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Assessment of the reporting quality of resistance training interventions in randomised controlled trials for lower limb tendinopathy: A systematic review

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ABSTRACT

Objectives: 1. To describe what exercises and intervention variables are used in resistance training interventions in randomised controlled trials for lower limb tendinopathy 2. To assess completeness of reporting as assessed by the Consensus on Exercise Reporting Template (CERT) and the Toigo and Boutellier framework. 3. To assess the implementation of scientific resistance training principles. 4. To assess therapeutic quality of exercise interventions with the i-CONTENT tool.

Design: Systematic review

Data sources: We searched MEDLINE, CINAHL, AMED, EMBase, SPORTDiscus, and the Cochrane library databases.

Elligibility criteria: Randomized controlled trials that reported using resistance exercises for lower limb tendinopathies.

Results: We included 109 RCTs. Eccentric heel drops were the most common exercise (43 studies), followed by isotonic heel raises (21), and single leg eccentric decline squats (18). Reporting of exercise descriptor items from the Toigo and Boutellier framework ranged from 0-13, with an average score of 9/13, and only 7 studies achieved a full 13/13. Reporting of items from the CERT ranged from 0-18, with an average score of 14/19. No study achieved a full 19/19, however 5 achieved 18/19. Scoring for resistance training principles ranged from 1-10, with only 11 studies achieving 10/10. Reporting across studies for the i-CONTENT tool ranged from 2-7, with an average score of 5 across included studies. A total of 19 studies achieved a full 7/7 score. Less than 50% of studies achieved an overall low risk of bias, highlighting the methodological concerns throughout studies

Conclusion: The reporting of exercise descriptors and intervention content was generally high across RCTs for lower limb tendinopathy, with most allowing exercise replication. However, reporting for some tendinopathies and content items such as adherence was poor, limiting optimal translation to clinical practice.

INTRODUCTION

Lower limb tendinopathies are some of the most prevalent musculoskeletal disorders seen in clinical practice, with a concurrently high prevalence among athletes and the general population.[1] Collectively, incidence and prevalence across the general population has been found to range from 7.0-11.8 and 10.5-16.6 per 1000 people, respectively.[2 3] Prevalence of Achilles and Patellar tendinopathies is higher in elite athletes, having been reported as high as 23 and 45% in elite running and jumping athletes.[4 5] Plantar heel pain has been reported in up to 18% in a cohort of running athletes.[6] The clinical hallmarks of lower limb tendinopathies include chronic tendon pain, functional limitations, impaired athletic performance, and reduced quality of life, with a recognised impact on an individual's psychological state.[7 8] The pathological hallmarks of tendinopathy involve a disrupted healing process, characterised by neovascularisation, presence of inflammatory cells and collagen structural derangement.[9] In total, a plethora of extrinsic and intrinsic factors linked to the pathogenesis of tendinopathy have been suggested, highlighting the multifactorial and heterogenic nature of both risk and pathological state in individuals with tendinopathy.[10] Resistance training, particularly eccentric resistance training has been the recognised gold standard first-line management option for lower limb tendinopathies for several years, due to a plethora of literature highlighting positive outcomes.[11 12] Despite the existence of a significant evidence base confirming the effectiveness of various types of resistance training for improving clinical outcomes for lower limb tendinopathies, there have been no comprehensive reviews examining the quality of the content and reporting of the employed resistance training interventions, despite their widespread clinical recommendations and implementation.[13-20]

It may be regarded as a highly important objective to determine the content, quality, and scientific implementation of common resistance training interventions in lower limb tendinopathy, as despite clinical benefit reported in the short-term, long-term outcomes often remain inadequate.[21] If reporting of the description and content of resistance training programs is inadequate, then translation of interventions to clinical practice may be suboptimal.[22] In recent years, attempts have been made to improve the reporting of exercise interventions in rehabilitation research to enhance exercise reproducibility and clinical translation. This effort has included the publication of two specific reporting tools in the British Journal of Sports Medicine (BJSM): The Consensus on Exercise Reporting Template (CERT) in 2016[23] and the i-CONTENT tool in 2021.[24] The i-CONTENT tool was developed to assess the therapeutic quality of exercise interventions in randomised controlled trials (RCTs), and the CERT allows for reporting detailed descriptions of exercises and their variables such as progression and tailoring, allowing clinical replication. Another common reporting tool, known as the Toigo and Boutellier framework, addresses limitations of the previous two tools, by including mechanobiological resistance training descriptors such as rest intervals, time under tension and relative load.[25] A recent systematic review by Holden et al.[26] published in the BJSM, assessed reporting quality of exercise interventions for patellofemoral knee pain using the Template for Intervention Description and Replication (TIDieR) tool and the Toigo and Boutellier framework. The authors highlighted the poor overall reporting of exercise interventions in patellofemoral pain, which limits the clinical translational of exercise research findings and recommended that future studies should use both the CERT and Toigo and Boutellier framework in conjunction to increase comprehensiveness of reporting. Both reporting tools have been used in several systematic reviews assessing exercise content reporting in rehabilitation for musculoskeletal disorders other than lower limb tendinopathy.[27-29] However, no previous systematic reviews have been conducted assessing exercise reporting in RCTs for lower limb tendinopathies, despite recommendations that tools such as the CERT be used for reporting in tendinopathy trials.[30-32] The aims of this systematic review were to evaluate the reporting of resistance training interventions for treating lower limb tendinopathies in RCTs. The review was guided by addressing the following review objectives on specific aspects of exercise reporting within lower limb tendinopathy resistance training interventions: 1. To describe what exercises and intervention variables are used in resistance training interventions in randomised controlled trials for lower limb tendinopathy 2. To assess completeness of reporting as assessed by the Consensus on Exercise Reporting Template (CERT) and the Toigo and Boutellier framework. 3. To assess the implementation of scientific resistance training principles. 4. To assess therapeutic quality of exercise interventions with the i-CONTENT tool.

METHODS

The methods of this systematic review were guided by Cochrane guidelines and the protocol was registered a priori in the PROSPERO International Prospective register of Systematic reviews (link). The systematic review was reported in accordance with the Preferred Reporting Items for Systematic reviews and Meta-analysis (PRISMA) guidelines.[33]

Data sources

A 3-step search strategy was implemented in this systematic review. It incorporated the following: 1) a limited search of MEDLINE and CINAHL using initial keywords, followed by analysis of the text words in the title or abstract and those used to describe articles to develop a full search strategy; 2) The full search strategy was adapted to each database and applied to MEDLINE, CINAHL, AMED, EMBase, SPORTDiscus, Cochrane library (Controlled trials, Systematic reviews), and PEDro. The following trial registries were searched: ClinicalTrials.gov, ISRCTN, The Research Registry, EU-CTR (European Union Clinical Trials Registry), ANZCTR (Australia and New Zealand Clinical Trials Registry). Databases were searched from inception to December 2021. 3) For each article located in steps 1 and 2, a search of cited and citing articles using Scopus and hand-searching where necessary, was conducted. Studies published in a language other than English were only included if a translation was available as translation services were not available to the authors.

Inclusion/exclusion criteria

The review included adults aged eighteen years or older with a diagnosis of a lower limb tendinopathy for any time duration. All lower limb tendinopathies were included, such as gluteal, hamstring, patellar, Achilles, tibialis posterior and peroneal tendinopathy. Plantar heel pain was included as it is considered to have a similar pathophysiology to tendinopathy.[22] This review considered randomized controlled trials only for inclusion. RCTs evaluating resistance training for the treatment of lower limb tendinopathies, including any type or format were considered. Any type of resistance training, including eccentric, concentric, isotonic, isometric, plyometric, heavy slow resistance training, general strength training or combinations of these exercise types was considered. The resistance training may be used as a first or second-line intervention for tendinopathy and may be delivered in isolation or combined with other treatments. Resistance training may be delivered across a range of settings, delivered by health or exercise professionals. Resistance training interventions may be delivered in a supervised or unsupervised manner, using any methods for training progression and monitoring.

Screening

Following the search, all identified citations were collated and uploaded into RefWorks and duplicates removed. Titles and abstracts were then screened by two independent reviewers for assessment against the inclusion criteria for the review. Potentially relevant studies were retrieved in full, and their citation details imported into Covidence (Veritas Health Innovation, Melbourne, Australia). Two independent reviewers then assessed the full text of selected citations in detail against the inclusion criteria. Any disagreements that arose between the reviewers at each stage of the study selection process were resolved through discussion or by input from a third reviewer.

Main outcomes

1. Description of exercises and intervention variables used in resistance training interventions in randomised controlled trials for lower limb tendinopathy 2. Assessment of completeness of reporting of resistance training as assessed by the Consensus on Exercise Reporting Template (CERT) and the Toigo and Boutellier framework. 3. Assessment of the implementation of scientific resistance training principles (specificity, progression, overload, individualisation) and reporting of relevant prescription components (frequency, intensity, sets, repetitions) and reporting of intervention adherence. 4.Assessment of therapeutic quality of exercise interventions with the i-CONTENT tool.

Data extraction

Data were extracted from studies using data extraction tools developed specifically by the reviewers for each source type. The data extracted included specific details regarding the population, concept, context, study methods and key findings relevant to the review questions. Any disagreements that arose between the reviewers were resolved through discussion. The data extracted included dimensions such as authors, year of publication, study type, purpose, population & sample size, methods, details of resistance training intervention, specific exercises and outcome measures used. Details of the resistance training interventions included setting, mode of delivery, type, dosage, and methods used to progress and adjust the training stimulus. The contents and variables of the specific resistance training exercises were extracted using the 13-item Toigo and Boutellier framework for exercise mechanobiological description and included parameters such as repetitions, load magnitude and time under tension. General information from the resistance training interventions such as exercise supervision and delivery methods were extracted using the CERT tool. Data on the therapeutic quality of exercise interventions was extracted using the 7 item i-CONTENT tool. An evaluation of the implementation of scientific resistance training principles was also conducted, by extracting data on the principles of specificity, overload, progression, individualisation, and adherence. The definitions and criteria for these principles are provided in table 1.

Risk of bias assessment

Included studies were critically appraised by two independent reviewers at study level for methodological quality using the Cochrane risk of bias tool. Any disagreements that arose between the reviewers were resolved through discussion or with a third reviewer. The results of the critical appraisal are reported in narrative form, and in FIGURE 5. All studies meeting the inclusion criteria, regardless of their methodological quality, underwent data extraction and synthesis and were included in the review.

Data analysis

The extracted data are presented in tabular form as tables and figures, in a manner that aligns with the objective of this systematic review. A narrative summary accompanies the tabulated results and describes how the results relate to the review objectives. Completeness of information regarding the resistance training interventions are presented as the number of complete items of the CERT, Toigo and Boutellier framework, i-CONTENT tool, and resistance training principles for each study.

Figure 1: PRISMA study flow diagram

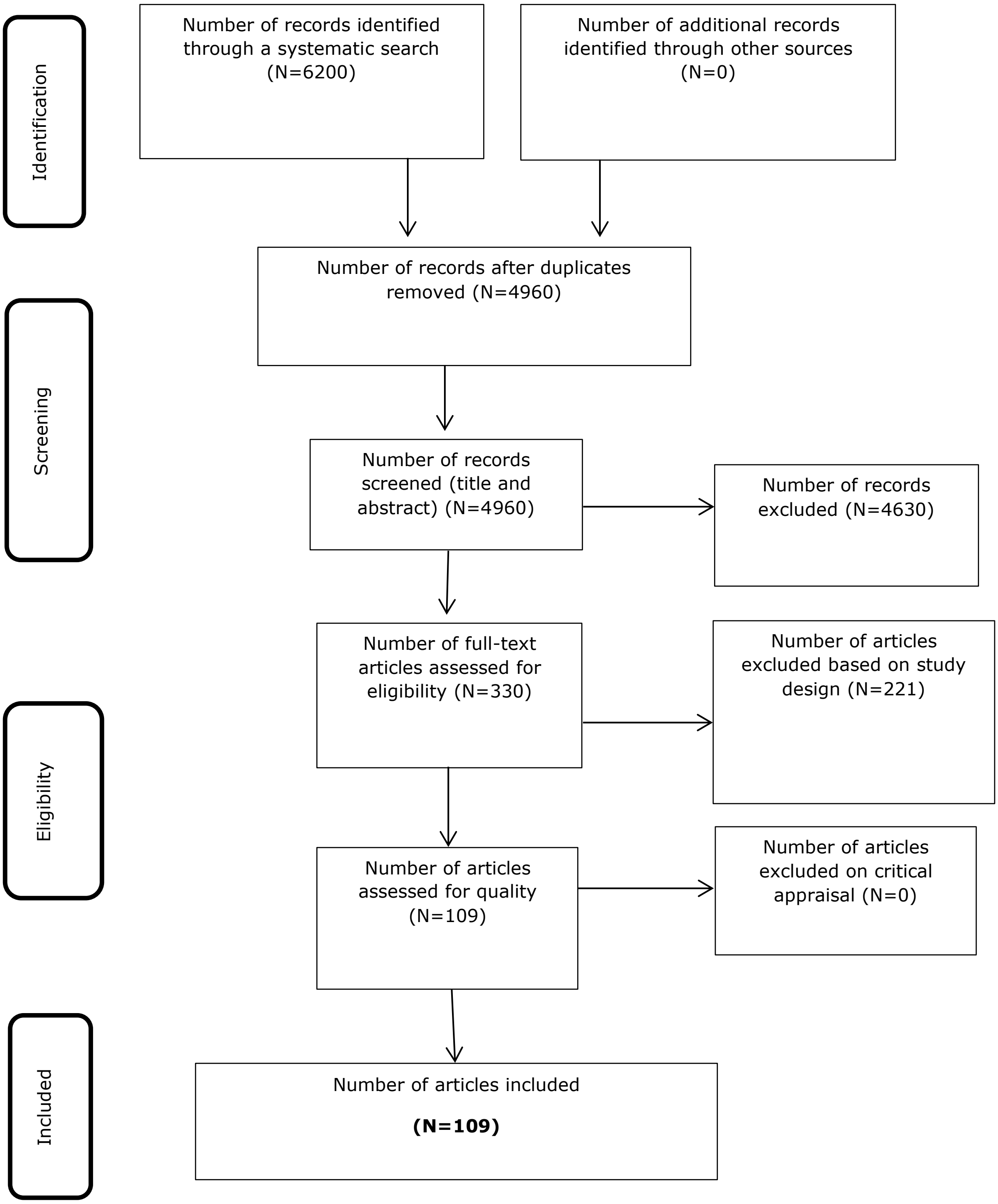

TABLE 1: Resistance training principles and training intervention criteria assessed

Principle	**Criteria for this review**
Specificity: Training and desired adaptations should be specific to the tendinopathy and relevant to desired outcomes	Appropriate population targeted and intervention designed to improve primary outcome
Progression: to allow for continuous adaptations, resistance or load must be increased providing a greater stress to the body	Training intervention was stated to be progressive with gradual increases in frequency, sets, repetitions, resistance or loading throughout intervention
Overload: for the intervention to improve strength, greater than normal stress and training volume must occur above current training levels	Interventions included baseline strength testing or rationale that intervention was of sufficient intensity and volume relative to baseline capacity
Individualisation: Training is tailored to the individual to allow for consideration of individual factors and training response	Training intervention considered methods to individually tailor exercises stimulus based on an individual's own factors or training response
Component of training	**Description**
Frequency	How many times per week or day
Intensity	Measurement method: RM, %RM, RPE, pain level
Time	Duration of session
Sets	How many sets of each exercise
Repetitions	How many repetitions of each exercise or target number of repetitions
Exercise selection	Outline and description of specific exercises used in intervention
Adherence	Was adherence to the training intervention monitored and reported?

TABLE 2: Application and reporting of key training principles

Principle/ criterion	Description		Score
Specificity	Design: have the authors designed the intervention to achieve desired outcomes? 1/10	Reporting: have the authors adequately described the intervention specificity? 1/10	2/10
Overload	Design: have the authors appropriately manipulated training variables to achieve desired outcomes? 1/10	Reporting: have the authors adequately described the intervention training variables? 1/10	2/10
Progression	Design: have the authors appropriately manipulated training variables to adequately progress the intervention? 1/10	Reporting: have the authors adequately described how intervention progression was achieved and assured? 1/10	2/10
Individualisation	Design: have the authors appropriately manipulated training variables to tailor the intervention adequately individually? 1/10	Reporting: have the authors adequately described how individually tailoring the intervention was achieved and assured? 1/10	2/10
Adherence	Design: have the authors appropriately designed and described methods for monitoring adherence? 1/10	Reporting: have the authors adequately reported individual adherence to training and training dose achieved? 1/10	2/10

RESULTS

Study characteristics

In total, 109 RCTs met the inclusion criteria and were included in the review. The publication year ranged from 1989 to 2021, with 26 RCTs (24%) being published since the year 2020. Achilles tendinopathy (51 RCTs) was the most frequently treated, followed by Patellar (35), Plantar heel pain (12), Gluteal (7), Posterior tibial (3) and Hamstring (1). Sample sizes of the included RCTs ranged from 6 to 204 and intervention duration ranged from a single session to 52 weeks, with 12 weeks being the most common duration, as implemented in 74 RCTs (68%). All the included studies evaluated the effect of the resistance training intervention on pain, with most also evaluating function outcomes using varies validated scales. Pain was assessed by a visual analogue scale (VAS) in 51 (47%) studies, and pain numeric rating scale (NRS-P) in 10 (9%) studies. Pain and function were assessed by the Victorian Institute of Sport Assessment – Achilles (VISA-A) in 35 (32%) studies, Victorian Institute of Sport Assessment – Patellar (VISA-P) in 29 (27%) studies, Victorian Institute of Sport Assessment – Gluteal (VISA-G) in 5 (5%) studies, and the Foot Function Index (FFI) in 11 (10%) studies.

