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Table 1. Methodological quality assessment of studies with AMSTAR 2 tool.

Studies	AMSTAR 2 ITEMS																
	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**	**OC**
Allen et al., 2021[27]	N	P	Y	P	Y	Y	P	N	Y	N	NMAC	NMAC	Y	N	NMAC	Y	C. Low
Al Attar et al., 2017[42]	Y	Y	Y	P	Y	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	Low
Bautista et al., 2021[28]	Y	Y	Y	P	N	N	Y	P	N	N	Y	Y	Y	Y	N	N	C. Low
Buskard et al., 2018[29]	Y	N	N	N	N	N	P	Y	N	N	N	N	N	Y	N	N	C. Low
Cullinane et al., 2014[30]	Y	P	Y	P	N	N	Y	N	N	N	NMAC	NMAC	Y	N	NMAC	Y	C. Low
Cuthbert et al., 2020[31]	Y	P	Y	P	N	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	C. Low
Dominguez-Romero et al., 2021[52]	Y	P	Y	P	N	Y	P	Y	Y	N	NMAC	NMAC	Y	Y	NMAC	Y	High
Douglas et al., 2017[32]	Y	N	N	P	N	N	Y	P	N	N	NMAC	NMAC	N	Y	NMAC	Y	C. Low
Ellis et al., 2015[6]	N	P	Y	P	Y	Y	P	P	P	N	NMAC	NMAC	N	Y	NMAC	Y	Low
Emirzeoğlu et al., 2021[33]	N	P	Y	P	N	N	Y	N	N	N	NMAC	NMAC	N	N	NMAC	N	C. Low
Frizziero et al., 2014[34]	N	P	Y	P	N	N	Y	N	N	N	NMAC	NMAC	Y	Y	NMAC	N	C. Low
Gérard et al., 2020[53]	Y	P	Y	P	Y	Y	Y	P	Y	N	Y	Y	Y	Y	Y	N	High
Goode et al., 2015[17]	Y	P	Y	P	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Low
Hibbert et al., 2008[43]	N	P	Y	Y	Y	Y	Y	P	Y	N	NMAC	NMAC	Y	Y	NMAC	N	Low
Karagiannis et al., 2017[44]	Y	P	Y	P	Y	Y	P	Y	Y	N	Y	N	Y	Y	N	Y	Low
Kulkarni et al., 2021[21]	Y	P	Y	P	Y	Y	Y	Y	Y	N	NMAC	NMAC	Y	Y	NMAC	Y	High
Larsson et al., 2019[47]	Y	Y	Y	P	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Low
Lim & Wong, 2018[35]	N	Y	Y	P	Y	Y	Y	N	N	N	NMAC	NMAC	Y	Y	NMAC	Y	C. Low
Liu et al., 2020[54]	Y	Y	Y	P	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Molinari et al., 2019[55]	Y	Y	Y	P	Y	Y	Y	P	Y	N	Y	Y	Y	Y	Y	N	High
Muniz Medeiros et al., 2021[45]	Y	Y	Y	P	Y	Y	Y	P	Y	N	Y	Y	Y	Y	N	N	Low
Murphy et al., 2019[22]	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	C. Low
Nuñez Sanchez & De Villarreal, 2017[36]	N	N	Y	P	Y	Y	P	N	N	N	N	N	N	N	N	N	C. Low
O'Sullivan et al., 2012[37]	Y	P	Y	P	Y	Y	P	N	Y	N	NMAC	NMAC	Y	N	NMAC	Y	C. Low
Ortega-Castillo and Medina-Porqueres, 2016[48]	Y	P	Y	P	Y	Y	Y	P	P	N	NMAC	NMAC	Y	N	NMAC	Y	Low
Petré et al., 2018[38]	N	P	N	P	N	N	P	N	N	Y	N	N	N	N	N	Y	C. Low
Raman et al., 2012[49]	Y	P	Y	P	Y	Y	Y	Y	Y	N	NMAC	NMAC	Y	N	NMAC	N	Low
Raya-González et al., 2021[39]	N	P	Y	P	Y	Y	P	N	Y	N	NMAC	NMAC	N	N	NMAC	Y	C. Low

