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The Effect of *Stretching* and *Strengthening* Exercises on Reducing Pain and Functional Disorders in *Subacromial Pain Syndrome: A Literature Review*

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ABSTRACT

Introduction: Shoulder pain is the third most common pain in musculoskeletal cases, after lower back and knee pain. These complaints are caused by various things, including subacromial pain syndrome. Subacromial pain syndrome is a synonym for rotator cuff syndrome, which refers to all non-traumatic unilateral shoulder problems involving the structures surrounding the subacromial. The purpose of this study was to determine the effect of stretching andstrengthening exercises on reducing pain and functional impairment in subacromialpain syndrome. **Methods:** The method used is a literature review with a narrative type. The data for the selected publication articles are RCTs for 2013-2022 in English. Search publication articles using search PEDro, and Google Scholar which are classified into inclusion and exclusion criteria. Data analysis by assessing the quality of journals using the PEDro scale, outline literature review of the PICO method and data synthesis. **Results:** Strengthening and stretching exercises show significant short-term functional improvement and pain reduction in subacromial pain syndrome. Additionally, specific rotator cuff and scapular exercises, combined with active/passive ROM exercises, significantly enhance function and reduce pain levels. **Conclusion:** Strengthening (eccentric, isometric) and stretching exercises on the posterior shoulder and rotator cuff or scapular in the short term have an effect on reducing pain (VAS), as well as a significant improvement in function (DASH scale).

Keywords*: Subacromial pain syndrome, pain, functional disorder, stretching, strengthening.*

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INTRODUCTION

Humans need prime body conditions to be able to support optimal physical activity. Physical activity is body movement produced by skeletal muscles with the help of energy (WHO, 2018). The energy released must be balanced or not excessive because it causes side effects or problems in the body, especially in the upper extremities.

One of the health problems that arises is pain and functional movement disorders of the body. The upper extremities are limbs that are vulnerable to functional disorders because they are often used for throwing, taking, lifting objects and so on. The part of the upper extremity that often experiences problems is the shoulder joint because it has high mobility and stability (Rosadi *et al*., 2021).

Disorders or complaints that often arise are shoulder pain and functional limitations during activities. Shoulder pain is the third most common pain complaint in *musculoskeletal* cases, after low back and knee pain (Thigpen *et al*., 2016). Shoulder complaints that often arise are pain when doing activities that raise the arms above the head, inability to hold objects, stiffness and swelling in the shoulders. These complaints are caused by various things, including *adhesive capsulitis, strains/sprains* and *subacromial pain syndrome.*

Subacromial pain syndrome is a synonym for *rotator cuff syndrome* related to all *unilateral*

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non-traumatic shoulder problems affecting the structures around the *subacromial*. This condition is characterized by functional limitations and pain that can worsen during or after lifting the arm during activities, as well as sleeping on the affected shoulder (Eliason *et al*., 2021). *Subacromial pain syndrome* is caused by intrinsic factors, namely tendon quality that decreases with age and extrinsic factors by problems with muscle extensibility, *postural* and *rotator cuff* tendon pathology, such as inflammation due to mechanical compression due to *overuse* (Michener *et al*., 2015).

The reported prevalence of shoulder pain ranges from 2.4 – 26% (Kelley *et al*., 2013) and is estimated to reach 67% in the general population (Chaconas *et al*., 2017). The biggest cause of shoulder pain is *subacromial pain syndrome*, estimated at around 44 – 65% (Bhattacharyya *et al*., 2014) and will increase with age (Nejati *et al*., 2017).

Physiotherapy is an individual or group health service to develop and maintain movement abilities and function throughout the life cycle. The role of physiotherapy in cases of *subacromial pain syndrome* aims to reduce pain and restore shoulder functionality. Physiotherapy can provide various interventions to achieve this goal, such as *electrical stimulation*, *taping*, *manual therapy* and exercise therapy.

The exercise therapy that can be given is *stretching* and *strengthening*. *Stretching* is a muscle stretching exercise which aims to increase muscle extensibility which consists of active, passive and *isometric* movements. Meanwhile, *strengthening* is *anaerobic* exercise which aims to increase muscle strength by contracting muscles against weight or force.

Randomized control trial (RCT) by Chaconas *et al*., (2017), shoulder *abductor eccentric* exercises for *subacromial impingement syndrome* had an effective effect on *rotator cuff* muscle function and strength rather than pain. RCT by Gutiérrez-espinoza *et al*., (2019), the addition of *stretching pectoralis minor* did not have a clinical effect on function and pain in *subacromial pain syndrome*. Meanwhile, in the RCT by Tahran & Yes, (2020), *posterior shoulder stretching* exercises have an impact on disability, functional improvement, reduction of pain during sleep and activity in *subacromial impingement syndrome.*

Based on the description of the data above, various types of exercise therapy interventions can be given to *subacromial pain syndrome*, especially their effect on functional abilities and pain symptoms. Therefore, researchers are interested in conducting a *literature review* to understand the effectiveness of *stretching* and *strengthening* exercises in reducing pain and functional disorders in cases of *subacromial pain syndrome*.

METHODS

The method used is a *literature review* with a *narrative* type which aims to get a general picture regarding a topic and potentially identify gaps in the literature. The selected published article data is RCTs from 2013-2022 in English. *Search* for published articles using PEDro search, and *Google Scholar* which is classified into inclusion and exclusion criteria, see Table 1. Data analysis by assessing journal quality using the PEDro *scale*, as in Table 2, PICO method *literature review outline* in Table 3 and data synthesis for the study, and link it to the research objectives, as in Table 4. Next, provide arguments from the *literature survey* and final arguments related to the topics discussed sequentially.