Content and Completeness of Exercise Description

Eccentric training was the most common type of resistance training, implemented in 77 (71%) studies, followed by general strength exercise in 17 (16%) studies, isometric in 13 (12%) studies, heavy slow resistance training (HSRT) in 12 (11%) studies, isotonic in 11 (10%) studies, concentric in 6 (6%) studies, hip strength exercises in 4 (4%) studies and isoinertial in 1 (1%) study. In terms of specific resistance training exercises implemented in the 109 studies, the Alfredson eccentric heel-drop was the most common exercise with 43 (39%) studies implementing it, followed by isotonic heel raises in 21 (19%) studies, single leg eccentric decline squats in 18 (17%) studies, knee extension in 11 (10%) studies, leg press in 6 (6%) studies, ankle inversion in 6 (6%) studies, plyometric jump exercises in 3 (3%) studies, hip abduction in 3 (3%) studies, hip bridging in 2 (2%) studies, lunges in 2 (2%) studies, and deadlifts in 1 (1%) study.

The number of items that described the Toigo and Boutellier framework exercise descriptors ranged from 0-13 out of a possible 13, with an average score across the 194 studies of 9/13. Only 7 (6%) studies achieved a full 13/13 for reporting items from the framework.[22 36 97 111 113 115 116] Overall reporting across all 109 studies for each item is presented in FIGURE 2. Only 3 items were reported by less than 80% of studies, rest between sets (26%), time under tension (23%) and volitional muscular failure (7%). The item with the highest percentage of reporting at 95%, was the contraction mode of the exercise employed in the intervention. Of the 19 items included in the CERT, reporting among included studies ranged from 0-18, with an average score across the 109 studies of 14/19. No study achieved a full score of 19, but 5[36 53 56 113 115] (5%) studies achieved a high score of 18/19, of these, 3[36 113 115] also achieved a full score of 13/13 for reporting exercise descriptors. Overall reporting for each item in the 109 studies is presented in FIGURE 3. Most items were well reported across studies, with only 5 items being reported less than 70%; adherence measures (61%), exercise delivered as planned (45%), adverse events (41%), fidelity measured (8%) and motivation strategies (1%), with the latter two items particularly poorly reported across the studies. Previous studies assessing the completeness of CERT items in musculoskeletal rehabilitation, determined that reporting completeness of items could be regarded as high (>75%), moderate (60 to 74%) or low (< 60%).[146-147] Based on this classification, 11 items can be rated as high, 4 as moderate and 4 as low.

Out of the 7 items of the i-CONTENT tool, reporting across studies ranged from 2-7, with an average score of 5 across included studies. A total of 19[126 121 120 119 115 113 111 109 92 87 81 66 69 64 56 53 51 35 36 22] studies achieved a full 7/7 score for the i-CONTENT tool with three of these achieving 18/19 for the CERT and 13/13 for the Toigo and Boutellier framework also.[36 113 115] Overall reporting for each item across the 109 studies is presented in FIGURE 4. The item with the lowest level of reporting was adherence to the exercise program, which was only reported in 39 studies (36%). Cochrane risk of bias scores (FIGURE 5) ranged from 1 to 7, with an average score of 4 across the included 109 RCTs, and only four studies achieving a full 7/7 score.[128 93 85 86] Due to the difficulty of blinding resistance training interventions, most studies had high risk of bias for blinding and those achieving 7/7 scores were able to implement blinding as resistance training was combined with another medical treatment. Therefore, scores of 5-7/7 were considered high scores in the overall plot. Despite this, less than 50% of studies achieved an overall low risk of bias, highlighting the methodological concerns and high risk of bias throughout the included resistance training intervention studies.

Application of Resistance Training Principles

An evaluation of the implementation of scientific resistance training principles was conducted, by evaluating the design and reporting of the key principles of specificity, overload, progression, individualisation, and adherence (TABLE 1). One point each was given for the design and reporting of each of the 5 principles, with a maximum score of 10/10 available. The scoring system was based on scales used in previous reviews with the same objective.[142-144] Scoring for resistance training principles ranged from 1 to 10 across the 194 studies, with only 11 studies (10%) achieving a full score of 10/10.[38 49 54 56 77 79 81 92 110 116 121] Only one study[133] did not implement and report the principle of specificity, whereas 193 (99%) studies implemented specificity by targeting the prescribed resistance training to the specific tendinopathy with the aim to improve pain and function. The principle of overload was not adequately implemented or reported in 21 studies, with 88 (81%) studies implementing overload by progressively increasing training resistance throughout the intervention. The principle of progression was not adequately implemented or reported in 26 studies, with 83 (76%) studies implementing progression, most commonly by increasing resistance though small increases in external weight. However only 22 (20%) studies accurately reported the exact amount of weight implemented in progression increments. Incremental increases in resistance ranged from 0.9-5kg, with 5kg being the most common, implemented in 18 (17%) studies. The principle of individualisation was not adequately implemented or reported in 26 studies, with 83 (76%) studies implementing individualisation, most commonly by adjusting training resistance based on pain response as implemented in 72 (66%) studies. Other reported methods for individually tailoring training included increasing exercise difficulty in 5 (5%) studies, exercise technique in 4 (4%) studies, as much volume as possible in 2 (2%) studies, and level of fatigue in 2 (2%) studies. The principle of adherence was not adequately implemented or reported in 21 studies, with 88 (81%) studies implementing adherence, most commonly by using an individual exercise diary as reported in 54 (50%) studies. However, only 35 (32%) studies reported the percentage of participants who achieved an acceptable level of resistance training adherence, which ranged from 42.5 to 100%.

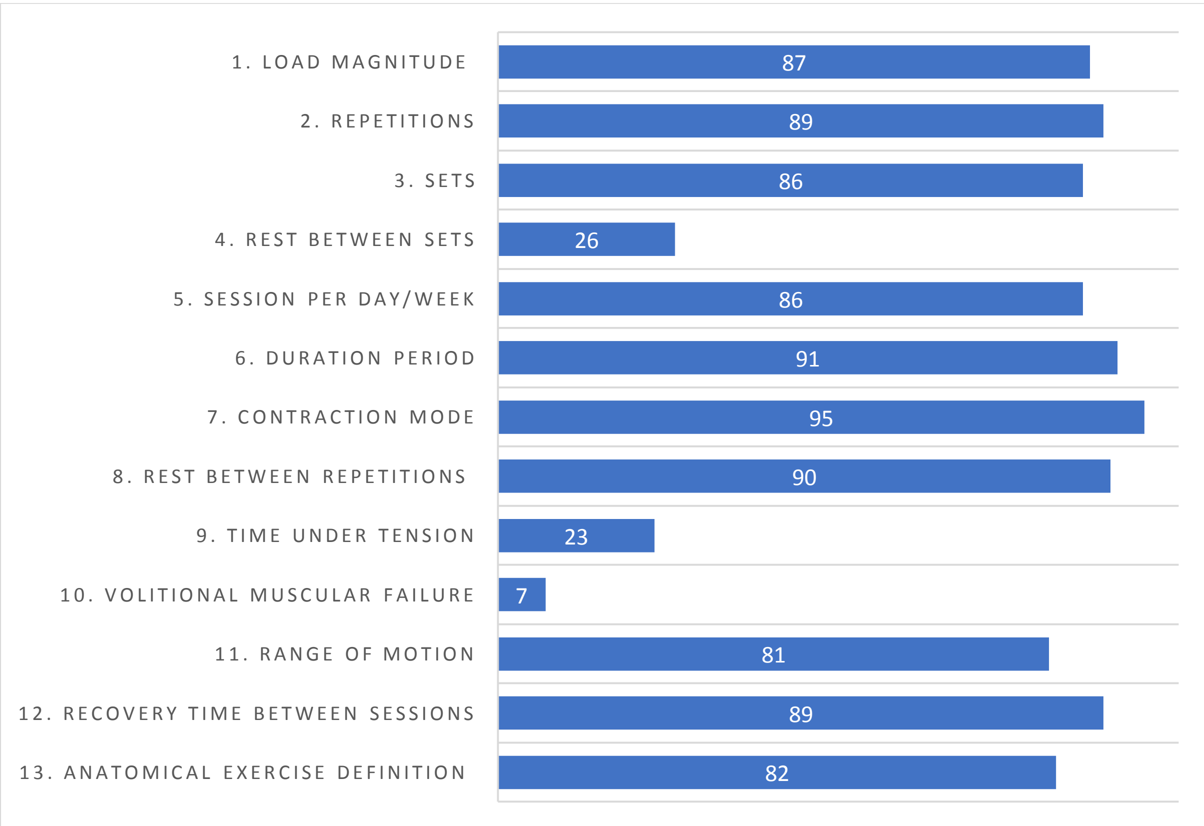

FIGURE 2: Percentage of RCTs (out of 109) with complete reporting for each item of the Toigo and Boutellier framework.

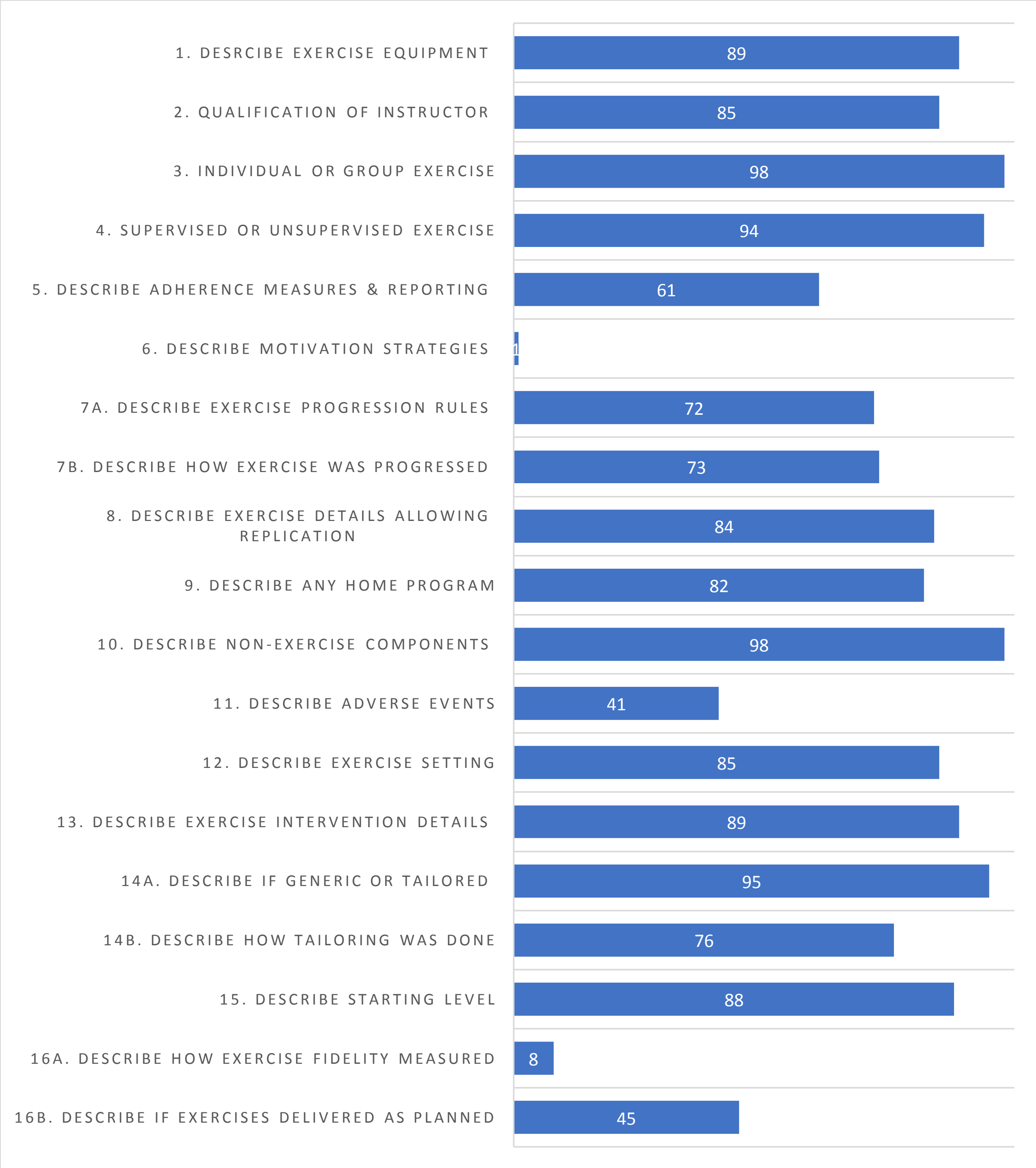

FIGURE 3: Percentage of RCTs (out of 109) with complete reporting for each item of the Consensus on Exercise Reporting Template (CERT).

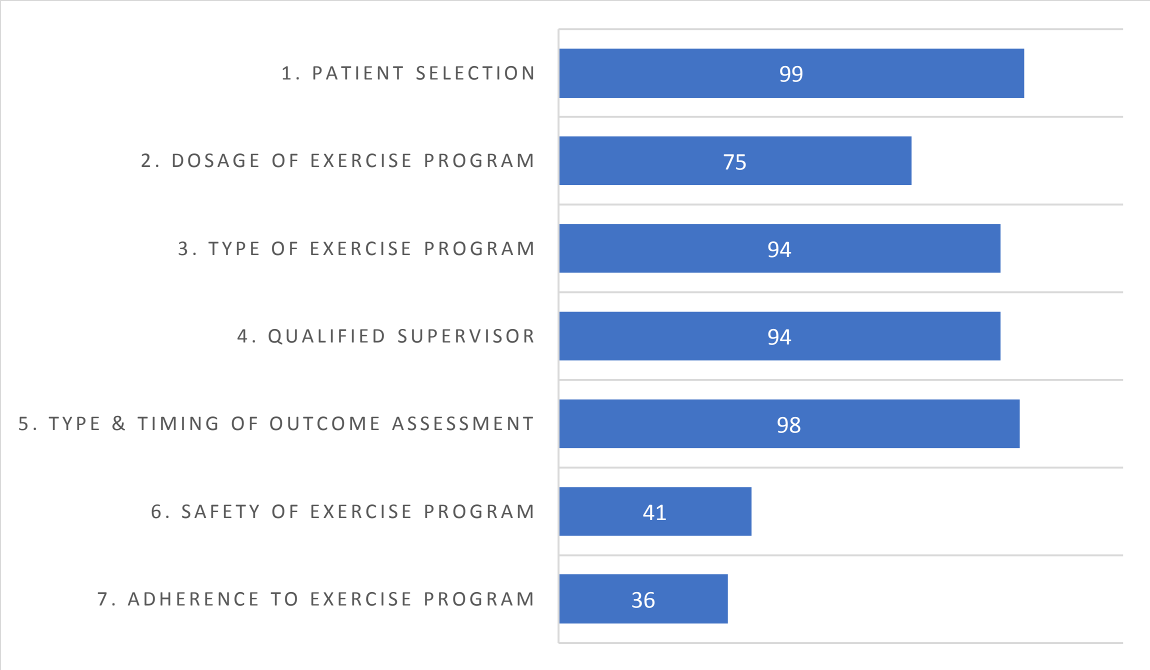

FIGURE 4: Percentage of RCTs (out of 109) with complete reporting for each item of the i-CONTENT tool.