Raya-González et al., 2021[46]	Y	P	Y	P	Y	Y	Y	P	Y	N	Y	Y	N	Y	N	N	Low
Roig et al., 2009[23]	Y	P	Y	P	Y	Y	Y	P	Y	Y	Y	N	N	Y	N	Y	Low
Roig et al., 2008[40]	N	P	N	Y	Y	Y	Y	P	Y	Y	NMAC	NMAC	N	Y	NMAC	N	C. Low
Schoenfeld et al., 2017[41]	N	N	Y	P	Y	Y	Y	N	N	N	N	N	N	N	Y	Y	C. Low
Wasielewski & Kotsko, 2007[50]	Y	P	Y	P	N	N	Y	P	P	N	NMAC	NMAC	Y	N	NMAC	N	Low
Woodley et al., 2007[56]	Y	P	Y	P	N	N	Y	Y	Y	N	NMAC	NMAC	Y	Y	NMAC	Y	High
Yoon et al., 2021[51]	Y	P	Y	P	Y	Y	Y	P	Y	N	Y	N	N	Y	N	Y	Low

1. Did the research questions and inclusion criteria for the review include the components of PICO?; 2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?; 3. Did the review authors explain their selection of the study designs for inclusion in the review?; 4. Did the review authors perform study selection in duplicate?; 5. Did the review authors perform study selection in duplicate?; 6. Did the review authors perform data extraction in duplicate?; 7. Did the review authors provide a list of excluded studies and justify the exclusions?; 8. Did the review authors describe the included studies in adequate detail?; 9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?; 10. Did the review authors report on the sources of funding for the studies included in the review?; 11. If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?; 12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?; 13. Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review?; 14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?; 15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?; 16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review? The rating of overall confidence (OC) was categorized, depending on fulfilled criteria: high (no or one non-clinical weakness), moderate (more than one non-clinical weakness; multiple non-critical weaknesses may diminish confidence in the review, and it may be appropriate to move the overall appraisal down from moderate to low confidence), low (one clinical flaw with or without non-clinical weaknesses), and critically low (more than one clinical flaw with or without non-clinical weaknesses). Selected critical domains are items 1, 3, 8, 9, 11, 14, and 15. Y = "Yes"; N = "No"; P = "Partial Yes"; NMAC = "No meta-analysis conducted".

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Table 2. Overview of previous reviews assessing the chronic effects of eccentric exercise in patient populations.

Author	**Population**	**Number of included studies in systematic review or Meta-analysis**	**Specialties about exercise programs**	**Output variables**	**Summary of key findings**
Cullinane et al., 2014	Patients who had undergone a diagnostic test for lateral epicondylitis.	12 (0)	EE program vs different therapies.	Function, grip strength, pain.	Use of isolated EE or with an AJT improves function and grip strength to their baseline measures. Evidence supports that the use of EEs compared with other treatment therapies produces greater outcomes of pain, function, and/or grip strength than therapies without the use of EEs.

