flexibility either through the increase in the knee ROM or the improvement observed in the linear tests of flexibility.

Although physical exercise is recommended as a non-pharmacological treatment for managing KOA individuals (5), there is no standard protocol, leading to significant variability among physical exercise protocols described by the selected studies.

Three studies (22,27,32) focused exclusively on stretching exercises. Aoki and colleagues (22) showed a significant improvement in knee ROM after at least 25 days of daily stretching exercises while individuals were awaiting admission for knee arthroplasty. Reid and McNair (32) reported a significant improvement in the knee extension ROM after one session of hamstring stretching at the Kincom Dynamometer. Reid and McNair (27) also reported a significant improvement in the knee extension ROM in the stretch group after six weeks of stretching exercises performed at the Kincom Dynamometer. Similarly, Flores-Garza and colleagues (15) suggested prescribing flexibility exercises during physical therapy in KOA individuals, and their observational study concluded that greater hamstring flexibility is associated with less pain, minor joint stiffness, and fewer functional limitations.

Three studies (23,26,31) included stretching, muscle strengthening, active ROM, and balance exercises, associating three or four types of physical exercises. Marconcin and colleagues (23) have not observed significant differences between the educational and the self-management educational groups in the CSR test, and no significant differences were also observed intragroup. In addition, the published study protocol (24) did not describe how the stretching and relaxation exercises were performed at the final 10 to 15 min of the physical exercise protocol, making the study's outcome inconclusive. On the contrary, Oida and colleagues (26) have found a significant improvement in knee ROM after three months of daily home exercises and eight presential classes. Likewise, in one group pilot study, Lee and colleagues (31), found improvements in joint stiffness after a twelve-week home exercise program (muscle stretching and strengthening and active ROM) performed twice a day at home and once a week at a community center, including education sessions.

Moura-Fernandes and colleagues (25) evaluated the acute effects of WBVE performed by obese individuals sitting in an ancillary chair in front of a side-alternating vibrating platform and arms placed over the knees. It was observed a significant improvement in ATF measurement after the intervention. A considerable improvement was verified in the intervention group compared to the control group (25). Kütter and colleagues (35) reported similar results using the ATF as an assessment in KOA individuals aged 40 years and over after one session of the WBVE and auriculotherapy in both groups (WBVE only - $P=0.03$ and WBVE associated with auriculotherapy - $P = 0.04$). In addition, the same work reported an improvement in the flexibility in both groups (WBVE only - $P = 0.02$ and WBVE associated with auriculotherapy-$P=0.01$) after five weeks (cumulative effect), twice a week, using a progressively increased frequency of the mechanical vibration (5 to 14 Hz); one bout of three minutes in each peak-to-peak displacement (2.5; 5.0, and 7.5mm) and 1 min of rest (35).

Two studies (28,29) investigated the effects of an aquatic exercise protocol in KOA individuals. Significant improvements were found in the flexibility and other physical function parameters (28,29). Similarly, in a meta-analysis, Ma and col-

leagues (36) also verified that aquatic exercises are efficacious for severe KOA individuals.
One study (30) investigated the effects of Tai Chi on knee ROM and concluded that this exercise significantly improves knee ROM. Chen and colleagues (37) encourage a regular practice of Tai Chi to maintain functional capacity and to improve the quality of life of older individuals with lower extremities OA.
Prescribing an optimal physical exercise program is essential to promote adequate flexibility, reduce functional limitation, pain, and stiffness, and promote better performance in the daily activities of KOA individuals (13,15,38). Despite the different modalities of physical exercise protocols, nine studies have shown a significant improvement in flexibility outcomes, such as greater ROM or lower limb mobility (22,25–32). Benner and colleagues (38) described a physical exercise program to treat patients with KOA to decrease pain and improve functional capacity by restoring normal knee ROM. Reduced flexion and extension mobility, even a few degrees, is associated with pain and decreased functional capacity. As well as Wellsandt and colleagues (9) concluded that traditional modes of exercise and emerging types, such as Tai Chi and aquatic exercises, promote improvements in a variety of outcomes in KOA individuals, including flexibility, pain, body composition, physical function, fatigue, sleep, quality of life, but the degree of improvement depends on the progression of the exercise and the use of proper dosage.
Although physical exercises are crucial in managing KOA, individuals do not always receive proper advice. Note that Inam and colleagues (39) concluded that even though the association of physical exercise with body-mass loss is recommended for KOA individuals, only a small portion of patients receives guidance regarding physical exercises. Additionally, most participants were willing to exercise if adequately advised (39). For this reason, health professionals should prescribe physical exercises.
The strength of this systematic review is providing an important data for health professionals engaged in KOA rehabilitation. It encourages using physical exercises as a therapeutic strategy to improve flexibility in older KOA individuals. Thus, increasing flexibility contributes to a better functional capacity of KOA individuals by reducing pain and the risk of injury. In perspective, the rehabilitation programs should include more exercises to enhance the flexibility.
The limitations of the study are related to the small number of studies that met the selection criteria. Furthermore, the included studies have limitations, such as heterogeneous samples and interventions. However, the current investigation presented essential findings on the benefits of physical exercises in improving flexibility in older KOA individuals.

Conclusion

Different modalities of physical exercise can improve the flexibility of older KOA individuals. However, more studies with better methodological quality are needed to increase the available knowledge on this topic. The health professionals engaged in KOA rehabilitation can use physical exercise as an intervention strategy to improve the functional capacity of older KOA individuals.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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