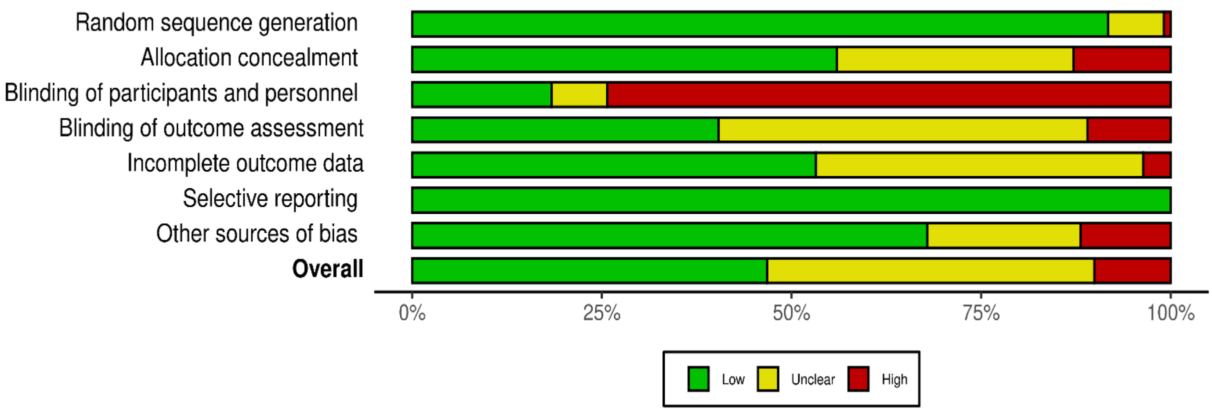

FIGURE 5: Cochrane risk of bias summary plot for the included 109 RCTs

TABLE 3: Characteristics and reporting scores of the 194 included studies

Author	Tendinopathy	Resistance training type	Resistance training exercise	TBF /13	CERT /19	RTP /10	ICT /7	ROB /7
Beyer et al.[34]	Achilles	HSRT, ECCT	Heel raises	12	17	9	6	5
Kongsgaard et al.[35]	Patellar	HSRT, ECCT	DSL squat, hack squat, leg press, squat	12	17	9	7	5
Riel et al.[22]	Plantar	HSRT	Heel raises	13	17	9	7	5
Stevens & Tan[36]	Achilles	ECCT	Alfredson heel-drop	13	18	9	7	5
Da Cunha et al.[37]	Patellar	ECCT	DSL squat	10	14	8	5	3
Kulig et al.[38]	P. tibial	Isokinetic ECCT, CONCT	Resisted adduction with plantarflexion	12	17	10	6	2
Bahr et al.[39]	Patellar	ECCT	DSL squat	11	14	8	5	3
Lee et al.[40]	Patellar	ECCT	DSL squat	11	14	9	4	2
Frohm et al.[41]	Patellar	ECCT	DSL squat	11	14	8	5	4
Silbernagel et al.[42]	Achilles	ECCT	Heel raises, plyometric heel raises	10	15	8	5	2
Balius et al.[43]	Achilles	ECCT	Alfredson heel-drop	8	10	4	5	4
Mafi et al.[44]	Achilles	ECCT, CONCT	Alfredson heel-drop	10	15	7	5	4
Norregaard et al.[45]	Achilles	ECCT	Alfredson heel-drop	10	15	9	5	4
Stasinopolous et al.[46]	Patellar	ECCT	DSL squat	10	14	7	4	4
De Vos et al.[47]	Achilles	ECCT	Alfredson heel-drop	10	16	9	6	5
Johannsen et al.[48]	Plantar	HSRT	Heel raises, inversion	3	5	2	4	6
MacDonald et al.[49]	Patellar	ECCT, ECCT + hip	DSL squat, isotonic hip exercises	10	16	8	6	2
Gatz et al.[50]	Achilles	ECCT, ECCT + Isom	Alfredson heel-drop	10	15	8	5	3
Ganderton et al.[51]	Gluteal	General strength EX	Isometric & isotonic hip exercises	10	17	9	7	5
Silbernagel et al.[52]	Achilles	General strength EX	Heel raises, plyometric heel raises	10	16	8	6	6
Clifford et al.[53]	Gluteal	Isom, Isot	Isometric & isotonic hip abduction exercises	12	18	9	7	2
Stergioulas et al.[54]	Achilles	ECCT	Heel raises	11	16	10	6	3
Rompe et al.[55]	Achilles	ECCT	Alfredson heel-drop	11	17	9	6	6
Mellor et al.[56]	Gluteal	General strength EX	Isometric & isotonic hip exercises	11	18	10	7	6
Van Ark et al.[57]	Patellar	Isot, Isom	Knee extension	12	16	8	5	3
Roos et al.[58]	Achilles	ECCT	Alfredson heel-drop	10	16	9	6	2
Chester et al.[59]	Achilles	ECCT	Alfredson heel-drop	10	15	7	6	3
Rompe et al.[60]	Achilles	ECCT	Alfredson heel-drop	10	16	8	6	6
Thijs et al.[61]	Patellar	ECCT	DSL squat	10	16	7	6	4
Horstmann et al.[62]	Achilles	ECCT	Alfredson heel-drop	11	15	7	5	4
Alfredson et al.[63]	Achilles	ECCT	Alfredson heel-drop	10	14	7	5	2
Alvarez et al.[64]	P. tibial	General strength EX	Heel raises, plantar-flexion, adduction, inversion	10	17	9	7	3
Kearney et al.[65]	Achilles	ECCT	Alfredson heel-drop	10	15	7	6	5
Tumilty et al.[66]	Achilles	ECCT	Alfredson heel-drop	10	17	9	7	6
Yelland et al.[67]	Achilles	ECCT	Alfredson heel-drop	10	17	8	6	5
McCormack et al.[68]	Achilles	ECCT	Alfredson heel-drop	10	15	5	6	3
Tumilty et al.[69]	Achilles	ECCT	Alfredson heel-drop	10	17	9	7	6
Cannell et al.[70]	Patellar	ECCT, Isot	Drop squat, knee extension & curl	11	14	8	5	3
Jonsson et al.[71]	Patellar	ECCT, CONCT	DSL squat	10	15	7	6	1
Kedia et al.[72]	Achilles	ECCT	Alfredson heel-drop	10	15	8	5	5
Herrington et al.[73]	Achilles	ECCT	Alfredson heel-drop	10	16	8	5	4
Houck et al.[74]	P. tibial	General strength EX	Heel raises, plantar-flexion, adduction, inversion	11	17	9	7	5
Dimitrios et al.[75]	Patellar	ECCT	DSL squat	11	17	8	6	3
Petersen et al.[76]	Achilles	ECCT	Alfredson heel-drop	10	16	8	6	3
Steunebrink et al.[77]	Patellar	ECCT	Alfredson heel-drop	10	15	10	6	5
Rompe et al.[78]	Achilles	ECCT	Alfredson heel-drop	11	17	8	6	5
Young et al.[79]	Patellar	ECCT	DSL squat	10	16	10	6	3
De Jonge et al.[80]	Achilles	ECCT	Alfredson heel-drop	10	14	8	5	5
Praet et al.[81]	Achilles	ECCT	Alfredson heel-drop	10	17	10	7	5

Rathleff et al.[82]	Plantar	HSRT	Heel raises	11	14	5	6	3
Knobloch et al.[83]	Achilles	ECCT	Alfredson heel-drop	10	11	2	4	4
Wheeler et al.[84]	Plantar	General strength EX	Heel raises, foot strength exercises	0	8	2	3	5
DeJonge et al.[85]	Achilles	ECCT	Alfredson heel-drop	6	11	5	4	7
De Vos et al.[86]	Achilles	ECCT	Alfredson heel-drop	6	11	5	4	7
Warden et al.[87]	Patellar	ECCT	DSL squat	10	17	9	7	6
Visnes et al.[88]	Patellar	ECCT	DSL squat	10	15	9	5	4
Van Ark et al.[89]	Patellar	Isom, Isot	Knee extension	12	14	8	5	1
Thompson et al.[90]	Gluteal	ECCT	Lunges, squats	6	10	5	5	6
Cacchio et al.[91]	Hamstring	General strength EX	Leg curls, lunge, squat, CM jumps, deadlift, hip strength exercises	8	7	4	3	5
Munteanu et al.[92]	Achilles	ECCT	Alfredson heel-drop	10	16	10	7	4
Van der Worp et al.[93]	Patellar	ECCT	DSL squat	9	16	8	6	7
Romero-morales et al.[94]	Achilles	ECCT	Alfredson heel-drop	10	15	8	4	4
Romero-morales et al.[95]	Achilles	ECCT	Alfredson heel-drop	10	15	8	5	4
Ryan et al.[96]	Plantar	General strength EX	Inversion & eversion	6	11	3	4	3
Riel et al.[97]	Plantar	Isom, Isot	Heel raises	13	14	7	5	5
Koszalinski et al.[98]	Achilles	ECCT	Alfredson heel-drop	7	10	2	4	2
Pearson et al.[99]	Achilles	ECCT	Alfredson heel-drop	1	5	7	4	3
Wang et al.[100]	Patellar	ECCT	Quadriceps & hams-tring strengthening	1	3	2	2	5
Notarnicola et al.[101]	Achilles	ECCT	NR	3	3	2	2	4
Dragoo et al.[102]	Patellar	ECCT	NR	1	5	2	4	4
Kaux et al.[103]	Patellar	ECCT	Wall squat	11	13	5	5	3
Abat et al.[104]	Patellar	ECCT	DSL squat	9	8	2	4	5
Biernat et al.[105]	Patellar	ECCT	DSL squat	10	14	7	5	2
Rio et al.[106]	Patellar	Isom, Isot	Knee extension	12	13	5	5	5
Rio et al.[107]	Patellar	Isom, Isot	Knee extension	12	16	9	6	5
Choudhary et al.[108]	Achilles	ECCT	NR	8	12	7	5	6
Cowan et al.[109]	Gluteal	General strength EX	Isometric & isotonic hip exercises	10	17	9	7	5
Habets et al.[110]	Achilles	ECCT, CONCT-ECCT	Alfredson heel-drop, heel raises	10	16	10	6	6
Ruffino et al.[111]	Patellar	HSRT, Isoinertial	Squat, leg press, knee extension, hack squat	13	17	9	7	5
Olesen et al.[112]	Patellar	HSRT	Squat, leg press, knee extension, hack squat	10	14	7	5	4
Hasani et al.[113]	Achilles	Isot	Heel raises	13	18	9	7	5
Mansur et al.[114]	Achilles	ECCT	Alfredson heel-drop	10	12	4	6	5
Sprague et al.[115]	Patellar	HSRT	Squat, leg press, knee extension, hack squat	13	18	9	7	3
Agergaard et al.[116]	Patellar	HSRT, .M-HSRT	Leg press & extension	13	17	10	6	4
Lopez-Royo et al.[117]	Patellar	ECCT	DSL squat	10	14	7	5	4
Abdelkader et al.[118]	Achilles	ECCT	Alfredson heel-drop	11	11	2	5	6
Van der Vlist et al.[119]	Achilles	ECCT	Heel raises, plyometric heel raises	12	17	9	7	4
Breda et al.[120]	Patellar	HSRT, ECCT	DSL squat, leg press, knee extension, hip strength exercises	10	17	9	7	5
Rabusin et al.[121]	Achilles	ECCT	Alfredson heel-drop	10	17	10	7	4
Solomons et al.[122]	Achilles	General strength EX	NR	1	11	6	5	3
Ramon et al.[123]	Gluteal	General strength EX	Bridging, hip abduction & extension	10	12	2	5	6
Scott et al.[124]	Patellar	HSRT	NR	1	5	2	4	5
Stefansson et al.[125]	Achilles	ECCT	Alfredson heel-drop	10	14	8	5	3
Boesen et al.[126]	Achilles	ECCT	Alfredson heel-drop	10	15	8	7	6
Chesterton et al.[127]	Plantar	General strength EX	Foot, calf & hip strength exercises	2	14	6	5	3
Rasenberg et al.[128]	Plantar	General strength EX	NR	1	0	3	2	7
Johannsen et al.[129]	Plantar	General strength EX	Heel raises, inversion	4	8	4	5	3
Thong-On et al.[130]	Plantar	General strength EX	Heel raises, inversion & eversion, toe curls	10	17	9	6	5
Cil et al.[131]	Plantar	General strength EX	Foot, ankle & hip exercises	9	10	5	5	3

Kamonseki et al.[132]	Plantar	Foot, hip Strength EX	Foot, ankle & hip exercises	10	13	5	5	4
Brown et al.[133]	Achilles	ECCT	Alfredson heel-drop	1	1	1	2	5
Niesen-Vertommen et al.[134]	Achilles	ECCT, CONCT	Heel raises	10	17	9	6	3
Jensen et al.[135]	Patellar	Isokinetic ECCT	Dynamometer heel raise	11	16	8	5	3
Yu et al.[136]	Achilles	ECCT, CONCT	Heel raises, Alfredson heel-drop	10	15	8	5	5
Wheeler et al.[137]	Gluteal	General strength EX	Hip abduction, bridging, clams	7	13	7	4	6
Zhang et al.[138]	Achilles	ECCT	Alfredson heel-drop	10	14	8	5	6
Bell et al.[139]	Achilles	ECCT	Alfredson heel-drop	7	14	6	6	6
Pietrosimone et al.[140]	Patellar	Isom	Knee extension	12	12	4	5	4
Holden et al.[141]	Patellar	Isom, Dynamic EX	Knee extension	12	13	5	5	4

Abbreviations: CERT: Consensus on Exercise Reporting Template, TBF: Toigo and Boutellier Framework, RTP: resistance training principles, ECCT: eccentric training, CONCT: concentric training, ISOM: Isometric: ISOT: Isotonic, EX: exercise, HSRT: heavy slow resistance training, , P.tibial: Posterior tibial, NR: not reported, DSL: decline single-leg, ICT: i-CONTENT tool, ROB: risk of bias.

DISCUSSION

The overall reporting of resistance training interventions in RCTs for lower limb tendinopathy was of high quality for most items on the evaluation tools used, however several common items were poorly reported across RCTs. Most studies provided enough detail to allow replication of the resistance training exercises and rehabilitation interventions, however concerns regarding reporting of adherence, fidelity, and specific progression parameters of interventions, prevents optimal clinical translation. The common areas of weakness were evident across the four different evaluation methods used, with all four highlighting the poor reporting and monitoring of adherence in resistance training interventions in RCTs. Although resistance training interventions have been found effective for lower limb tendinopathies in many of the included RCTs and are subsequently recommended in practice, the lack of reported adherence to these interventions may influence their true effectiveness and outcomes. Poor reporting of adherence and fidelity of interventions likely impacts on true clinical benefit and may prevent accurate interpretation and translation of research findings to clinical practice. Not reporting or acknowledging issues with intervention adherence may also prevent recognition of this issue as an intervention component which needs to be improved in future studies. Although most items of the Toigo and Boutellier framework were well reported, several key items were poorly reported; rest intervals, time under tension and volitional muscular failure. These mechanobiological exercise descriptors are important components related to the exercise dosage and therefore mechanical and physiological stimulus of tendons, which is well recognised as in important component of stimulating positive tendon changes.[145] The resistance training principle of progression also had poor reporting in relation to how it was implemented and with what specific loads, preventing complete clinical replication of this principle in many studies.

Despite the highlighted reporting issues, the overall high quality of reporting found in this review was better than for other musculoskeletal disorders assessed in other reviews applying tools such as the CERT and Toigo and Boutellier framework. The quality of exercise content reporting has been found to be low in exercise rehabilitation interventions for hamstring strains,[146] groin injury,[147] Achilles tendon ruptures,[29] rotator cuff disorders,[28] knee osteoarthritis,[148-149] patellofemoral pain,[26] knee injuries,[27] fibromyalgia,[150] juvenile arthritis,[151] hand osteoarthritis,[152] pelvic floor dysfunction,[153-154] low back pain,[155-156] ACL injury,[157] and femoral-acetabular impingement.[158] The only other musculoskeletal condition with comparably high levels of exercise reporting as assessed by the CERT was hip osteoarthritis, which had an average CERT score of 13/19.[159] Item 8 of the CERT was met by 84% of studies included in this review, which may be considered its most relevant item as it relates to providing enough exercise details to allow replication. In comparison reporting of this item was much lower in the reviews for hamstring strains[146] (43%), knee osteoarthritis[148] (26%), rotator cuff disorders[28] (29%), groin injuries[147] (15%), and Achilles tendon ruptures[29] (26%), highlighting the higher quality of exercise reporting and replication for lower limb tendinopathies. Despite the higher levels of overall reporting in RCTs found in this review, there was still some key areas of weakness and the previously mentioned reviews all had generally poor reporting, which suggests the lack of accurate reporting and therefore implementation of resistance training in musculoskeletal rehabilitation trials is likely a widespread problem, requiring immediate attention and addressing in future rehabilitation research. The combination of the four different, yet inter-related assessment tools: the CERT, i-CONTENT tool, Toigo and Boutellier framework and resistance training principles, alongside methodological quality assessment of RCTs, allowed for a comprehensive assessment of content and quality of resistance training interventions and deriving greater insights. The complimentary nature of the tools allowed for a more in-depth analysis of the interventions than using any tool in isolation would allow for.

Moving forward in clinical practice

The combined objectives of this review sought to identify the key prescription content of resistance training interventions for lower limb tendinopathies, therefore allowing translation of key intervention variables to clinicians which could be reproduced in clinical practice. This level of detail is commonly not provided in systematic reviews aiming to determine effectiveness, which was not an aim of this review. While most studies did provide enough details to allow both specific exercise and full intervention replication, the areas of weakness highlighted, prevents full clinical translation of many interventions employed. The supplementary material for this review provides all the extracted data and key prescription content from the interventions and can help to guide clinicians in clinical practice. Several studies scored highly across all the tools employed, so the authors recommend these as a starting point for clinicians requiring fully reproducible resistance training programs for implementing in rehabilitation for lower limb tendinopathies.

Moving forward in research

This systematic review has highlighted that despite generally high resistance training reporting standards in RCTs for lower limb tendinopathies, there are common areas of weakness which need to be improved by standardised reporting in tendinopathy research. The use of different reporting assessment tools in conjunction allowed for a comprehensive assessment of resistance training intervention reporting. However, several key elements known to influence musculoskeletal rehabilitation outcomes, such as an individual's psychological state and pain tolerance are not included in these reporting tools.[7] Therefore, the development of a more rehabilitation specific scale for implementing and reporting resistance training interventions should be explored in future research to optimise clinical translation of research resistance exercise interventions. The authors recommend that due to the multifactorial and heterogenic nature of tendinopathy, a specific tendinopathy reporting assessment tool for exercise interventions in RCTs should be investigated in future research. Recently, a consensus paper published in the BJSM, highlighted the formation of the REPORT-PFP, which aims to improve reporting of quantitative patellofemoral pain studies.[160] A similar approach appears warranted for tendinopathy research, due to the specificities of the pathology. Until such a tool exists, the authors share the recommendations of others such as Holden et al.[161] that current tools such as the CERT, Toigo and Bouellier framework and i-CONTENT tool should be used to assess exercise reporting in exercise interventions for musculoskeletal conditions such as tendinopathy.

Limitations

This systematic review has assessed a broad range of resistance training interventions, so there is therefore vast heterogeneity in findings across all the studies, so findings should be interpreted with caution. However, determining effectiveness of interventions through meta-analysis techniques was not the objective of the review, with the aims focused on the description, reporting and implementation of resistance training in interventions for lower limb tendinopathies. Only studies available in English language were included, which may introduce language bias. Although many studies included were published before the publication of the i-CONTENT (2021), CERT (2016), and Toigo and Boutellier framework (2006), there was no obvious reporting discrepancies from earlier to more recent studies, despite the culture of reporting becoming more widespread in recent years. Both scales are transparent and contain sufficient exercise details to allow 100% replication if fully followed, despite not being rehabilitation or tendinopathy specific. Most of the studies included in this review were for Achilles and patellar tendinopathies which also had the highest quality reporting, with other lower limb tendinopathies poorly represented and with comparatively poorer overall reporting quality. Therefore, the findings of this review cannot be generalised to all lower limb tendinopathies, with future research required to address the dearth of resistance training interventions for lower limb tendinopathies not involving the Achilles or patellar tendon.

CONCLUSIONS

The reporting of exercise descriptors and intervention content was generally high across resistance training interventions in RCTs for lower limb tendinopathies, with most allowing exercise replication. However, reporting for some tendinopathies and content items such as adherence was poor, limiting optimal translation to clinical practice. There is a need for standardised reporting in research investigating resistance training interventions for tendinopathy, with the combination of tools such as the CERT, i-CONTENT and Toigo and Boutellier framework advocated for allowing optimal clinical translation of interventions. Taking a comprehensive and transparent approach to exercise reporting will ensure all key elements of resistance training prescription are considered, which may optimise both clinical outcomes and clinical translation of interventions and findings.