Dominguez-Romero et al., 2021	Patients with rotator cuff tendinopathy in absence of other shoulder diagnoses (adults).	8 (0)	Comparing the effectiveness of different intervention muscle-development exercises (EE versus CON or conventional exercise; home EE versus supervised EE; heavy-load EE with traditional training protocol versus only traditional training protocol…)	Shoulder function and shoulder pain.	ECC training requires 2-4 weeks to generate structural alteration (improvement of CSA) in the skeletal muscle. One study found statistically and clinically significant differences in favor of ECC training compared to a conventional exercise program. Special attention on an appropriate amount of load, rather than on the method of physical exercise used.
Ellis et al., 2015[6]	Adults with cardiorespiratory disease.	10 (0)	EE versus CE.	MS, body mobility, fitness.	Greater improvements in fitness, strength, and mobility after the EE program compared to the CE program. Fitness: heart rate, oxygen consumption (VO_2), and power output were significantly improved from baseline following EE (but no significant differences between ECC and CON exercise).
Frizziero et al., 2014[34]	Adult patients with a diagnosis of Achilles, patellar, or supraspinatus tendinopathy, lateral epicondylitis (LET), adductor-related groin pain, an ACL tear, or hamstring strains.	56 (0)	Patellar tendinopathy (EE versus other therapeutic exercise protocol or with physical therapies), Achilles tendinopathy (EE versus CE or stretching or ice or massage…).	Level of pain, functional improvement, satisfaction, or return to sport.	Isolated ECC muscle training and the Silbernagel combined protocol seem equally effective for Achilles tendinopathy treatment. EE combined with extracorporeal shock wave therapy (ESWT) is more effective than EE alone in mid-portion Achilles tendinopathy, while in insertional tendinopathy ESWT and cold air and high-energy laser therapy lead to better and longer results in VISA-A score, pain rating, and Likert scale. EE outcome for patellar tendinopathy improved from the baseline and in no case was it harmful. Evidence of effectiveness of EE in LET in comparison with other treatments is low. ACL strain, hamstring strain, adductor tendinopathy, groin pain, and shoulder tendinopathy - only 1 or 2 (in case of adductors) manuscripts for each one of them.
Karagiannis et al., 2017[44]	Adult patients with ischemic heart disease.	4 (3)	ECC training versus CON training (traditional training).	VO_{2MAX}, functional capacity.	Moderate to weak evidence of the effectiveness of ECC exercise for functional capacity for ischemic cardiac patience. Studies did not show any statistically significant differences between the levels of VO_{2MAX} after ECC training intervention or CON training intervention.

Larsson et al., 2019[47]	Adult patients diagnosed with subacromial impingement syndrome.	7 (7)	EE training versus other types of exercise (resistance/mobility/aerobic) or other interventions (massage/mobilization/manipulation/TENS/corticosteroid inactions) or other types of EE.	Pain, muscle function.	EE provides a slightly better effect on pain but not on function. Pain after 6 months or 1 year was smaller after EE intervention. Pain during exercise does not seem to provide greater improvement in pain or function compared with pain-free exercise. It seems that exercise at higher intensities might yield better results.
Lim and Wong, 2018[35]	Patients with patellar tendinopathy.	10 (0)	EE versus passive interventions, CE or isometric exercise, or heavy slow resistance training.	Pain, function for patellar tendinopathy.	The 4-week EE program was superior in reducing pain than passive interventions. Improving in function for all EE groups to a similar or greater extent compared with other intervention programs. Isometric exercise provides better acute or short-term pain reduction, while EE is showing greater results for chronic or long-term pain reduction (up to 1 year).
Murphy et al., 2019[22]	Patients with Achilles tendinopathy for greater than 3 months.	7 (6)	Heavy ECC calf training (HECT) vs natural history (wait-and-see group) or traditional physiotherapy (massage, US) or sham interventions (placebo) or heavy slow resistance training.	Pain, function.	Better results of rehabilitation with HECT protocol may be observed, compared to natural history or traditional physiotherapy ("may" - lack of strong evidence which can be provided by more research-oriented articles with greater test battery).
Ortega-Castillo and Medina-Porqueres, 2016[48]	Adult participants with a clinical diagnosis of epicondylar tendinopathy or shoulder impingement.	12 (0)	EE versus other therapeutic interventions.	Pain, strength.	EEs are effective for upper limb tendinopathies treatment. Its superiority against other methods (isotonic exercise, CE, natural therapy, contraction-relax-stretching exercises, physiotherapy - Cyriax massage and Mill's manipulation, traditional treatment - internal and external shoulder rotation with TheraBand, or unspecific mobility exercises - neck and shoulder) is not totally clear.
Raman et al., 2012[49]	Patients with lateral epicondylitis.	11 (0)	Resistance exercises versus AJT (heat, ice, bands, stretching) or other physiotherapy interventions (US, cross-friction massage, TENS, Cyriax physiotherapy, bioptron light).	Pain, function, strength.	The study showed that the supervised isotonic EE program produced the largest effect in the reduction of pain in the improvement of function and improvement of pain-free grip strength (moderate evidence of research). Effects of ECC programs are the same regardless of the duration of symptoms.