Recommendations for research

- Future research investigating resistance training interventions for lower limb tendinopathies should follow recommended standardised reporting guidelines and tools such as the CERT, Toigo and Boutellier framework and i-CONTENT tool in combination to allow comprehensive reporting.
- Authors should be encouraged to include full details of the exercises and parameters of investigated resistance training interventions to allow their clinical replication. These details can be provided in supplementary materials or appendices if it is not possible to include them within articles.
- Researchers should consider other methods for communicating content and parameters of efficacious resistance training interventions to clinicians such as providing written and visual materials to assist translation such as training manuals, guidebooks, infographics, videos, pictures, diagrams, online platforms such as social media and websites.

What is already known?

- Resistance training interventions, particularly eccentric training have been consistently found to improve pain and function in lower limb tendinopathies.

- Resistance training loading programs are considered the gold standard first-line interventions for treating lower limb tendinopathies.
- Resistance training interventions contain several key prescription variables which can impact physiological tendon responses and clinical outcomes.

What are the new findings?

- The overall reporting detail of specific resistance exercises and their intervention parameters are generally high across RCTs for lower limb tendinopathies, with some common areas of weakness.
- Reporting of intervention adherence and fidelity is particularly poor across studies, which may influence their true clinical benefit reported in studies.
- Most resistance training interventions report enough details to allow exercise replication in clinical practice.
- We have provided guidance to clinicians in the supplementary material on the key exercise prescription details from RCTs, alongside scores of their quality to allow clinical replication in tendinopathy rehabilitation.

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APPENDICES

APPENDIX 1: MEDLINE search strategy:

1. MH tendinopathy OR MH fasciitis, plantar KW tendin* OR KW tendon* OR KW tendinopath* OR KW plantar OR KW Achilles OR KW Patellar OR KW Gluteal OR KW Greater trochanter*)

2. MH resistance training OR MH exercise OR MH physical therapy modalities OR MH physical therapy specialty OR KW physiotherapy OR KW physical therapy OR KW exercis* OR KW strength training OR KW training

3. 1 AND 2

KW: Keyword, MH: MeSH heading

Dates inception-December 31st 2021

Planned limits: English language only

APPENDIX 2: Table 4: Study characteristics & reporting scores

Author	Tendinopathy	Intervention groups	Sample size	Intervention duration (wks)	Outcomes + measures	Follow-up length (weeks)	Outcomes/ results	TBF /13	CE RT /19
RCT									
Beyer et al. 2015	Achilles	1. HSRT 2. ECCT	58	12	Pain (VAS), Function (VISA-A), Ultrasound	52	Both interventions were effective, with HSRT having greater patient satisfaction at 12 but not 52 weeks.	12	17
Kongsgaard et al. 2009	Patellar	1. CSI 2. HSRT 3. ECCT	37	12	Pain (VAS), Function (VISA-P), Ultrasound	26	All groups improved, with only exercise groups maintaining improvements at 6 months. HSRT has good short- and long-term clinical effects.	12	17
Riel et al. 2019	Plantar heel	1. fixed HSRT 2. Self-dosed HSRT	70	12	Function (FHSQ), Pain (self-efficacy), ultrasound	12	Both groups improved pain and function, with no significant differences between groups.	13	17
Stevens & Tan 2014	Achilles	1. fixed ECCT 2. Self-dosed ECCT	28	6	Pain (VAS), Function (VISA-A)	6	Both groups improved pain and function, with no significant differences between groups.	13	18
Da Cunha et al. 2012	Patellar	1. ECCT pain 2. ECCT no pain	17	12	Pain (VAS), Function (VISA-P)	12	No difference between groups, both groups improved pain and function.	10	14
Kulig et al. 2009	Posterior tibial	1. ECCT 2. CONCT 3. Orthoses	36	12	Pain (VAS), function (FFI)	12	Eccentric program was more effective than concentric or orthoses alone.	12	17
Bahr et al. 2006	Patellar	1. ECCT 2. surgery	35	12	Pain, function (VISA-P)	12	Both groups improved, no significant difference between groups. Trend favouring ECCT.	11	14
Lee et al. 2020	Patellar	1. ECCT 2. ECCT + ESWT	34	12	Pain (VAS), function (VISA-P), ultrasound	12	Combining exercise and ESWT could not been shown to be more effective than exercise alone	11	14

Frohm et al. 2007	Patellar	1. Standard ECCT 2. Overload ECCT	20	12	Pain (VAS), function (VISA-P)	12	Both treatment groups improved in the short term, with no significant difference between groups.	11	14
Silbernagel et al. 2001	Achilles	1. Overload ECCT 2. control	40	12	Pain (VAS), function, task performance	52	No significant difference between groups, at 1-year ECCT group more satisfied with outcomes.	10	15
Balius et al. 2016	Achilles	1. ECCT 2. ECCT + supplement 3. Supplement + stretching	59	12	Pain (VAS), function (VISA-A), ultrasound	12	Reduction in pain at rest was greater in the groups who took the supplement than in the ECCT alone group	8	10
Mafi et al. 2001	Achilles	1. ECCT 2. CONCT	44	12	Pain (VAS), function	12	The results after treatment with eccentric training was significantly better ($P<0.002$) than after concentric training.	10	15
Norregaard et al. 2007	Achilles	1. ECCT 2. Stretching	45	12	Manually tested Pain, function	52	Marked improvement in symptoms and findings could be gradually observed in both groups during the 1-year follow-up period.	10	15
Stasinopolous et al. 2004	Patellar	1. ECCT 2. Ultrasound 3. MT	30	4	Pain	4	ECCT was statistically significantly better than the other two treatments at the end of treatment.	10	14
De Vos et al. 2007	Achilles	1. ECCT 2. ECCT +night splint	70	12	Pain, function (VISA-A)	12	Both groups improved pain and function, with no significant difference between groups	10	16
Johannsen et al. 2019	Plantar Heel	1. HSRT 2. CSI 3. HSRT + CSI	90	12	Pain (VAS), function (FFI), ultrasound	26	Combined treatment is superior both in the short- and in the long-term.	3	5
MacDonald et al. 2019	Patellar	1. ECCT 2. ECCT + hip exercises	41	12	Pain, function (VISA-P, LEFS)	24	Favourable effects were demonstrated with combined treatment of eccentric squat and hip muscle strengthening or squat only	10	16
Gatz et al. 2020	Achilles	1. ECCT 2. ECCT + isometric	42	12	Pain, function (VISA-A),	12	Isometric exercises do not have additional benefit when combined with eccentric exercises, as assessed over a 3-month intervention period.	10	15

					shear wave elastography				
Ganderton et al. 2018	Gluteal	1. Ex 2. Sham Ex	94	12	Pain, function (VISA-G)	52	Lack of treatment effect was found with the addition of an exercise program to education	10	17
Silbernagel et al. 2007	Achilles	1. Rehab with continued sports 2. Control	38	12	Pain (VAS), function (VISA-A)	26	Significant improvement and no negative effects demonstrated from continuing Achilles tendon-loading activity, such as running and jumping, with the use of a pain-monitoring model, during treatment.	10	16
Clifford et al. 2019	Gluteal	1. isometric Ex 2. Isotonic Ex	30	12	Pain (NRS), function (VISA-G), QoL	12	Both groups effective in reducing pain and improving function, no difference between groups.	12	18
Stergioulas et al. 2008	Achilles	1. ECCT + LLLT 2. ECCT	52	8	Pain (VAS), function (VISA-A)	12	LLLT accelerates clinical recovery when added to ECCT	11	16
Rompe et al. 2008	Achilles	1. ECCT 2. ESWT	50	12	Pain, function (VISA-A)	16	ESWT superior to ECCT at 16 weeks.	11	17
Mellor et al. 2018	Gluteal	1. Ex, education 2. CSI 3. control	204	8	Pain (NRS), function (VISA-G), QoL (EQ5D), GROC	52	At 52-week follow-up, education plus exercise led to better global improvement than corticosteroid injection use, but no difference in pain intensity	11	18
Van Ark et al. 2016	Patellar	1. isotonic Ex 2. Isometric Ex	29	4	Pain (NRS), function (SLDS)	4	Both isometric and isotonic exercise programs improved pain and function	12	16
Roos et al. 2004	Achilles	1. ECCT 2. ECCT + night splint 3. Night splint	44	6	Pain, function (FAOS)	52	ECCT more effective than night splint for improving pain and function	10	16
Chester et al. 2008	Achilles	1. ECCT 2. Ultrasound	16	12	Pain (VAS), function (FILLA), QoL (EQ5D)	12	There were no significant differences between groups or clear trends over time. Both interventions proved acceptable with no adverse effects.	10	15
Rompe et al. 2007	Achilles	1. ECCT 2. ESWT 3. Control	75	12	Pain, function (VISA-A)	16	ECCT and ESWT showed comparable positive results. The wait-and-see strategy was ineffective.	10	16

Thijs et al. 2017	Patellar	1. ECCT + ESWT 2. ECCT	52	12	Pain, function (VISA-P)	12	No additional effect of ESWT to EECT for pain and function improvement.	10	16
Horstmann et al. 2013	Achilles	1. ECCT 2. Vibration training 3. control	58	12	Pain (VAS), function, tendon structure	24	Pain improvements were greatest in the eccentric group.	11	15
Alfredson et al. 1998	Achilles	1. ECCT 2. CT control	30	12	Pain (VAS)	12	Significant improvement with ECCT	10	14
Alvarez et al. 2006	Posterior tibial	1. Strength Ex + orthoses 2. Stretching + orthoses	39	12	Pain, function (FFI)	12	Both groups significantly improved in pain and function over the 12-week trial period. The self-report measures showed minimal differences between the treatment groups.	10	17
Kearney et al. 2013	Achilles	1. ECCT 2. PRP injection	20	12	Pain (VAS), function (VISA-A)	26	Both interventions effective, with PRP having better outcomes, however there was no significant difference.	10	15
Tumilty et al. 2012	Achilles	1. ECCT 2. ECCT + LLLT	40	12	Pain (VAS), function (VISA-A)	52	There was no statistically significant difference in VISA-A scores between groups.	10	17
Yelland et al. 2011	Achilles	1. ECCT 2. ECCT + prolotherapy 3. prolotherapy	43	12	Pain (VAS), function (VISA-A), costs	52	prolotherapy and particularly ECCT combined with prolotherapy give more rapid improvements in symptoms than ECT alone but long-term VISA-A scores are similar.	10	17
McCormack et al. 2016	Achilles	1. ECCT 2. ECCT + MT	16	12	Pain (NPRS), function (VISA-A)	52	ECCT + MT more effective than ECCT only at improving function during both short- and long-term follow-up	10	15
Tumilty et al. 2016	Achilles	1. ECCT 1 2. ECCT 1 + LLLT 3. ECCT 2 4. ECCT 2 +LLLT	80	12	Pain, function (VISA-A)	12	Twice-daily exercise sessions are not necessary as equivalent results can be obtained with two exercise sessions per week. The addition of LLLT can bring added benefit.	10	17
Cannell et al. 2001	Patellar	1. ECCT 2. Isotonic Ex	19	12	Pain (VAS), return to sport	12	Progressive drop squats and leg extension/curl exercises both reduced pain and enable return to sport	11	14

Jonsson et al. 2005	Patellar	1. ECCT 2, CONCT	19	12	Pain (VAS), function, (VISA-P)	12	eccentric, but not concentric, quadriceps training on a decline board, seems to reduce pain in PT	10	15
Kedia et al. 2014	Achilles	1. CT 2. ECCT + CT	36	12	Pain (VAS), function (SF36)	12	No significant differences between groups. CT and ECCT both effective.	10	15
Herrington et al. 2007	Achilles	1. ECCT + US + MT 2. US + MT	25	12	Pain, function (VISA-A)	12	ECCT + CT was more effective than CT alone for pain and function.	10	16
Houck et al. 2015	Posterior tibial	1. Orthosis + stretching 2. + strength Ex	39	12	Pain, function (FFI)	12	Both groups significantly improved in pain and function over the 12-week trial period. minimal differences between the treatment groups.	11	17
Dimitrios et al. 2012	Patellar	1. ECCT 2. ECCT + stretching	43	4	Pain, function (VISA-P)	24	ECCT and static stretching exercises is superior to ECCT alone to reduce pain and improve function	11	17
Petersen et al. 2007	Achilles	1. ECCT 2. Brace 3. ECCT + brace	100	12	Pain (VAS), function (AOFAS), QoL (SF-36)	54	The VAS score for pain, AOFAS score, and SF-36 improved significantly in all 3 groups at all 3 follow-ups, no significant difference between groups	10	16
Steunebrink et al. 2013	Patellar	1. ECCT + GTN 2. ECCT	33	12	Pain, function (VISA-P)	24	GTN + ECCT does not improve clinical outcome compared to placebo patches + ECCT	10	15
Rompe et al. 2009	Achilles	1. ECCT + ESWT 2. ECCT	68	12	Pain, function (VISA-A)	52	Combined ECCT + ESWT more effective at 4 months follow-up	11	17
Young et al. 2005	Patellar	1. ECCT step 2. ECCT decline	17	12	Pain (VAS), function (VISA-P)	52	Both groups improved pain and sporting function at 12 months. Decline squat more effective.	10	16
De Jonge et al. 2010	Achilles	1. ECCT 2. ECCT + night splint	58	12	Pain, function (VISA-A)	52	ECCT with or without a night splint improved functional outcome at 1-year. no significant difference in clinical outcome between groups.	10	14
Praet et al. 2019	Achilles	1. ECCT + collagen peptides	20	26	Pain, function (VISA-A)	26	Oral supplementation of collagen peptides may accelerate the clinical benefits of ECCT.	10	17
Rathleff et al. 2015	Plantar heel	1. HSRT 2. stretching	48	12	Pain, function (FFI)	52	HSRT superior to plantar fascia stretching for pain and function	11	14

Knobloch et al. 2008	Achilles	1. ECCT + brace 2. ECCT	116	12	Pain (VAS), function (FAOS)	12	No additional effect of heel brace to ECCT alone.	10	11
Wheeler et al. 2017	Plantar heel	1. General Ex 2. Ex + night splint	40	12	Pain (VAS), Function (FFI, FAAM)	12	Improvement in both groups, with no significant differences between groups.	0	8
DeJonge et al. 2011	Achilles	1. PRP + ECCT 2. Placebo injection + ECCT	54	12	Pain & Function (VISA-A)	52	Both groups improved with no additional benefit of PRP over ECCT	6	11
De Vos et al. 2010	Achilles	1. PRP + ECCT 2. Placebo injection + ECCT	54	12	Pain & Function (VISA-A)	24	Both groups improved with no additional benefit of PRP over ECCT	6	11
Warden et al. 2008	Patellar	1. US + ECCT 2. Placebo US + ECCT	37	12	Pain: VAS-usual, VAS-worst	12	US did not provide any additional benefit over placebo + ECCT.	10	17
Visnes et al. 2005	Patellar	1. ECCT 2. Normal volleyball training	29	12	Function (VISA-P)	26	No effect of ECCT compared with those who continued volleyball training	10	15
Van Ark et al. 2018	Patellar	1. Isometric EX 2. Isotonic EX	29	4	Tendon US, Pain (NRS), Function (VISA-P)	4	Tendon structural properties did not change in either group despite positive clinical outcomes.	12	14
Thompson et al. 2019	Gluteal	1. PRP injection + ECCT 2. Saline + ECCT	48	4	Pain (NRS)	52	No significant differences in improvements between groups.	6	10
Cacchio et al. 2011	Hamstring	1. ESWT 2. Strength Ex + stretching	40	3	Pain (VAS)	12	ESWT significantly superior to exercise for pain and function.	8	7
Munteanu et al. 2014	Achilles	1. ECCT + custom orthoses 2.	140	12	Pain (NRS), Function (VISA-A)	52	Custom orthoses no more effective than sham orthoses when combined with ECCT.	10	16

		ECCT + sham orthoses							
Van der Worp et al. 2014	Patellar	1. F-ESWT + ECCT 2. R-ESWT + ECCT	43	12	Pain (VAS), Function (VISA-P)	14	Both groups improved with no significant differences between groups.	9	16
Romero-morales et al. 2018	Achilles	1.ECCT + Vibration 2. ECCT + Cryotherapy	61	12	US Rectus anterior thickness & distance	12	ECCT + vibration superior to cryotherapy	10	15
Romero-morales et al. 2020	Achilles	1.ECCT + Vibration 2. ECCT + Cryotherapy	61	12	Pain & Function (VISA-A)	12	No significant differences between groups, both improved	10	15
Ryan et al. 2014	Plantar Heel	1. PT EX 2. CSI & stretching	56	12	Pain (VAS), Function (FADI)	12	Both groups improved, with no significant differences between groups.	6	11
Riel et al. 2018	Plantar heel	1. Isometric EX 2. Isotonic EX 3. Walking	20	3	Pain (VAS), PPI, US PF thickness	3	Isometric no better than isotonic or walking for reducing pain.	13	14
Koszalinski et al. 2020	Achilles	1. DN, MT, ECCT 2. MT, ECCT	22	4	Pain (NPRS), Function (FAAM), GROC	12	Both groups improved, with no significant difference between groups.	7	10
Pearson et al. 2012	Achilles	1. ABI + ECCT 2. ECCT	33	12	Function (VISA-A)	12	Small short-term improvement with addition of ABI to ECCT	1	5
Wang et al. 2007	Patellar	1. ESWT 2. ECCT	50	12	Function (VISA-P)	52	ESWT more effective than standard treatment including ECCT	1	3
Notarnicola et al. 2013	Achilles	1. CHELT + ECCT 2. ESWT + ECCT	60	8	Pain (VAS), Function (RMS)	26	CHELT group had quicker and better pain improvement and functional recovery.	3	3
Dragoo et al. 2014	Patellar	1. PRP, DN + ECCT 2. DN + ECCT	23	12	Pain (VAS), Function (VISA-P)	12	Addition of PRP improves short-term recovery, but no long-term difference	1	5
Kaux et al. 2019	Patellar	1. PRP +ECCT 2.HAI + ECCT	33	12	Pain (VAS), Function (VISA-P)	12	Both groups effective at medium-term, only PRP lead to pain decrease associated with strength increase	11	13
Abat et al. 2016	Patellar	1. Electro PT + ECCT 2. USGET + ECCT	60	8	Pain & Function (VISA-P)	8	USGET + ECCT had better outcomes for pain and function	9	8

Biernat et al. 2014	Patellar	1. ECCT 2. Normal training	28	12	Pain & Function (VISA-P)	24	ECCT group superior for pain and function improvement	10	14
Rio et al. 2015	Patellar	1. Isometric EX 2. Isotonic EX	6	Single session	Pain (SLD squat, VISA-P), MVIC	Single session	A single session of isometric EX significantly reduced pain & increased MVIC compared to isotonic EX.	12	13
Rio et al. 2017	Patellar	1. Isometric EX 2. Isotonic EX	20	4	Pain (SLD squat, VISA-P)	4	Both groups reduced pain, Isometric EX had significantly greater immediate analgesic effects	12	16
Choudhary et al. 2021	Achilles	1. Nutrition SUPP + ECCT 2. Diclofenac + ECCT	40	12	Pain (VAS), US	12	Both groups improved clinical outcomes, Nutrition SUPP + ECCT was superior.	8	12
Cowan et al. 2021	Gluteal	1.MHT + EX 2. EX + placebo 3. MHT + placebo 4. Placebo	132	12	Pain & function (VISA-G), GRoC	52	MHT or placebo combined with EX + education was effective for improving clinical outcomes.	10	17
Habets et al. 2021	Achilles	1. Alfredson ECCT 2. Silbernagel CONCT-ECCT	40	52	Pain (VAS), Function (VISA-A)	52	Both groups improved clinical outcomes, with no significant difference between groups.	10	16
Ruffino et al. 2021	Patellar	1. HSRT 2. Inertial Flywheel EX	42	12	Pain & function (VISA-P)	12	Both groups improved clinical outcomes, with no significant difference between groups.	13	17
Olesen et al. 2021	Patellar	1. HSRT + IGF-1 injection 2. HSRT + saline	40	12	Pain (VAS), Function (VISA-P)	52	Both groups improved clinical outcomes, with no significant difference between groups.	10	14
Hasani et al. 2021	Achilles	1. HI-LTUT EX 2. HI-HTUT EX 3. LI-HTUT EX 4. LI-LTUT EX	48	12	Trial measures, Pain & function (VISA-A)	12	A fully powered RCT would be feasible, with strategies to improve adherence & fidelity required.	13	18
Mansur et al. 2021	Achilles	1. ESWT + ECCT 2. ECCT	119	12	Pain (VAS), Function (VISA-A)	24	Both groups improved clinical outcomes, with no significant difference between groups.	10	12

Sprague et al. 2021	Patellar	1. HSRT + PGA 2. HSRT + PFA	15	12	Trial measures, Pain & function (VISA-P)	12	A fully powered RCT would be feasible, both groups improved clinical outcomes.	13	18
Agergaard et al. 2021	Patellar	1. HSRT 2.M-HSRT	44	12	Pain (NRS-P), Function (VISA-P)	52	Both groups improved clinical outcomes, with no significant difference between groups.	13	17
Lopez-Royo et al. 2021	Patellar	1, DN + ECCT 2. PNE + ECCT 3. ECCT	48	10	Pain (VAS), Function (VISA-P)	22	All groups improved clinical outcomes, with no significant difference between groups.	10	14
Abdelkader et al. 2021	Achilles	1. ESWT + ECCT 2. ECCT + SHAM	50	4	Pain (VAS), Function (VISA-A)	56	Both groups improved clinical outcomes, combined group had superior outcomes.	11	11
Van der Vlist et al. 2020	Achilles	1. HVIGI + ECCT 2. Placebo + ECCT	80	24	Pain & Function (VISA-A)	24	Both groups improved clinical outcomes, with no significant difference between groups.	12	17
Breda et al. 2020	Patellar	1. PTLE 2. ECCT	76	24	Pain & Function (VISA-P)	24	PTLE was superior for improving clinical outcomes compared to ECCT.	10	17
Rabusin et al. 2021	Achilles	1. Heel lifts 2. ECCT	100	12	Pain & Function (VISA-A)	12	Both groups improved clinical outcomes, heel lifts group had superior outcomes.	10	17
Solomons et al. 2020	Achilles	1. DN + EX 2. Sham DB + EX	52	12	Pain & Function (VISA-A)	52	Both groups improved clinical outcomes, with no significant difference between groups.	1	11
Ramon et al. 2020	Gluteal	1. F-ESWT + EX 2. Sham + EX	103	4	Pain (VAS), Function RMS), Harris hip score	26	F-ESWT combined with EX was superior for improving clinical outcomes, with a success rate of 87% at last follow-up.	10	12
Scott et al. 2019	Patellar	1. LR-PRP + HSRT 2. LP-PRP + HSRT 3. Saline + HSRT	57	6	Pain & Function (VISA-P), GRoC	52	PRP injections + HSRT no more effective than saline + HSRT for improving clinical outcomes.	1	5
Stefansson et al. 2019	Achilles	1. PM 2. ECCT 3. Both combined	60	4	Pain & Function (VISA-A)	24	All groups improved clinical outcomes, with no significant difference between groups.	10	14

Boesen et al. 2017	Achilles	1. HVIGI + ECCT 2. PRP + ECCT 3. Saline + ECCT	60	6	Pain (VAS), Function (VISA-A)	24	Treatment with HVIGI or PRP, with ECCT was more effective for improving clinical outcomes compared to saline + ECCT.	10	15
Chesterton et al. 2021	Plantar heel	1. Advice 2. Advice + EX 3. Advice + orthoses 4. Advice, EX & orthoses	82	12	Pain (NRS-P), Function (FFI), trial measures	12	A fully powered RCT would be feasible	2	14
Rasenberg et al. 2020	Plantar heel	1. Education + EX 2. Education, EX, insoles 3. Education, EX, sham insoles	185	12	Pain (NRS-P), Function (FFI),	12	All groups improved clinical outcomes, with no significant difference between groups.	1	0
Johannsen et al. 2020	Plantar heel	1. Surgery + strength EX 2. CSI + strength EX	30	12	Pain (VAS), Function (FFI)	104	Surgery + strength EX was superior for improving clinical outcomes.	4	8
Thong-On et al. 2019	Plantar heel	1. stretching 2. Strength EX	84	8	Pain (VAS)	8	Both groups improved clinical outcomes, with no significant difference between groups.	10	17
Cil et al. 2019	Plantar heel	1. Outpatient RX 2. Home EX	47	8	Pain (VAS), Function (FFI)	8	Both groups improved clinical outcomes, with the outpatient group having superior outcomes.	9	10
Kamonseki et al. 2016	Plantar heel	1. Foot EX 2. Foot & hip EX 3. Stretching	83	8	Pain (VAS), function (FAOS)	8	All groups improved clinical outcomes, with no significant difference between groups.	10	13
Brown et al. 2006	Achilles	1. Aprotinin + ECCT 2. Placebo + ECCT	26	12	Pain & Function (VISA-A)	52	Both groups improved clinical outcomes, with no significant difference between groups.	1	1
Niesen-Vertommen et al. 1992	Achilles	1. ECCT 2. CONCT	17	12	Pain (VAS)	12	ECCT was superior for improving clinical outcomes	10	17

Jensen et al. 1989	Patellar	1. Stretching 2. Stretching + Isokinetic ECCT	8	31	Pain (VAS), Quad strength	8	Quadriceps strength increased but knee pain increased with ECCT compared to healthy controls.	11	16
Yu et al. 2013	Achilles	1. ECCT 2. CONCT	32	8	Pain (VAS), muscle strength	8	ECCT was superior to CONCT for improving clinical outcomes	10	15
Wheeler et al. 2021	Gluteal	1. Max dose ESWT + Strength EX 2. Low dose ESWT + Strength EX	120	6	Pain & Function (VISA-G), Oxford hip score	26	Both groups improved clinical outcomes, with no significant difference between groups.	7	13
Zhang et al. 2013	Achilles	1. Accupunture 2. ECCT	64	8	Pain (VAS), Function (VISA-A)	24	Both groups improved clinical outcomes, with the acupuncture group being significantly superior.	10	14
Bell et al. 2013	Achilles	1. ABI + ECCT 2. Placebo + ECCT	53	12	Pain & function (VISA-A)	26	Both groups improved clinical outcomes, with no significant difference between groups.	7	14
Pietrosimone et al. 2020	Patellar	1. Isometric EX 2. Sham TENS	28	Single session	Pain & function (VISA-P), biomechanics	Single session	Single session isometric EX did not have acute effects on pai or landing biomechanics.	12	12
Holden et al. 2020	Patellar	1. Isometric EX 2. Dynamic EX	21	Single session	Pain (NRS, PPT)	Single session	Both groups immediately decreased pain but not after 45 mins, no difference between groups.	12	13

Abbreviations: ECCT: eccentric training, ESWT: extracorporeal shockwave therapy, DN: dry needling; MT: manual therapy, EX: exercise; VAS: visual analogue scale, NRS-P: pain numeric rating scale, VISA-A: Victorian Institute of Sport Assessment – Achilles, VISA-P: Victorian Institute of Sport Assessment – Patellar, VISA-G: Victorian Institute of Sport Assessment – Gluteal, VISA-H: Victorian Institute of Sport Assessment – Hamstring, FFI: Foot Function Index, LEFS: Lower Extremity Function Scale, WKS: weeks, US: ultrasound, PRP: platelet-rich plasma, HSRT: heavy slow resistance training: CONCT: concentric training, E-STIM: electrical stimulation, CSI: corticosteroid injection: LLLT: low-level laser therapy, FADI: Foot and ankle disability index, AOFAS: American orthopaedic foot and ankle score, UGPE: ultrasound guided percutaneous electrolysis, HVIGI: high-volume image guided injection: MRI: magnetic resonance imaging: RMS: Roles and Maudsley score, MHT: menopause hormone therapy, PPI: pain pressure intensity; FAAM: foot and ankle ability measure.

APPENDIX 3: Table 5: Application of resistance training principles

Author	Specificity	Over load	Progression + method	Individualised + method	Frequency (d/wk)	Intensity	Time (min)	Sets	Reps	Exercise mode/type	Adherence	RTP /8, Total /10
Beyer et al. 2015	Y	Y	Y, increase resistance/ load	Y, pain response 4-5/10	3	15RM – 6RM	107 x wk (HSRT) 308 x wk (ECCT)	3-4	15-6	Heel raises, with external weights	Y, diary (78-92%)	7, 9
Kongsgaard et al. 2009	Y	Y	Y, increase resistance	Y, pain response 3/10	3	15RM – 6RM	NR	3-4	15-6	DSL squats, squat, leg press, hack squat, with external weights	Y, diary (89-91%)	7, 9
Riel et al. 2019	Y	Y	Y, increase resistance or volume	Y, as many sets as possible	3	8RM – 12RM	tut	3-5, AMAP	8-12	Heel raises, loaded backpack	Y, diary, 29% not returned	7, 9
Stevens & Tan 2014	Y	Y	Y, increase resistance or volume	Y, as many reps as possible	7, 2xd	15RM	NR	2 x 6 (12)	15 (180 total)	Heel raises (straight leg & bent knee), loaded backpack	Y, diary, above 75%	7, 9
Da Cunha et al. 2012	Y	Y	Y, increase resistance (5kg inc)	Y, pain response	3	15RM	NR	3	15	Eccentric decline squat	NR	8, 8
Kulig et al. 2009	Y	Y	Y, increase resistance (0.9kg conforce spring)	Y, increase isokinetic resistance as able	7, 2xd	15RM	NR	2 x 3 (6)	15 (180)	Isokinetic resisted horizontal adduction with plantar flexion	Y, diary, 68% (39-98)	8, 10
Bahr et al. 2006	Y	Y	Y, increase resistance (5kg inc)	Y, pain response less 3/10, increase 5kg	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	DSL squat, loaded backpack	NR	8, 8

Lee et al. 2020	Y	Y	Y, increase resistance (5kg inc)	Y, pain response 4/10, increase 5kg	7, 2Xd	15RM	NR	2 X 3 (6)	15 (180)	DSL squat, loaded backpack	Y, diary	8, 9
Frohm et al. 2007	Y	Y	Y, increase resistance (5kg inc)	Y, pain response 5/10, increase 5kg	1.2 2. 7, 2xd	15-16RM	70 mins x session	3-4	15-16	1. The Bromsman eccentric overload training device 2. DSL squat, loaded backpack	NR	8,8
Silbernagel et al. 2001	Y	Y	Y, increase resistance, volume, speed & difficultly	Y, pain response 5/10	7	5-15RM	NR	3	5-15	Double and single leg Slow Heel raises, fast rebounding heel raises	Y, diary	7, 8
Balius et al. 2016	Y	NR	NR	NR	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	Alfredson heel raises, straight & bent knee	PT recorded; 70% minimum allowed	2, 4
Mafi et al. 2001	Y	Y	Y, increase resistance	Y, pain response	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	Alfredson heel raises, straight & bent knee, loaded with backpack or weight machines	NR	7, 7
Norregaard et al. 2007	Y	Y	Y, increase resistance (5kg inc)	Y, pain response, increase 5kg	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	Alfredson heel raises, straight & bent knee, loaded with backpack	Y. diary, results NR	8, 9
Stasinopolous et al. 2004	Y	Y	Y, increase resistance	Y, pain response	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	DSL squat, handheld external weights	NR	7, 7
De Vos et al. 2007	Y	Y	Y, increase resistance	Y, pain response	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	Alfredson heel raises, straight & bent knee, loaded with	Y, diary, (70-74%)	7, 9

										backpack or weight machines		
Johannsen et al. 2019	Y	UC	UC	NR	3	NR	NR	NR	NR	(1) heel-raises, (2) flexion of the first toe against elastic band. (3) Inversion of the foot against elastic band	NR	2, 2
MacDonald et al. 2019	Y	Y	Y, increase resistance (5kg inc)	Y, pain response 5/10, increase 5kg, correct technique	7, 2xd	15RM	NR	2 X 3 (6)	15 (180)	DSL squat eccentric protocol with addition of isotonic hip exercise, loaded backpack	Y, diary, 42.5% full	8, 10
Gatz et al. 2020	Y	Y	Y, increase resistance	Y, pain response	7, 2 X D	15RM	NR	2 X 3 (6)	15 (180)	Alfredson eccentric heel raise protocol + isometric exercise	Y, verbal, NR	7, 8
Ganderton et al. 2018	Y	Y	Y, increase difficulty	Y, individual ability determined progression	7, 2 x d	5-15RM	30MIN X D	2-4	5-15	isometric loading of gluteals, and kinetic chain strength exercises	Y, diary, 75%	7, 9
Silbernagel et al. 2007	Y	Y	Y, Increase resistance, volume, and speed of exercises	Y, Increased resistance, volume, and speed guided by Pain response	7	10-20RM	NR	3	10-20	2-legged, 1-legged, eccentric, and fast rebounding toe raises, plyometric exercise. Loaded with backpack or weight machine	Y, diary	7, 8
Clifford et al. 2019	Y	Y	Y, increase resistance band strength	Y, pain response 5/10	7	6-10RM	6min TUT x d	3-6	6-10	Isotonic & isometric hip abduction, loaded with bands	Y, diary, (58-70%)	7, 9

Stergioulas et al. 2008	Y	Y	Y, increase resistance (4kg inc)	Y, pain response 5/10	4	12RM	NR	12	12	Eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary (85-100%)	8, 10
Rompe et al. 2008	Y	Y	Y, increase resistance (5kg inc)	Y, pain response, increase 5kg	7, 2 X D	10-15RM	NR	3 X 2 (6)	10-15 (180)	Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, verbal, NR	8, 9
Van Ark et al. 2016	Y	Y	Y, increase resistance 2.5% per week	Y, pain response, correct technique, 2.5% increase	4	isometric (80% 1RM) isotonic (80% 8RM)	NR	4-5	5-8	Leg extension machine, external weight. Audio used for speed tempo	NR	8, 8
Roos et al. 2004	Y	Y	Y, increase resistance	Y, pain response	7, 2 X D	15RM	NR	1-3	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary (50-75%)	7, 9
Chester et al. 2008	Y	Y	Y, increase resistance	Y, pain response	7	15RM	NR	3 X 2 (6)	15 (90)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	NR	7, 7
Rompe et al. 2007	Y	Y	Y, increase resistance (5kg inc)	Y, pain response, increase 5kg	7, 2 X D	10-15RM	NR	3 X 2 (6)	10-15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	NR	8, 8
Thijs et al. 2017	Y	Y	Y, increase resistance	Y, pain response, 4/10	7, 2 X D	15RM	NR	3 X 2 (6)	15 (180)	DSL eccentric squat, loaded backpack	NR	7, 7
Horstmann et al. 2013	Y	Y	Y, increase resistance + volume,	Y, increase resistance + volume,	7	15RM	NR	3-4	15	Modified Alfredson eccentric heel raise, knee	NR	7, 7

			based on fatigue	based on fatigue						straight & flexed, loaded backpack		
Alfredson et al. 1998	Y	Y	Y, increase resistance	Y, pain response	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack or weight machine	NR	7, 7
Alvarez et al. 2006	Y	Y	Y, increase resistance (elastic bands) and volume	Y, increase resistance based on pain response + correct technique	7, 2 X D	30RM	NR	3	30	Isotonic exercise with elastic bands, increased resistance (elastic bands strength) 1. Bilateral heel raises 2. Ankle plantar flexion with adduction and Inversion. 3. Unilateral heel raises (standing)	Y, diary (79%)	7, 9
Kearney et al. 2013	Y	Y	Y, progress from DL to SL with increased resistance	Y, pain response, progress from DL to SL with increased load	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack, DL progressing to SL	NR	7, 7
Tumilty et al. 2012	Y	Y	Y, increase resistance	Y, pain response	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary (70%)	7, 9