Roig et al., 2008[40]	Adult populations with different chronic health conditions (coronary artery disease, Parkinson's disease, stroke, obstructive pulmonary disease, osteoarthritis).	9 (0)	EE (+ dynamic and isometric exercises) versus dynamic and isometric exercises alone; ECC cycling versus CON cycling (in both they used ether calisthenics/stretching/relaxation/walking/lifting weights upper extremities) ECC isokinetic versus CON isokinetic.	Muscle function, MS.	During ECC muscle actions, skeletal muscle generates greater levels of force, with a reduced metabolic, hemodynamic, and cardiorespiratory cost, than CON contractions. ECC actions can be used to restore musculoskeletal function without stressing the cardiopulmonary system.
Wasielewski and Kotsko, 2007[50]	Adult participants with a clinical diagnosis of tendinosis.	11 (0)	Isotonic EE (+ with or without other therapeutic interventions) versus CE or AJT (night splinting or nonthermal US or friction massage).	Pain reduction, functional improvement.	EE was more effective than splinting, friction massage, and nonthermal US but no more effective than no treatment during the competitive athletic season (while training). 12 weeks of EE reduced tendinosis-related pain and stimulated collagen synthesis but did not change the rate of collagen degradation (EE may strengthen the tendon and protect it from subsequent overuse).
Woodley et al., 2007[56]	Adult patients with Achilles tendinopathy, patellar tendinopathy, lateral epicondylitis tendinopathy.	11 (0)	EE program versus CE programs or other physiotherapy and AJT interventions (stretching/US/ friction massage/splints).	Pain, function, satisfaction/return to activity.	Limited level of evidence: EE reduces pain in patellar tendinopathy at the 12-week stage of treatment when compared to CE; EE is effective on satisfaction/return to activity in patellar tendinopathy. Limited level of evidence: an increase in function using EE compared to US in the treatment of lateral epicondylitis. Results of patients who returned to activity were more positive for EE compared to CE (with moderate evidence). Limited level of evidence: in Achilles tendinopathy limited evidence supporting EE compared to CE and US.
Yoon et al., 2021[51]	Patients with lateral elbow tendinopathy.	6 (6)	EE versus CON or isotonic exercises or other physiotherapy and AJT interventions (US, ice, massage, stretching, bands).	Pain reduction, strength, functional improvement.	EE combined with AJT (US, brace, stretching, ice, or massage) showed beneficial effects of pain reduction and MS improvement. The EE showed better effects on pain reduction compared to other strengthening exercises. The differences in MS and function between the groups were not significant (EE versus other exercise protocols).

ECC – eccentric; CON – concentric; EE – eccentric exercise; CE – concentric exercise; MS – muscle strength; AJT – adjuvant therapy; US – ultrasound; CSA – cross-sectional area.

Table 3. Overview of previous reviews assessing the chronic effects of eccentric exercise in athlete population.

Author	Population	Number of included studies in systematic review or Meta-analysis	Specialties about exercise programs	Output variables	Summary of key findings
Allen et al., 2021[27]	Healthy soccer players of various training levels.	11 (0)	FLY training versus normal soccer training or CON loaded exercise or plyometric training or resistance CON with plyometric training.	MS, muscle power, sprint, COD and jump performance, agility performance.	By using of FLY device, we can report higher electromyographic activity, improved sprint, COD (in male soccer players), agility (T-Test agility, Y-agility), and jumping performance (jumping ability), and hypertrophic adaptations. FLY training can effectively improve CON and (especially) ECC isokinetic knee flexor strength. FLY training increased muscle power and produces greater storage of elastic energy which can provide greater force output during jumping and COD performance.
Al Attar et al., 2017[42]	Football players (only 1 study included women).	5 (5)	NHE (inside of warm-up program) versus usual warm-up program or traditional only dynamic warm-up.	Risk of hamstring strain injury.	Integrating NHE (alone or in conjunction with other EEs for knee flexors) in warm-up decreases the probability of hamstring strain injury for football players. The integration of NHE decreased the risk of injury by 51%.
Bautista et al., 2021[28]	Team sports players.	20 (7) [sprint performance) + 13 (ES)]	NHE versus current training dynamics or performed another type of intervention (sprint intervention…).	Sprint performance, ES, FL.	NHE resulted in an improved sprint performance by 0.04 s [0.01s, 0.08s] and improvement of ES of knee flexors. There was a moderate relationship between ES of knee flexors (KF) and 20 m sprint performance. A small amount of training (32 repetitions per week) was as effective as a high number of repetitions per week to increase m. biceps femoris FL and ES_{KF} for recreationally active males. Well-trained individuals' improvements in ES of KF were less consistent, although the effect size was similar. Individuals with greater body mass may benefit more from the use of the NHE for ES development of the KF. Body mass explained more than 90% of the variance in the effect size of ES_{KF} in well-trained team sport players. ES_{KF} effects on sprint performance in well-trained team sport players.

Buskard et al., 2018[29]	Sport students with little to no resistance training experience (3-4x) + people with a minimum of 2 years continuous RT participation.	5 (5)	Supramaximal ECC training vs CE.	MS.	Supramaximal ECC training didn't appear to be more effective than traditional methods at improving lower-body CON 1RM.
Cuthbert et al., 2020[31]	Professional/recreational/amateur athletes and healthy young adults.	12 (12) [sprint performance) + 13 (ES)]	Interventions that included NHE.	ECC hamstring strength and m. biceps femoris architecture (PA and FL).	Both (high and low) volume prescriptions can produce large-to-very large improvements in strength (ECC torque and ECC force) and muscle architecture (PA and FL) over a minimum duration of 6 weeks. A reduction in overall training volume does not necessarily mean a negative effect (the focus needs to be on allowing the intensity of the exercise to increase, as would occur in traditional strength training - important: keeping the training volume constant, to allow them to slowly produce force over a greater range of motion). Lower the training volume but keep it constant after that.
Goode et al., 2015[17]	Athletes with risk of incurring hamstring injuries (not participating in a hamstring rehabilitation program) and without a history of a hamstring injury.	4 (4)	FLY ergometer versus training without FLY hamstring exercise intervention; NHE versus stretching or normal, CON training protocol.	Risk of a hamstring injury.	ECC hamstring strengthening provides a significant and strong 65% decreased risk of a hamstring injury. Evidence is inconclusive because of decreased intervention compliance which was connected to effects of delayed onset muscle soreness (DOMS).
Hibbert et al., 2008[43]	Athletes or senior athletes with or without acute/chronic hamstring strain.	7 (0)	EEs (+ with extra shapes of intervention) versus other exercise programs (+ with or without stretching); Isokinetic ECC (or combined CON-ECC) training versus isokinetic CON training;	Incidence of the injury, severity of the injury.	EEs are effective training protocols to reduce the incidence and subsequent recurrence of hamstring strains. EEs decreased the incidence of hamstring strains, but no significant difference in severity of the injury. The coupling of ECC training with other interventions may have limited or beneficial effects on the incidence and severity of hamstring strains.

			ECC group without a control group.		
Raya-González et al., 2021[46]	Healthy adults who are experienced in strength training.	9 (9)	FLY resistance training versus control group (traditional resistance training).	COD, jumping, sprinting performance.	Sprinting time decreased following FLY resistance training. Jumping ability showed a significant moderate effect (0,65) after FLY resistance training interventions (2-3 times per week). COD's improvements were significant. Increases in MS, muscle size and greater forces are achieved during the ECC muscular action. Greater velocities of the ECC phase of the movements are also responsible for performance improvements after FLY resistance training.

ECC – eccentric; CON – concentric; EE – eccentric exercise; CE – concentric exercise; ES – eccentric strength; MS – muscle strength; NHE – Nordic hamstring exercise; FLY – flywheel; COD – change of direction; FL – fascicle length; PA - pennation angle.

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Table 4. Overview of previous reviews assessing the chronic effects of eccentric exercise in the older adult population.