Yelland et al. 2011	Y	Y	Y, increase resistance	Y, pain response 4/10	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary	7, 8
McCormack et al. 2016	Y	Y	Y, increase resistance	NR	7, 2 X D	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	NR	5, 5
Tumilty et al. 2016	Y	Y	Y, increase resistance	Y, pain response, 4/10	2	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack. 2Xwk V D	Y, diary, 70-100%	7, 9
Cannell et al. 2001	Y	Y	Y, increase resistance with fixed loading protocol & external weight	Y, pain response	5	10-20RM	NR	3	10-20	Progressive drop squats and leg extension/curl exercises, fixed loading protocol, external weights	NR	8, 8
Jonsson et al. 2005	Y	Y	Y, increase resistance	Y, self-acceptable pain response	7, 2 X D	15RM	NR	3 X 2 (6)	15 (180)	Eccentric v concentric DSL squat, loaded backpack	NR	7, 7
Mellor et al. 2018	Y	Y	Y, increase diffciculty/ intensity (BORG)	Y, pain response 5/10, BORG scale (13-17 target)	7	BORG (13-17)	30 min x session	1-2	3-15	Comprehensive progressive exercise program targeting hip muscles, monitored by pain response and BORG scale. External load NR.	Y, diary, 80%	8, 10

										Spring resistance for hip abduction		
Kedia et al. 2014	Y	Y	Y, increase resistance	Y, exercise difficultly, increase resistance	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary, NR	7, 8
Herrington et al. 2007	Y	Y	Y, increase speed and resistance	Y, increase speed and resistance based on pain response	7, 2 X D	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary, NR	7, 8
Houck et al. 2015	Y	Y	Y, increase resistance – elastic bands strength	Y, increase resistance based on pain response & Ex technique	7, 2 X D	30RM	30 min x session	3 X 2 (6)	30 X 3 X 3 (180)	Bilateral & unilateral heel raises, ankle plantarflexion with adduction & inversion. Resistance bands	Y, diary (79%)	7, 9
Dimitrios et al. 2012	Y	Y	Y, increase resistance with handheld weights	Y, pain response	5	15RM	NR	3	15	Eccentric DSL squat, handheld weights	Y, diary, NR	7, 8
Petersen et al. 2007	Y	Y	Y, increase resistance	Y, pain response	7, 3 x D	15RM	NR	3 X 3 (9)	15 (270)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary, NR	7, 8
Steunebrink et al. 2013	Y	Y	Y, increase resistance (5kg inc)	Y, pain response, 3/10 = increase load	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson - Eccentric DSL squat	Y, diary (70%)	8, 10
Rompe et al. 2009	Y	Y	Y, increase resistance (5kg inc)	Y, pain response	7, 2 X D	15RM	NR	3 X 2 (6)	10-15 (180)	Modified Alfredson eccentric heel raise, knee	NR	8, 8

										straight & flexed, loaded backpack		
Young et al. 2005	Y	Y	Y, increase speed, then resistance (5kg inc)	Y, pain response	7. 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson DSL squat, loaded backpack	Y, diary (72%)	8, 10
De Jonge et al. 2010	Y	Y	Y, increase resistance	Y, pain response	7, 2 x d	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack or weight machine	Y, diary	7, 8
Praet et al. 2019	Y	Y	Y, increase speed, then resistance (5kg inc until max 60kg)	Y, pain response	7, 2 X D	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel raise, knee straight & flexed, loaded backpack	Y, diary (78-84%)	8, 10
Rathleff et al. 2015	Y	Y	Y, increase resistance	NR	3	12-8RM	NR	3-5	12-8	Heel raise on step with toes maximally dorsiflexed on towel	NR	5, 5
Knobloch et al. 2008	Y	NR	NR	NR	7, 2 X D	15RM	NR	3 X 2 (6)	15 (180)	Modified Alfredson eccentric heel drop, knee straight & flexed	NR	2, 2
Wheeler et al. 2017	Y	NR	NR	NR	NR	NR	NR	NR	NR	stretching, calf & foot muscle strengthening and balance exercises.	NR	2, 2
De Jonge et al. 2011	Y	NR	NR	Y, pain response	7	NR	NR	NR	180	Alfredson eccentric heel drop, knee straight & flexed,	Y, Verbal	4, 5

De Vos et al. 2010	Y	NR	NR	Y, pain response	7	NR	NR	NR	180	Alfredson eccentric heel drop, knee straight & flexed,	Y, Verbal	4, 5
Warden et al. 2008	Y	Y	Y, increase resistance with hand weights	Y, pain response	7	15RM	NR	3	15 (45)	Modified Alfredson DSL squat, hand weights	Y, diary, 65%	7, 9
Visnes et al. 2005	Y	Y	Y, increase resistance (5kg inc)	Y, pain response	7, 2 X D	15RM	NR	3 X 2 (6)	15 (90)	Modified Alfredson DSL squat, loaded backpack	Y, diary	8, 9
Van Ark et al. 2018	Y	Y	Y, increase resistance (2.5% per week)	Y, pain response	4	8RM	NR	4X2	8X2	Leg extension machine	NR	8, 8
Thompson et al. 2019	Y	NR	NR	Y, pain response	7, 2 X D	10-15RM	NR	1 X 2	10-15	leg lunges, single stance knee bends, and side lying eccentric flexion, side bending and extension	Y, NR	4, 5
Cacchio et al. 2011	Y	Y	NR	NR	3	6-10RM	NR	3-4	6-10	Loaded with weights: leg curls, hip flexion & extension, deadlift, lunge, half squat, countermovemen t jump	NR	4, 4
Munteanu et al. 2014	Y	Y	Y, increase resistance (5kg inc)	Y, pain response	7, 2 X D	15RM	NR	3 X 2	15	Alfredson eccentric heel-drop protocol	Y, diary (57%)	8, 10
Van der Worp et al. 2014	Y	Y	Y, increase resistance	Y, pain response	5	15RM	NR	3 X 2	15	DSL squat, loaded backpack (Visnes protocol)	Y, diary	7, 8
Romero-morales et al. 2018	Y	Y	Y, increase resistance	Y, pain response	7, 2 X D	15RM	NR	3 X 2 (6)	15 (90)	Modified Alfredson heel-drop protocol	Y, diary	7, 8

Romero-morales et al. 2020	Y	Y	Y, increase resistance	Y, pain response	7, 2 X D	15RM	NR	3 X 2 (6)	15 (90)	Modified Alfredson heel-drop protocol	Y, diary	7, 8
Ryan et al. 2014	Y	NR	NR	NR	7	15RM	NR	3-5	15	Forefoot extension, ankle inversion & eversion, SL standing, stretching.	Y, diary	2, 3
Riel et al. 2018	Y	Y	Y, increase resistance	Y, increase resistance individually	3	8RM	64/S set, 256/S total	4	8	Heel-raise with loaded backpack	NR	7, 7
Koszalinski et al. 2020	Y	NR	NR	NR	NR	15RM	NR	3	15	Alfredson eccentric heel-drop, Ankle adduction, Towel crunches	NR	2, 2
Pearson et al. 2012	Y	Y	Y, increase resistance	Y, pain response	NR	NR	NR	NR	NR	Alfredson eccentric heel-drop, no details given	NR	7, 7
Wang et al. 2007	Y	NR	NR	NR	NR	NR	NR	NR	NR	Eccentric strengthening of quadriceps and hamstrings	NR	2, 2
Notarnicola et al. 2013	Y	NR	NR	NR	NR	NR	NR	3	10	Eccentric exercise unspecified	NR	2, 2
Dragoo et al. 2014	Y	NR	NR	NR	NR	NR	NR	NR	NR	Eccentric exercise unspecified	NR	2, 2
Kaux et al. 2019	Y	Y	Y, increase volume	NR	3	15-20RM	NR	5-7	15	Bodyweight eccentric wall squat	NR	5, 5
Abat et al. 2016	Y	NR	NR	NR	NR	15RM	15min	3	15	Eccentric DSL squat	NR	2, 2
Biernat et al. 2014	Y	Y	Y, increase difficulty	Y, pain response	7	15RM	NR	3X2 (6)	15 (90)	Eccentric DSL squat	NR	7, 7

Rio et al. 2015	Y	Y	NR	NR	Single session	8RM	NR	4	8	Biodex (isometric) Leg extension machine (isotonic)	Y, supervised	4, 5
Rio et al. 2017	Y	Y	Y, increase resistance (2.5% weekly)	Y, fatigue	4	8RM	NR	4	8	Leg extension machine	Y, supervised	8, 9
Holden et al. 2020	Y	Y	NR	NR	Single session	8RM	NR	3	8	Biodex (isometric) Leg extension machine (isotonic)	Y, supervised	4, 5
Choudhary et al. 2021	Y	Y	Y, increase repetitions	Y, pain response	7, 3 X D	15RM	NR	3	15 (45)	ECCT – no details	NR	7, 7
Cowan et al. 2021	Y	Y	Y, individual ability determined progression	Y, increase difficultly	7, 2 x D	5-15RM	15min x 2 (30)	2-4	5-15	isometric loading of gluteals, and kinetic chain strength exercises	Y, diary (70-94%)	7, 9
Habets et al. 2021	Y	Y	Y, increase resistance (5kg inc in backpack - AG), + increase speed (SG)	Y, pain response	7, 2 x D (AG)	15RM (AG)	NR	6 (AG) 3 (SG)	180 (AG) 15 (SG)	Alfredson ECCT heel drop VS Silbernagel CONCT-ECCT heel raise	Y, diary, 74% (AG) 77% (SG)	8, 10
Ruffino et al. 2021	Y	Y	Y, increase resistance	Y, pain response	3	6-15RM	50MIN	4	6-15	HSRT (modified Kongsgaard protocol): squat, hack squat, leg press. Flywheel: squat, leg press, knee extension.	Y, diary, 88% (HSRT), 90% (Flywheel)	7, 9
Olesen et al. 2021	Y	Y	Y, increase resistance	Y, pain response	3	6-15RM	NR	4	6-15	HSRT (modified Kongsgaard protocol): squat,	NR	7, 7

										knee extension, leg press.		
Hasani et al. 2021	Y	Y	Y, increase resistance	Y, pain response & difficultly	3	6-18RM	39-53MINS	4	6-18	Seated & standing calf raises on smith machine: high (6 RM) or low intensity (18 RM) exercise, performed with either high (6 s) or low (2) time-under-tension.	Y, diary, 49-68%	7, 9
Mansur et al. 2021	Y	Y	NR	NR	7, 2 X D	15RM	NR	3 x 2 x 2 (12)	15 x 3 x 2 x 2 (180)	Modified Alfredson heel drop protocol	NR	4, 4
Sprague et al. 2021	Y	Y	Y, increase resistance	Y, pain response	3	6-15RM	NR	4	6-15	HSRT (modified Kongsgaard protocol): squat, knee extension, leg press.	Y, diary (67-86%)	7, 9
Agergaard et al. 2021	Y	Y	Y, increase resistance (% of 1RM)	Y, pain response	3	55-90% 1RM	NR	3-5	4-15	HSRT: leg press, knee extension	Y, diary, 78-86%	8, 10
Lopez-Royo et al. 2021	Y	Y	Y, increase speed	Y, pain response	7, 2 X D	15RM	NR	3	15	Young ECCT Protocol: DSL squat	NR	7, 7
Abdelkader et al. 2021	Y	NR	NR	NR	7, 2 X D	15RM	NR	3	15	Modified Alfredson heel drop protocol, 4 weeks only	NR	2, 2
Van der Vlist et al. 2020	Y	Y	Y, increase resistance (backpack or weights)	Y, pain response	7	15RM	NR	3	15	Silbernagel protocol: isometric, CONCT, ECCT, plyometric, calf raises,	Y, diary, 76%	7, 9

Breda et al. 2020	Y	Y	Y, increase resistance & difficultly	Y, pain response	3-7	6-15RM, 70% MVIC (isometric)	NR	4	6-15	ECCT: DSL squat, PTLE: isometric, isotonic, plyometric EX, leg press, leg extension, sport specific, hip abduction & extension EX	Y, diary, 40-49%	7, 9
Rabusin et al. 2021	Y	Y	Y, increase resistance (5kg inc in backpack)	Y, pain response	7, 2 X D	15RM	NR	3 (12)	15 (180)	Alfredson ECCT heel drop protocol	Y, diary, 60-94%	8, 10
Solomons et al. 2020	Y	NR	NR	Y, pain response	NR	NR	NR	NR	NR	Isometric, CONCT, ECCT, no details	Y, diary, 83-100%	4, 6
Ramon et al. 2020	Y	NR	NR	NR	7	10RM	NR	1	10	Gluteal EX: Bridging, hip abduction & extension	NR	2, 2
Scott et al. 2019	Y	NR	NR	NR	3	NR	NR	NR	NR	HSRT (modified Kongsgaard protocol):no details	NR	2, 2
Stefansson et al. 2019	Y	Y	Y, increase resistance (5kg inc in backpack)	Y, pain response	7, 2 x D	10-15RM	NR	1-3	10-15	Alfredson ECCT heel drop protocol	NR	8, 8
Boesen et al. 2017	Y	Y	NR	Y, pain response	7, 2 x D	15RM	NR	6	180	Alfredson ECCT heel drop protocol	Y, diary, 70%	6, 8
Chesterton et al. 2021	Y	NR	Y, increase difficulty	Y, pain response	NR	NR	NR	NR	NR	Progressive foot, calf and hip strength EX, no details	Y, diary	5, 6
Rasenberg et al. 2020	Y	NR	NR	NR	NR	NR	NR	NR	NR	Rathleff heel-raise protocol, no details	Y, diary	2, 3

Johannsen et al. 2020	Y	NR	NR	NR	3	NR	NR	NR	NR	Ankle inversion, first toe flexion, heel raises (performed slowly)	Y, diary, 100%	2, 4
Thong-On et al. 2019	Y	Y	Y, increase resistance	Y, increase difficulty	7	10-15RM	NR	3	10-15	Heel raises, toe curles, ankle inversion & eversion with resistance bands	Y, diary	7, 9
Cil et al. 2019	Y	Y	Y, increase repetitions	NR	7	10-15RM	NR	3	10-15	Strength EX; foot intrinsic, ankle & hip, TheraBand	NR	5, 5
Kamonseki et al. 2016	Y	Y	Y, increase resistance	NR	7	10-15RM	NR	3	10-15	Strength EX: Toe curl, short foot, inversion, eversion, PF, DF, hip External rotation & abduction	NR	5, 5
Brown et al. 2006	NR	NR	NR	NR	NR	NR	NR	NR	NR	Alfredson protocol, no details	Y, verbal	0, 1
Niesen-Vertommen et al. 1992	Y	Y	Y, increase resistance (10% of bodyweight)	Y, pain response	6	10RM	NR	5	10	ECCT (stanish protocol) vs CONCT heel raises on a step	Y, diary	8, 9
Jensen et al. 1989	Y	Y	Y, increase speed/velocity	Y, difficultly	3	Speed (30-70 degrees /s), 5RM	NR	6-4	5	ECCT: isokinetic dynamometer	Y, diary	7, 8
Yu et al. 2013	Y	Y	Y, increase resistance (5-10lbs)	Y, pain response	3	NR	50MIN	3	15	ECCT heel drop: modified Alfredson & Stanish protocols CONCT heel riase: Mafi protocol	NR	8, 8

Wheeler et al. 2021	Y	Y	Y, increase repetitions as able	Y, pain response	7	NR	NR	NR	NR	Isotonic hip strength EX: abduction, bridging clams	NR	7, 7
Zhang et al. 2013	Y	Y	Y, increase resistance (5kg inc in backpack)	Y, pain response	7	15RM	NR	3	15	Modified Alfredson heel drop protocol	NR	8, 8
Bell et al. 2013	Y	NR	NR	Y, pain response	7	NR	NR	NR	180	Alfredson heel drop protocol, no details	Y, diary, 62-65%	4, 6
Pietrosimone et al. 2020	Y	Y	NR	NR	Single session	70% MVIC	NR	5	45/s	Isometric knee extension	NR	4, 4

Abbreviations: ECCT: eccentric training, Y: yes, NR: not reported, D: day, RM: repetition maximum, KG: kilogram, INC: increment, MVIC: maximum voluntary isometric contraction, HSRT: heavy slow resiatnce training, RPE: rating of perceived exertion, MIN: minutes, EX: exercise. RIR: repetitions in reserve, RTP: resistance training principles, WK: week, PF: plantarflexion, DF: dorsiflexion, CONCT: concentric training; DSL: decline single leg

APPENDIX 4: Table 6: Toigo and Boutellier framework exercise descriptors reporting for each study

Author	T1: load magnitude	T2: repetitions	T3: sets	T4: rest between sets	T5: sessions per d/wk.	T6: duration period	T7: contraction mode	T8: rest between reps	T9: tut	T10: muscular failure	T11:rom	T12: recovery between sessions	T13: anatomical exercise definition	TBF TOTAL/13
BEYER 2015	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	12
KONGSGAARD 2009	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	12
RIEL 2019	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	Y	Y	Y	Y	13
STEVENS 2014	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	Y	Y	Y	Y	13
CUNHA 2012	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
KULIG 2009	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	12
BAHR 2006	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11
LEE 2020	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11
FROHM 2007	Y	Y	Y	Y	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	11
SILBERNAGEL 2001	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
BALIUS 2016	N	Y	Y	N	Y	Y	Y	Y, NIL	N	N	N	Y	Y	8
MAFI 2001	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
NORREGAARD 2007	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10

STASINOPOLOUS 2004	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
DE VOS 2007	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
JOHANNSEN 2018	N	N	N	N	Y	Y	N	N	N	N	N	Y	N	3
MACDONALD 2019	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
GATZ 2020	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
GANDERTON 2018	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
SILBERNAGEL 2007	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
CLIFFORD 2019	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	12
STERGIOULAS 2008	Y	Y	Y	Y	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	11
ROMPE 2008	Y	Y	Y	Y	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	11
VAN ARK 2016	Y	Y	Y	Y	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	12
ROOS 2004	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
CHESTER 2008	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
ROMPE 2007	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
THIJS 2017	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
HORSTMANN 2013	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11

ALFREDSON 1998	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
ALVAREZ 2006	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
KEARNEY 2013	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
TUMILTY 2012	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
YELLAND 2011	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
MCCORMACK 2016	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
TUMILTY 2016	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
CANNELL 2001	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11
JONSSON 2005	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
MELLOR 2018	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11
KEDIA 2014	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
HERRINGTON 2007	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
HOUCK 2015	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11
DIMITRIOS 2012	Y	Y	Y	Y	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	11
PETERSEN 2007	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
STEUNEBRINK 2013	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
ROMPE 2009	Y	Y	Y	Y	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	11