Author	**Population**	**Number of included studies in systematic review or Meta-analysis**	**Specialties about exercise programs**	**Output variables**	**Summary of key findings**
Kulkarni et al., 2021[21]	Healthy participants aged over 60 years.	10 (0)	EE (maximal ECC contraction, FLY resistance exercise training, CON-EE, ECC resistance training without equipment) versus no exercise intervention or CE.	Balance, mobility, endurance, the incidence of falls.	ECC-biased exercises exhibit significant improvements in balance, mobility, and endurance in healthy older adults. Hardly any significant differences were observed between ECC and CON intervention. The reduction in the incidence of falls was greater in response to CE than to EE. A duration as short as about 6-12 weeks of regular EE seems sufficient to illustrate its beneficial effects.
Molinari et al., 2019[55]	Older adults with the absence of any pathology that could interfere with the effects of the training.	6 (6)	ECC-focused training (the main feature was an emphasis of the ECC phase) versus conventional strength training (combination of CON and ECC actions in exercise protocol).	MS.	All studies presented a large effect size for the ECC-focused training evaluated in the pre vs. post-training comparison for MS, whereas at the conventional strength group, 2 studies had a moderate effect size. Different morphological adaptations were seen between EE versus CON and isometric exercise, due to an addition of sarcomeres in series and parallel, increasing CSA, which is observed in the ECC training.

ECC – eccentric; CON – concentric; EE – eccentric exercise; CE – concentric exercise; MS – muscle strength; FLY – flywheel; CSA – cross-sectional area.

Table 5. Overview of previous reviews assessing the chronic effects of eccentric exercise in other populations.

Author	Population	Number of included studies in systematic review or Meta-analysis	Specialties about exercise programs	Output variables	Summary of key findings
Douglas et al., 2017[32]	Patients who had undergone a diagnostic test for lateral epicondylitis.	40 (0)	ECC training vs CON or traditional resistance training.	MS, muscle power, muscle stretch-shortening cycle performance, muscle hypertrophy, FL, CSA, exercise-induced muscle damage.	Heavier ECC load provides greater increases in ES than CON or traditional resistance training. Muscle contraction velocity, muscle, and tendon strength, and increase of muscle power (rate of force development) can increase greater by fast versus slow ECC training. Leg sprinting stiffness has been found to increase greatly following ECC training. Stretch-shortening cycle performance also appears to improve to a greater extent with especially fast ECC training. A greater increase in distal muscle size of especially fast-twitch muscle fibers (hypertrophy) has been found with ECC training, especially heavier ECC training, while fast ECC velocities also induced a larger increase in muscle CSA (CSA). The increase in FL was greater with ECC training. It also provided a greater propensity for exercise-induced muscle damage.
Emirzeoğlu et al., 2021[33]	Any adults	12 (0)	NHE or razor hamstring curl or EE on isokinetic dynamometer versus control group without problems (same exercises) or same exercises with different intensity or progression.	Muscle architecture (CSA, muscle thickness, PA, FL).	Regardless of duration, frequency, number of sets, and a number of repetitions in a training session or in total, ECC training increases FL of the biceps femoris muscle, but a greater increase was found with studies where patients made a greater number of repetitions per training session (not the duration of the training program). Progressive training leads to a greater increase in FL just like muscle potion, the intensity of training, and the training method. Great decrease in PA; a greater number of repetitions per training session may contribute to longer maintenance of the reduced PA after training. Muscle thickness (MT) increased just for the first 4 weeks of interventions. If the average number of repetitions in each training session is increased, there may be an increase in MT after 4 weeks. ECC training significantly increases CSA, especially in them. biceps femoris - short head and semitendinosus muscles (even in a single session).

Gérard et al., 2020[53]	Healthy adults (18-50 years of age).	10 (9)	EE for long head of m. biceps femoris (NHE, knee-flexion exercise, hamstrings curl, hip-extension exercise) versus CE or normal activity or no activity.	FL, muscle thickness, PA, ECC hamstring strength.	Hamstring FL increased in the ECC group when NHE (NHE) was administered before field training (only before, not after). Muscle thickness increased in the ECC group when the NHE was administered after field-training sessions (only after training). PA increased in the ECC group when the NHE was administered after field-training sessions (only after training). ES training more effectively increased ECC hamstring strength (before and after field training) than CON training which reduced hamstring strain injuries after the protocol.
Liu et al., 2020[54]	Healthy individuals without a history of injury.	11 (10)	ECC overload training versus other types of training (basic handball training, squats...).	COD speed performance.	The ECC overload training group was 1,35 standard deviations shorter than in the control group, so it provided a better COD speed performance.
Muniz Medeiros et al., 2021[45]	Healthy adults.	12 (9)	NHE versus no intervention or CE.	MS, FL.	NHE (NHE) enhance both KFs ES and biceps femoris long head FL. NHE training generated significant increases in ES in all studies. NHE training promoted significant increases in the biceps femoris long head FL (even in low-volume programs).
Nuñez Sanchez & De Villarreal, 2017[36]	Healthy participants.	35 (13)	ECC overload training in the FLY system versus CE or other systems/devices.	Muscle volume, MS.	The effect size of muscle volume of the experimental group was significantly higher compared with the effect size of the control group (ECC contractions cause greater muscle damage, which increases the production of muscle fiber proteins, and therefore, greatly increases muscle hypertrophy compared with CON contractions). The increase in strength was significantly higher with the existence of ECC overload during the exercise. Negative correlation between age and the size of the effect produced by increased muscle mass after training processes.
O'Sullivan et al., 2012[37]	Adults with or without a history of injury.	6 (0)	EE versus CE or static stretching or mixed CON/ECC.	Muscle FL, joint range of motion.	ECC training is effective at increasing lower limb flexibility - muscle FL (the effect was consistent across different muscle groups - quadriceps, hamstring, and calf). Increase in joint range of motion for all observed muscles (the effect was consistent again - hamstring, calf, quadriceps).

Petré et al., 2018[38]	Healthy men and women (without age-restriction).	20 (20)	FLY overload training versus non-training passive control group or conventional resistance training (free-weight strength training).	Maximal strength muscle hypertrophy (CSA, muscle volume/mass), power, functional tests (horizontal displacement, vertical displacement).	Significant increase in maximal strength with a very large effect size from pre- to post-test. Significant increase in hypertrophy in muscle CSA and muscle volume/mass with moderate effect sizes after 5-8 weeks. Significant increase in power with a large effect size. Significant improvement in horizontal and vertical displacements (decreased times) with a large effect size from pre- to post-test.
Raya-González et al., 2021[39]	Female participants.	7 (0)	FLY resistance training.	MS, power, CSA, velocity, mobility, tendon stiffness, performance (vertical and horizontal jump), FL, PA.	FLY resistance training is an effective method for increasing power, MS, physical performance such as jumping, 1-RM, isometric strength, and CON, ECC squat outputs, increase in cross-section area, positive changes in FL, and PA in healthy young females. It moderately improved isometric strength, largely improved power (of knee extensors), and very largely improved tendon stiffness, velocity, mobility, and balance in the older adults population.
Roig et al., 2009[23]	Healthy adults.	20 (10)	ECC resistance training versus CON resistance training.	MS, muscle mass.	ECC resistance training performed greater improvements in ES compared to CON training. Strength gains from ECC training tended to be more velocity-dependent. ES increased more with ECC training than CON training increased CON strength. Adaptations after ECC training are highly specific to the velocity and type of contraction. EE is more effective than CE in increasing muscle girth, and CSA.
Schoenfeld et al., 2017[41]	Healthy individuals without any direct conditions or using medicals that can impact hypertrophic response.	15 (15)	ECC actions (isokinetic dynamometer/leg-press/knee extension machine) versus CON actions.	Muscle hypertrophy (CSA).	ECC-only muscle actions resulted in greater effect size compared with CON-only actions (results did not rise to statistical significance) - a modest hypertrophic benefit with the use of ECC actions. ECC-only training produces greater type II fiber hypertrophy than CON-only training.

ECC – eccentric; CON – concentric; EE – eccentric exercise; CE – concentric exercise; ES – eccentric strength; MS – muscle strength; US – ultrasound; NHE – Nordic hamstring exercise; FLY – flywheel; COD – change of direction; FL – fascicle length; PA - pennation angle; CSA – cross-sectional area.