YOUNG 2005	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
DE JONGE 2010	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
PRAET 2019	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
RATHLEFF 2015	Y	Y	Y	N	Y	Y	Y	Y, NIL	Y	N	Y	Y	Y	11
KNOBLOCH 2008	Y	Y	Y	N	Y	Y	Y	Y, NIL	N	N	Y	Y	Y	10
WHEELER 2017	N	N	N	N	N	N	N	N	N	N	N	N	N	0
CHOUDHARY 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	N	Y	N	8
COWAN 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
HABETS 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
RUFFINO 2021	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	Y	Y	Y	Y	13
OLESEN 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
HASANI 2021	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	Y	Y	Y	Y	13
MANSUR 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
SPRAGUE 2021	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	Y	Y	Y	Y	13
AGERGAARD 2021	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	Y	Y	Y	Y	13
LOPEZ-ROYO 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10

ABDELKADER 2021	Y	Y	Y	Y	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	11
VAN DER VLIST 2020	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	N	Y	Y	Y	12
BREDA 2020	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
RABUSIN 2021	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
SOLOMONS 2020	N	N	N	N	N	N	Y	N	N	N	N	N	N	1
RAMON 2020	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
SCOTT 2019	N	N	N	N	N	N	Y	N	N	N	N	N	N	1
STEFANSSON 2019	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
BOESEN 2017	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
CHESTERTON 2021	N	N	N	N	N	N	N	Y,NIL	N	N	N	N	Y	2
RASENBERG 2020	N	N	N	N	N	N	Y	N	N	N	N	N	N	1
JOHANNSEN 2020	N	N	N	N	Y	Y	Y	N	N	N	N	Y	N	4
THONG-ON 2019	Y	Y	Y	Y	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
CIL 2019	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	N	9
KAMONSEKI 2016	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10

BROWN 2006	N	N	N	N	N	N	Y	N	N	N	N	N	N	1
NIESEN-VERTOMMEN	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
JENSEN 1989	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	Y	Y	Y	Y	11
YU 2013	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
WHEELER 2021	N	N	N	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	7
ZHANG 2013	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
BELL 2013	Y	Y	N	N	Y	Y	Y	Y,NIL	N	N	N	Y	N	7
PIETROSIMON E	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	12
DE JONGE 2011	Y	Y	N	N	N	Y	Y	Y,NIL	N	N	N	Y	N	6
DE VOS 2010	Y	Y	N	N	N	Y	Y	Y,NIL	N	N	N	Y	N	6
WARDEN 2008	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
VISNES 2005	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
VAN ARK 2018	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	N	Y	Y	Y	12
THOMPSON 2019	Y	Y	Y	N	Y	N	Y	Y,NIL	N	N	N	Y	N	6
CACCHIO 2011	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	N	Y	N	8
MUNTEANU 2014	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
VAN DER WORP 2014	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	N	9

ROMER-MORALES 2018	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
ROMERO-MORALES 2020	Y	Y	Y	N	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	10
RYAN 2014	Y	Y	Y	N	Y	Y	N	Y,NIL	N	N	N	Y	N	6
RIEL 2018	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	Y	Y	Y	Y	13
KOSZALINSKI 2020	Y	Y	Y	N	N	Y	Y	Y,NIL	N	N	N	N	Y	7
PEARSON 2012	N	N	N	N	N	Y	N	N	N	N	N	N	N	1
WANG 2007	N	N	N	N	N	N	Y	N	N	N	N	N	N	1
NOTARNICOLA 2013	N	Y	Y	N	N	N	Y	N	N	N	N	N	N	3
DRAGOO 2014	N	N	N	N	N	N	Y	N	N	N	N	N	N	1
KAUX 2019	Y	Y	Y	Y	Y	Y	Y	Y,NIL	N	N	Y	Y	Y	11
ABAT 2016	Y	Y	Y	Y	N	Y	Y	Y,NIL	N	N	Y	N	Y	9
BIERNAT 2014	Y	Y	Y	Y	N	Y	Y	Y,NIL	N	N	Y	Y	Y	10
RIO 2015	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	N	Y	Y	Y	12
HOLDEN 2020	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	N	Y	Y	Y	12
RIO 2017	Y	Y	Y	Y	Y	Y	Y	Y,NIL	Y	N	Y	Y	Y	12

Abbreviations: Y: yes, N: no, TBF: Toigo and Boutellier framework.

APPENDIX 5: Table 7: Consensus on Exercise Reporting Template (CERT) items reporting for each study

C1: equipment	C2: instructor	C3: individual /group	C4: un/supervised	C5: adherence measure & reported	C6: motivation	C7a: progression rules	C7b: progressed how	C8: exercise details replication	C9: describe home program	C10: nonexercise components	C11: adverse events	C12: exercise setting	C13: exercise intervention details	C14 a: generic or tailored	C14b: tailored how	C15: describe starting level	C16a: fidelity measured	C16b: exercise delivered as planned	CERT TOTAL/19	Author
Y	Y, PT	Y, I	Y, UN	Y	N	Y	Y	Y	Y	Y. EX ONLY	N	Y	Y	Y, I	PAIN	Y	Y	Y	17	BEYER 2015
Y	Y	Y, I	Y, both	Y	N	Y	Y	Y	Y, NA	Y, EX ONLY	Y	Y	Y	Y, G	N	Y	Y	Y	17	KONGSGAARD 2009
Y	Y	Y, I	Y, UN	Y	N	Y	Y	Y	Y	Y, EX ONLY	Y	Y	Y	Y, I	AMAP	Y	N	Y	17	RIEL 2019
Y	Y	Y, I	Y, UN	Y	N	Y	Y	Y	Y	Y, EX ONLY	Y	Y	Y	Y,I	AMAP	Y	Y	Y	18	STEVENS 2014
Y	Y, PT	Y, I	Y,SUP	N	N	Y	Y	Y	Y,NA	Y, EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	CUNHA 2012
Y	Y,PT	Y, I	Y,both	Y	N	Y	Y	Y	Y	Y, ORTHOSES	N	Y	Y	Y	IRAA	Y	Y	Y	17	KULIG 2009
Y	Y,PT	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	BAHR 2006
Y	N	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,ESWT	N	Y	Y	Y,I	PAIN	Y	N	N	14	LEE 2020
Y	Y	Y, I	Y,SUP	N	N	Y	Y	Y	Y,NA	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	FROHM 2007
Y	Y	Y, I	Y,SUP	Y	N	Y	Y	Y	Y,NA	Y	N	Y	Y	Y,I	PAIN	Y	N	N	15	SILBERNAGEL 2001

N	Y	Y, I	Y,SUP	Y	N	N	N	Y	Y,NA	Y,SUPP	N	N	Y	Y,G	N	N	N	Y	10	BALIUS 2016
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,NA	N	Y	Y	Y	PAIN	Y	N	Y	15	MAFI 2001
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,NA	N	Y	Y	Y	PAIN	Y	N	N	15	NORREGAARD 2007
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,STRETCH	N	Y	Y	Y,I	PAIN	Y	N	N	14	STASINOPOLOUS 2004
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,SPLINT	N	Y	Y	Y,I	PAIN	Y	N	Y	16	DE VOS 2007
N	Y	Y, I	Y,UN	Y	N	N	N	N	N	Y,CSI	N	N	N	N	N	N	N	N	5	JOHANNSEN 2018
Y	Y,PT	Y, I	Y,SUP	Y	N	Y	Y	Y	Y,NA	Y,HIP EX	N	Y	Y	Y,I	PAIN	Y	N	Y	16	MACDONALD 2019
Y	N	Y, I	Y,UN	Y	N	Y	Y	Y	Y,NA	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	N	15	GATZ 2020
Y	Y,PT	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EDUCATION	Y	Y	Y	Y,I	ABILITY	Y	N	Y	17	GANDERTON 2018
Y	Y,PT	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	N	16	SILBERNAGEL 2007
Y	Y,PT	Y, I	Y,both	Y	N	Y	Y	Y	Y	Y,EDUCATION	Y	Y	Y	Y,I	PAIN	Y	Y	Y	18	CLIFFORD 2019
Y	Y,PT	Y, I	Y,SUP	Y	N	Y	Y	Y	Y	Y,LLLT	N	Y	Y	Y,I	PAIN	Y	N	Y	16	STERGIOULAS 2008
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	ROMPE 2008
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN,TECHNIQUE	Y	N	Y	16	VAN ARK 2016

Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,SPLINT	N	Y	Y	Y,I	PAIN	Y	N	Y	16	ROOS 2004
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,ULTRAS OUND	Y	Y	Y	Y,I	PAIN	Y	N	N	15	CHESTER 2008
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	N	16	ROMPE 2007
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,ESWT	Y	Y	Y	Y,I	PAIN	Y	N	N	16	THIJS 2017
Y	Y	Y, I	Y,SUP	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	FATIGUE	Y	N	N	15	HORSTM ANN 2013
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	ALFREDS ON 1998
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,ORTHOS ES	Y	Y	Y	Y,I	PAIN,TEC HNIQUE	Y	N	Y	17	ALVAREZ 2006
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	N	15	KEARNEY 2013
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,LLLT	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	TUMILTY 2012
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,PROLOT HERAPY	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	YELLAND 2011
Y	Y	Y, I	Y,both	N	N	Y	Y	Y	Y	Y,ASTYM	Y	Y	Y	Y,G	N	Y	N	Y	15	MCCORM ACK 2016
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,LLLT	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	TUMILTY 2016
Y	Y	Y, I	Y,BOTH	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	CANNELL 2001
Y	Y	Y, I	Y,both	N	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	N	15	JONSSON 2005

Y	Y	Y, I	Y,both	Y	N	Y	Y	Y	Y	Y,EDUCATION	Y	Y	Y	Y,I	PAIN,BORG	Y	Y	Y	18	MELLOR 2018
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,CON RX	N	Y	Y	Y,I	DIFFICULTY	Y	N	N	15	KEDIA 2014
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	Y	16	HERRINGTON 2007
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,ORTHOSES	Y	Y	Y	Y,I	PAIN,TECHNIQUE	Y	N	Y	17	HOUCK 2015
Y	Y	Y, I	Y,SUP	Y	N	Y	Y	Y	Y	Y,STRETCH	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	DIMITRIOS 2012
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,BRACE	Y	Y	Y	Y,I	PAIN	Y	N	N	16	PETERSEN 2007
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,GTN	N	Y	Y	Y,I	PAIN	Y	N	N	15	STEUNEBRINK 2013
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,ESWT	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	ROMPE 2009
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	Y	16	YOUNG 2005
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,SPLINT	N	Y	Y	Y,I	PAIN	Y	N	N	14	DE JONGE 2010
Y	Y	Y, I	Y,UN	Y	N	Y	Y	Y	Y	Y,SUPP	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	PRAET 2019
Y	Y	Y, I	Y,UN	N	N	Y	Y	Y	Y	Y,ORTHOSES	Y	Y	Y	Y,G	N	Y	N	N	14	RATHLEFF 2015
Y	YY	Y, I	Y,UN	N	N	N	N	Y	Y	Y,BRACE	N	Y	Y	Y,G	N	Y	N	N	11	KNOBLOCH 2008
Y	Y	Y, I	Y,UN	N	N	N	N	N	Y	Y,SPLINT	N	Y	N	Y,G	N	N	N	N	8	WHEELER 2017

Y	Y	Y,I	Y,UN	N	N	N	N	Y	Y	Y,SUPP	N	Y	Y	Y,I	PAIN	Y	N	N	12	CHOUDHARY 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,MHT	Y	Y	Y	Y,I	DIFFICULTY	Y	N	Y	17	COWAN 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	Y	16	HABETS 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	RUFFINO 2021
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,IGF-1	N	Y	Y	Y,I	PAIN	Y	N	N	14	OLESEN 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	Y	Y	18	HASANI 2021
Y	Y	Y,I	Y,UN	N	N	N	N	Y	Y	Y,ESWT	Y	Y	Y	Y,G	N	Y	N	N	12	MANSUR 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	Y	Y	18	SPRAGUE 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	Y	17	AGERGAARD 2021
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,DN,PNE	N	Y	Y	Y,I	PAIN	Y	N	N	14	LOPEZ-ROYO 2021
Y	Y	Y,I	Y,UN	N	N	N	N	Y	Y	Y,ESWT	N	Y	Y	Y,G	N	Y	N	N	11	ABDELKADER 2021
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,HVIGI	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	VAN DER VLIST 2020
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	BREDA 2020

Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,HEEL LIFTS	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	RABUSIN 2021
Y	Y	Y,I	Y,UN	N	N	N	N	Y	Y	Y,DN	Y	N	N	Y,I	PAIN	N	N	Y	11	SOLOMONS 2020
Y	Y	Y,I	Y,UN	N	N	N	N	Y	Y	Y,ESWT	Y	Y	Y	Y,G	N	Y	N	N	12	RAMON 2020
N	Y	Y,I	Y,UN	N	N	N	N	N	N	Y,PRP	N	N	N	Y,G	N	N	N	N	5	SCOTT 2019
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,PM	N	Y	Y	Y,I	PAIN	Y	N	N	14	STEFANSSON 2019
Y	Y	Y,I	Y,UN	Y	N	N	N	Y	Y	Y,PRP,HVIGI	Y	Y	Y	Y,I	PAIN	Y	N	Y	15	BOESEN 2017
Y	Y	Y,I	Y,UN	Y	N	N	N	N	N	Y,ORTHOSES	Y	Y	Y	Y,I	PAIN	Y	Y	Y	14	CHESTERTON 2021
N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	0	RASENBERG 2020
N	Y	Y,I	Y,UN	Y	N	N	N	N	N	Y,SURGERY,CSI	Y	N	N	N	N	Y	N	Y	8	JOHANNSEN 2020
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX ONLY	Y	Y	Y	Y,I	DIFFICULTY	Y	N	Y	17	THONG-ON 2019
N	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,MT	N	N	N	Y,G	N	Y	N	N	10	CIL 2019
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,EX	N	Y	Y	Y,G	N	Y	N	N	13	KAMONSEKI 2016
N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	1	BROWN 2006
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	NIESEN-VERTOMMEN

Y	Y	Y,I	Y,BOTH	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	DIFFICULTY	Y	N	Y	16	JENSEN 1989
Y	Y	Y,I	Y,UN	N	Y	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	15	YU 2013
Y	Y	Y,I	Y,UN	N	N	Y	Y	N	Y	Y,ESWT	N	Y	Y	Y,I	PAIN	Y	N	N	13	WHEELER 2021
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	ZHANG 2013
Y	Y	Y,I	Y,UN	Y	N	N	N	N	Y	Y,EX ONLY	Y	Y	Y	Y,I	PAIN	Y	N	Y	14	BELL 2013
Y	Y	Y,I	Y,SUP	N	N	N	N	Y	Y	Y,EX ONLY	N	Y	Y	Y,G	N	Y	N	Y	12	PIETROSIMONE
Y	Y	Y,I	Y,UN	Y	N	N	N	N	Y	Y,PRP	N	N	Y	Y,I	PAIN	Y	N	N	11	DE JONGE 2011
Y	Y	Y,I	Y,UN	Y	N	N	N	N	Y	Y,PRP	N	N	Y	Y,I	PAIN	Y	N	N	11	DE VOS 2010
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,US	Y	Y	Y	Y,I	PAIN	Y	N	Y	17	WARDEN 2008
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,EX	N	Y	Y	Y,I	PAIN	Y	N	N	15	VISNES 2005
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	VAN ARK 2018
N	Y	Y,I	Y,UN	N	N	N	Y	N	Y	Y,PRP	N	Y	Y	Y,I	PAIN	N	N	N	10	THOMPSON 2019
Y	N	Y,I	Y,UN	N	N	N	N	Y	N	Y,CON RX	N	N	Y	N	N	Y	N	N	7	CACCHIO 2011
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,ORTHOSES	Y	Y	Y	Y,I	PAIN	Y	N	N	16	MUNTEANU 2014

Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,ESWT	Y	Y	Y	Y,I	PAIN	Y	N	N	16	VAN DER WORP 2014
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y, VIB/CRY	N	Y	Y	Y,I	PAIN	Y	N	N	15	ROMER-MORALES 2018
Y	Y	Y,I	Y,UN	Y	N	Y	Y	Y	Y	Y,VIB/CRY	N	Y	Y	Y,I	PAIN	Y	N	N	15	ROMERO-MORALES 2020
Y	Y	Y,I	Y,UN	Y	N	N	N	N	Y	Y,EX ONLY	N	Y	Y	Y,G	N	Y	N	N	11	RYAN 2014
Y	Y	Y,I	Y,SUP	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,G	RESISTANCE	Y	N	N	14	RIEL 2018
Y	Y	Y,I	Y,SUP	N	N	N	N	Y	N	Y,MT	N	Y	Y	Y,G	N	Y	N	N	10	KOSZALINSKI 2020
N	Y	Y,I	N	N	N	N	N	N	N	Y,ABI	N	N	N	Y,G	PAIN	N	N	N	5	PEARSON 2012
N	N	Y,I	N	N	N	N	N	N	N	Y,ESWT	N	N	N	Y,G	N	N	N	N	3	WANG 2007
N	N	Y,I	N	N	N	N	N	N	N	Y,CHELT	N	N	N	Y,G	N	N	N	N	3	NOTARNICOLA 2013
N	Y	Y,I	N	N	N	N	N	N	N	Y,PRP	Y	N	N	Y,G	N	N	N	N	5	DRAGOO 2014
Y	Y	Y,I	Y,SUP	N	N	Y	Y	Y	Y	Y,PRP,HAI	N	Y	Y	Y,G	Y	N	N	N	13	KAUX 2019
Y	Y	Y,I	N	N	N	N	N	Y	N	Y,USGET	N	N	Y	Y,G	N	Y	N	N	8	ABAT 2016
Y	Y	Y,I	Y,UN	N	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	PAIN	Y	N	N	14	BIERNAT 2014

Y	Y	Y,I	Y,SUP	Y	N	N	N	Y	Y	Y,EX ONLY	N	Y	Y	Y,G	N	Y	N	Y	13	RIO 2015
Y	Y	Y,I	Y,SUP	Y	N	N	N	Y	Y	Y,EX ONLY	N	Y	Y	Y,G	N	Y	N	Y	13	HOLDEN 2020
Y	Y	Y,I	Y,SUP	Y	N	Y	Y	Y	Y	Y,EX ONLY	N	Y	Y	Y,I	FATIGUE	Y	N	Y	16	RIO 2017

Abbreviations: Y: yes, N: no, UN: unsupervised,, SUP: supervised, G: general, I: individualised, CERT: consensus on exercise reporting template, EX: exercise, RPE: rating of perceived exertion, MT: manual therapy, ESWT: extracorporeal shockwave therapy, PRP: platelet-rich plasma, UGPE: ultrasound guided percutaneous electrolysis, LLLT: low-level laser therapy, ESTIM: electrical stimulation, CON RX: conventional rehabilitation, CSI: corticosteroid injection, ABI: autologous blood injection: ACP: autologous conditioned plasma

APPENDIX 6: Table 8: Scoring sheet of the i-CONTENT tool (Low / High Risk for Ineffectiveness)

Author	Patient selection	Dosage of the exercise program	Type of the exercise program	Qualified supervisor	Type and timing of outcome assessment	Safety of the exercise program	Adherence to the exercise program	Total score /7
Beyer et al. 2015	L	L	L	L	L	H	L	6
Kongsgaard et al. 2009	L	L	L	L	L	L	L	7
Riel et al. 2019	L	L	L	L	L	L	L	7
Stevens & Tan 2014	L	L	L	L	L	L	L	7
Da Cunha et al. 2012	L	L	L	L	L	H	H	5
Kulig et al. 2009	L	L	L	L	L	H	L	6
Bahr et al. 2006	L	L	L	L	L	H	H	5
Lee et al. 2020	L	L	L	H	L	H	H	4

Frohm et al. 2007	L	L	L	L	L	H	H	5
Silbernagel et al. 2001	L	L	L	L	L	H	H	5
Balius et al. 2016	L	H	L	L	L	H	L	5
Mafi et al. 2001	L	L	L	L	L	H	H	5
Norregaard et al. 2007	L	L	L	L	L	H	H	5
Stasinopolous et al. 2004	L	L	L	L	H	H	H	4
De Vos et al. 2007	L	L	L	L	L	H	L	6
Johannsen et al. 2019	L	H	L	L	L	H	H	4
MacDonald et al. 2019	L	L	L	L	L	H	L	6
Gatz et al. 2020	L	L	L	H	L	L	H	5
Ganderton et al. 2018	L	L	L	L	L	L	L	7
Silbernagel et al. 2007	L	L	L	L	L	L	H	6
Clifford et al. 2019	L	L	L	L	L	L	L	7
Stergioulas et al. 2008	L	L	L	L	L	H	L	6
Rompe et al. 2008	L	L	L	L	L	L	H	6
Mellor et al. 2018	L	L	L	L	L	L	L	7

Van Ark et al. 2016	L	L	L	L	L	H	H	5
Roos et al. 2004	L	L	L	L	L	H	L	6
Chester et al. 2008	L	L	L	L	L	L	H	6
Rompe et al. 2007	L	L	L	L	L	L	H	6
Thijs et al. 2017	L	L	L	L	L	L	H	6
Horstmann et al. 2013	L	L	L	L	L	H	H	5
Alfredson et al. 1998	L	L	L	L	L	H	H	5
Alvarez et al. 2006	L	L	L	L	L	L	L	7
Kearney et al. 2013	L	L	L	L	L	L	H	6
Tumilty et al. 2012	L	L	L	L	L	L	L	7
Yelland et al. 2011	L	L	L	L	L	L	H	6
McCormack et al. 2016	L	L	L	L	L	L	H	6
Tumilty et al. 2016	L	L	L	L	L	L	L	7
Cannell et al. 2001	L	L	L	L	L	H	H	5
Jonsson et al. 2005	L	L	L	L	L	L	H	6
Kedia et al. 2014	L	L	L	L	L	H	H	5

Herrington et al. 2007	L	L	L	L	L	H	H	5
Houck et al. 2015	L	L	L	L	L	L	L	7
Dimitrios et al. 2012	L	L	L	L	L	L	H	6
Petersen et al. 2007	L	L	L	L	L	L	H	6
Steunebrink et al. 2013	L	L	L	L	L	H	L	6
Rompe et al. 2009	L	L	L	L	L	L	H	6
Young et al. 2005	L	L	L	L	L	H	L	6
De Jonge et al. 2010	L	L	L	L	L	H	H	5
Praet et al. 2019	L	L	L	L	L	L	L	7
Rathleff et al. 2015	L	L	L	L	L	L	H	6
Knobloch et al. 2008	L	H	L	L	L	H	H	4
Wheeler et al. 2017	L	H	H	L	L	H	H	3
DeJonge et al. 2011	L	H	L	L	L	H	H	4
De Vos et al. 2010	L	H	L	L	L	H	H	4
Warden et al. 2008	L	L	L	L	L	L	L	7

Visnes et al. 2005	L	L	L	L	L	H	H	5
Van Ark et al. 2018	L	L	L	L	L	H	H	5
Thompson et al. 2019	L	L	L	L	L	H	H	5
Cacchio et al. 2011	L	H	L	H	L	H	H	3
Munteanu et al. 2014	L	L	L	L	L	L	L	7
Van der Worp et al. 2014	L	L	L	L	L	L	H	6
Romero-morales et al. 2018	L	L	L	L	H	H	H	4
Romero-morales et al. 2020	L	L	L	L	L	H	H	5
Ryan et al. 2014	L	H	L	L	L	H	H	4
Riel et al. 2018	L	L	L	L	L	H	H	5
Koszalinski et al. 2020	L	H	L	L	L	H	H	4
Pearson et al. 2012	L	H	L	L	L	H	H	4
Wang et al. 2007	L	H	H	H	L	H	H	2
Notarnicola et al. 2013	L	H	H	H	L	H	H	2
Dragoo et al. 2014	L	H	H	L	L	L	H	4

Kaux et al. 2019	L	L	L	L	L	H	H	5
Abat et al. 2016	L	H	L	L	L	H	H	4
Biernat et al. 2014	L	L	L	L	L	H	H	5
Rio et al. 2015	L	H	L	L	L	H	L	5
Rio et al. 2017	L	L	L	L	L	H	L	6
Choudhary et al. 2021	L	L	L	L	L	H	H	5
Cowan et al. 2021	L	L	L	L	L	L	L	7
Habets et al. 2021	L	L	L	L	L	H	L	6
Ruffino et al. 2021	L	L	L	L	L	L	L	7
Olesen et al. 2021	L	L	L	L	L	H	H	5
Hasani et al. 2021	L	L	L	L	L	L	L	7
Mansur et al. 2021	L	L	L	L	L	L	H	6
Sprague et al. 2021	L	L	L	L	L	L	L	7

Agergaard et al. 2021	L	L	L	L	L	H	L	6
Lopez-Royo et al. 2021	L	L	L	L	L	H	H	5
Abdelkader et al. 2021	L	H	L	L	L	H	L	5
Van der Vlist et al. 2020	L	L	L	L	L	L	L	7
Breda et al. 2020	L	L	L	L	L	L	L	7
Rabusin et al. 2021	L	L	L	L	L	L	L	7
Solomons et al. 2020	L	H	L	L	L	L	H	5
Ramon et al. 2020	L	H	L	L	L	L	H	5
Scott et al. 2019	L	H	L	L	L	H	H	4
Stefansson et al. 2019	L	L	L	L	L	H	H	5
Boesen et al. 2017	L	L	L	L	L	L	L	7

Chesterton et al. 2021	L	H	L	L	L	L	H	5
Rasenberg et al. 2020	L	H	H	H	L	H	H	2
Johannsen et al. 2020	L	H	H	L	L	L	L	5
Thong-On et al. 2019	L	L	L	L	L	L	H	6
Cil et al. 2019	L	L	L	L	L	H	H	5
Kamonseki et al. 2016	L	L	L	L	L	H	H	5
Brown et al. 2006	H	H	L	H	L	H	H	2
Niesen-Vertommen et al. 1992	L	L	L	L	L	L	H	6
Jensen et al. 1989	L	L	L	L	L	H	H	5
Yu et al. 2013	L	L	L	L	L	H	H	5
Wheeler et al. 2021	L	H	L	L	L	H	H	4

Zhang et al. 2013	L	L	L	L	L	H	H	5
Bell et al. 2013	L	H	L	L	L	L	L	6
Pietrosimone et al. 2020	L	H	L	L	L	H	L	5
Holden et al. 2020	L	H	L	L	L	H	L	5

Abbreviations: L: Low, H: High.

APPENDIX 7: Table 9: RISK OF BIAS TABLE (1-2 low, 3-4 moderate, 5-7 high)

study	Sequence generation	Allocation concealment	Blinding participants, personnel	Blinding outcome assessment	Incomplete outcome data (ATTRITION)	Selective outcome reporting	Other bias	Overall
Beyer et al. 2015	Y	Y	N	Y	UC 11/58	N	N	5
Kongsgaard et al. 2009	Y	Y	N	UC	N 2/39	N	N	5
Riel et al. 2019	Y	Y	N	N	N 4/70	N	N	5
Stevens & Tan 2014	Y	Y	N	Y	UC 6/28	N	N	5
Da Cunha et al. 2012	y	uc	N	UC	n 3/17	n	UC SAMPLE	3
Kulig et al. 2009	UC	UC	N	UC	N 4/36	N	Y BASELINE	2
Bahr et al. 2006	Y	Y	N	UC	UC 5/40 crossover	n	Y crossover n5	3
Lee et al. 2017	UC	UC	N	UC	UC 6/34	N	N	2
Frohm et al. 2007	Y	Y	N	UC	N	N	UC SAMPLE	4
Silbernagel et al. 2001	UC	UC	N	uc	Uc 9/40	n	n	2
Balius et al. 2016	Y	UC	N	UC	N 3/58	N	N	4
Mafi et al. 2001	y	UC	N	UC	n	n	n	4
Norregaard et al. 2007	y	y	n	uc	Uc 7-10/45	n	n	4
Stasinopolous et al. 2004	y	uc	n	y	n	n	Uc sample	4
De Vos et al. 2007	y	y	n	y	Uc 7/70	n	n	5

Johannsen et al. 2019	Y	Y	N	Y	N	N	N	6
MacDonald et al. 2019	Y	UC	N	UC	UC 11/31	N	UC SAMPLE	2
Gatz et al. 2020	Y	UC	N	UC	UC 12/42	N	N	3
Ganderton et al. 2018	Y	Y	N	Y	UC 13/94	N	N	5
Silbernagel et al. 2007	Y	Y	N	Y	N	N	N	6
Clifford et al. 2019	Y	N	N	N	UC 7/30	N	UC SAMPLE	2
Stergioulas et al. 2008	UC	UC	N	Y	UC 12/52	N	N	3
Rompe et al. 2008	Y	Y	N	Y	N 5/50	N	N	6
Mellor et al. 2018	Y	Y	N	Y	N	N	N	6
Van Ark et al. 2016	Y	Y	N	UC	UC 9/29	N	UC SAMPLE	3
Roos et al. 2004	Y	UC	N	UC	UC 9/44	N	UC SAMPLE	2
Chester et al. 2008	Y	UC	N	UC	N	N	UC GROUP DIFF/ SAMPLE	3
Rompe et al. 2007	Y	Y	N	Y	N	N	N	6
Thijs et al. 2017	Y	Y	N	UC	UC 11/52	N	N	4
Horstmann et al. 2011	Y	Y	N	UC	N	N	UC GROUP DIFF	4
Alfredson et al. 1998	N	N	N	N	N	N	uc	2
Alvarez et al. 2006	Y	N	N	UC	UC 3/36	N	N	3
Kearney et al. 2013	Y	Y	N	Y	N	N	UC SAMPLE	5
Tumilty et al. 2012	Y	Y	Y	UC	N 7/40	N	N	6
Yelland et al. 2011	Y	Y	N	Y	N	N	UC SAMPLE	5

McCormack et al. 2016	Y	Y	N	UC	UC 4/16	N	UC SAMPLE	3
Tumilty et al. 2016	Y	Y	Y	Y	UC 16/80	N	N	6
Cannell et al. 2001	Y	UC	N	UC	N	N	UC SAMPLE	3
Jonsson et al. 2005	UC	UC	N	UC	UC 3/15	N	UC SAMPLE	1
Kedia et al. 2014	Y	Y	N	UC	N	N	N	5
Herrington et al. 2007	Y	UC	N	Y	N	N	UC SAMPLE	4
Houck et al. 2015	Y	Y	N	UC	N	N	N	5
Dimitrios et al. 2012	UC	UC	N	UC	N	N	N	3
Petersen et al. 2007	Y	UC	N	UC	UC 14/86	N	N	3
Steunebrink et al. 2013	Y	Y	N	UC	N	N	N	5
Rompe et al. 2009	Y	Y	N	Y	UC 7/68	N	N	5
Young et al. 2005	y	uc	n	uc	n	n	Uc sample	3
De Jonge et al. 2010	y	y	n	y	Uc 8/70	n	n	5
Praet et al. 2019	y	y	n	y	n	n	Uc sample	5
Rathleff et al. 2015	y	uc	n	uc	Uc 10/48	n	n	3
Knobloch et al. 2008	Y	Y	N	UC	UC 24/116	N	N	4
Wheeler et al. 2017	y	y	n	uc	n	n	n	5
DeJonge et al.	Y	Y	Y	Y	N	N	N	7
De Vos et al.	Y	Y	Y	Y	N	N	N	7
Warden et al.	Y	Y	Y	Y	UC 10/37	N	N	6
Visnes et al. 2005	Y	N	N	UC	N	N	N	4
Van Ark et al.	UC	N	N	Y	UC 8/26	N	UC sample	1

Thompson et al.	Y	Y	Y	UC	N	N	N	6
Cacchio et al.	Y	Y	UC	Y	UC 6/40	N	N	5
Munteanu et al.	Y	Y	N	UC	UC 50/140	N	N	4
Van der Worp et al.	Y	Y	Y	Y	N	N	N	7
Romero-morales	Y	N	N	N	N	N	N	4
Romero-morales	Y	N	N	N	N	N	N	4
Ryan et al.	Y	N	N	N	UC 9/65	N	N	3
Riel et al.	Y	Y	Y	Y	UC	N	Y crossover	5
Koszalinski et al.	Y	UC	N	UC	Y 15/22	N	UC sample	2
Pearson et al.	Y	UC	N	UC	UC 12/40	N	N	3
Wang et al.	Y	N	N	Y	N	N	N	5
Notarnicola et al.	Y	Y	UC	UC	UC	N	N	4
Dragoo et al.	Y	Y	Y	UC	UC 5/23	N	Y crossover	4
Kaux et al.	UC	UC	UC	UC	N	N	N	3
Abat et al.	Y	Y	UC	UC	N 4/60	N	N	5
Biernat et al.	Y	UC	UC	UC	UC	N	UC	2
Rio et al.	Y	Y	N	Y	N	N	Y crossover	5
Rio et al.	Y	UC	UC	Y	N	N	N	5
Choudhary et al.	Y	Y	N	Y	N	N	N	6
Cowan et al.	Y	Y	Y	UC	UC 12/132	N	N	5
Habets et al.	Y	Y	N	Y	N	N	N	6
Ruffino et al.	Y	Y	N	N	N	N	N	5
Olesen et al.	Y	UC	Y	UC	UC 4/40	N	N	4
Hasani et al.	Y	Y	N	Y	UC 7/48	N	N	5
Mansur et al.	Y	Y	Y	UC	UC 23/119	N	N	5
Sprague et al.	Y	N	N	N	N	N	Y sample	3
Agergaard et al.	Y	UC	N	Y	UC 5/44	N	N	4
Lopez-Royo et al.	Y	UC	N	UC	N	N	N	4

Abdelkader et al.	Y	UC	Y	Y	N	N	N	6
Van der Vlist et al.	Y	N	N	N	N	N	N	4
Breda et al.	Y	Y	N	Y	UC 9/76	N	N	5
Rabusin et al.	Y	Y	N	N	UC 20/100	N	N	4
Solomons et al.	Y	N	N	Y	UC 6/52	N	Y sample	3
Ramon et al.	Y	Y	Y	Y	UC 12/103	N	N	6
Scott et al.	Y	Y	N	Y	N 4/61	N	N	5
Stefansson et al.	Y	UC	N	Y	UC 7/60	N	UC sample	3
Boesen et al.	Y	UC	Y	Y	N	N	N	6
Chesterton et al.	Y	Y	N	N	UC 10/82	N	Y sample	3
Rasenberg et al.	Y	Y	Y	Y	N	N	N	7
Johannsen et al. 2	Y	N	N	N	UC 3/30	N	N	3
Thong-On et al.	Y	N	Y	UC	N	N	N	5
Cil et al. 2	Y	UC	N	UC	UC	N	N	3
Kamonseki et al.	Y	UC	N	Y	Y 25/83	N	N	4
Brown et al.	Y	Y	Y	Y	Y 7/18	N	Y sample	5
Niesen-Vertommen	Y	UC	UC	UC	N	N	Y sample	3
Jensen et al.	Y	UC	UC	UC	N	N	Y sample	3
Yu et al.	Y	Y	N	UC	N	N	N	5
Wheeler et al.	Y	Y	Y	UC	N	N	N	6
Zhang et al.	Y	Y	N	Y	N	N	N	6
Bell et al.	Y	Y	Y	UC	N	N	N	6
Pietrosimone et al.	Y	Y	N	Y	Y 7/35	N	Y sample	4
Holden et al.	Y	Y	N	UC	N	N	Y crossover, sample	4

Abbreviations: Y: yes, N: no, UC: unclear.

APPENDIX 8: FIGURE 6: Cochrane risk of bias plot for each study