RESULTS

Haik *et al* (2015) and Gutiérrez *et al* (2019) stated the effect of *strengthening* and *stretching* exercises in the short term on significant functional improvement, as well as reducing pain in cases of *subacromial pain* or *impingement syndrome*. Meanwhile, Moslehi *et al* (2020) and Nejati *et al* (2017) suggested a significant effect on both functional and pain levels with specific exercises for the *rotator cuff* or *scapular* plus active/passive ROM exercise (table 4).

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Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Population	*Subacromial* patient's *pain/impingement/rotator cuff tendinopathy/syndrome*	Shoulder fracture/dislocation
Intervention	*Stretching* (static, dynamic, isometric) *prime mover shoulder joint* muscle*; rotator cuff (infraspinatus, supraspinatus, subscapularis,teres minor) & griddle; trapezius (upper, lower), pectoralis minor* *Strengthening (eccentric, concentric, isometric)* otot *prime mover shoulder joint; rotator cuff (supraspinatus, infraspinatus, teres minor) & griddle; trapezius (upper, lower), serratus anterior*	*Aerobic*, SWD,NMES and *tapping*
Comparison	Pain (VAS) and shoulder function (DASH *scale*) before and after the intervention	There isn't any
Outcome	Shoulder functional improvement (DASH *scale*) and pain reduction (VAS)	There isn't any

Table 2. *Eligibility Criteria* PEDro *Scale* Result

Criteria	Haik et al	Tomás et al	Ingwersen et al	Gutiérre et al	Moslehiet al	Boudreauet al	Nejatiet al
Random allocation	✓	✓	✓	✓	✓	✓	✓
Concealed allocation	✓	x	✓	✓	✓	✓	x
Baseline							
Comparability	✓	✓	✓	✓	✓	✓	✓
Blind subject	xx	xx	x	x	xx	xx	x
Blind Therapist			x	x			x
Blind assessors	✓	✓	✓	✓	x	✓	✓
Adequate follow-up	✓	x	✓	✓	✓	✓	x
Intention to treat analysis	✓	✓	✓	✓	x	✓	x
Between-group comparison	✓	✓	✓	✓	✓	✓	✓
Estimate &variability	✓	✓	✓	✓	✓	✓	✓
Total	8	6	8	8	6	8	5

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Table 3. Outline Literature Review (PICO) Results

Title	*Population*	*Intervention*	*Comparison*	*Outcome*
Stretching, Strengthening Exercises with or Without Manual Therapy on Scapular Kinematics, Function & Pain in SIS Patients, Haik *et al* (2015)	46 patients had a history *of non-traumatic* shoulder pain, *painful arch*, 1 or more positive SIS tests (jobe, neer, Hawkins Kennedy), Painful passive/isometric external rotation at 90 degrees abduction and tenderness on palpation of the *rotator cuff* tendons.	Intervention group (n = 23); Stretching both arms without pain in the *pectoralis minor* muscle, *upper trapezius, and posterior shoulder* (3 repetitions for 30 seconds, pause 30 seconds). *strengthening external rotation, shoulder extension; (latissimus dorsi) shoulder protraction; (serratus anterior); prone lying + elastic band; supine* arm flexed 90 degrees, elbow extended, pull the *elastic band* towards the front (3 sets of 10 repetitions, pause 1 minute). Therapy manuals; grade 3 & 4 mobilization 45 minutes each on the affected arm. The control group (n = 23) did not receive manual therapy.	*Scapular kinematic, functional (DASH scale) Pain & mechanical sensitivity (VAS).* Pain (VAS), Functional, (DASH *scale*) & *kinematic error.*	There was a functional increase & decrease in pain, as well as mechanical sensitivity in the *exercise* group without *manual therapy* after 4 weeks. SFT exercises can control pain & improve function. The rehabilitation program + EMG *feedback* is thought to be effective in improving functional, and kinematic & reducing pain after 8 weeks.
Improved Scapular Focused Exercise Feedback in SIS Patients, Moslehi *et al* (2020)	75 patients with shoulder pain > 6 weeks, 2 of the following conditions are present; *full arc* flexion or abduction pain, external rotation resistance pain. abduction. Positive test; neer, hawkins-kennedy or Jobe test.	Intervention group (n = 25): 1. *Shoulder position* (week 1), 2. *Scapular-focused treatment* (SFT); *strengthening; eccentric, intrinsic* (weeks 2-7), 3. Flexibility & *isometric stretching of the rotator cuff* (Weeks 4 & 8). Group + EMG *biofeedback* (SFTF) (n = 25); exercise was the same as the intervention group. The control group (n = 25) was not given SFT.		

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Title	*Population*	*Intervention*	*Comparison*	*Outcome*
Does Stretching the Pectoralis Minor Provide Additional Benefits Over an Exercise Program in SAPS Patients, Gutiérrez et al (2019)	80 patients aged > 18 years were diagnosed with SAPS at Central Metropolitan Health Service Chile, complaining of anterolateral shoulder pain > 3 months, 1 or more positive tests; neer / Hawkins-Kennedy / pain against resistance during external rotation or empty can test.	Intervention group (n = 40); *scapular control;* 1. *Shoulder* flexion 60 degrees (*supine*) progressively 90 degrees (sitting) + *elastic band.* 2. Protraction with *elbow* extension (*supine*) + elastic band (close kinetic chain). 3. *Shoulder extension* (*prone*) and arm extension. *Glenohumeral control*; 1. Isometric adduction with a pillow at the elbow, then do isometric external rotation. 2. Isometric adduction at 30-60 degrees glenohumeral abduction. *Stretching*; 1. *Pectoralis minor "unilateral cornel stretch"* (10 repetitions for 1 minute, pause 30 seconds). 2. Passive *stretching upper trapezius & posterior capsule* 3 times. Pain-free *movement shoulder* retraction, abduction in the *scapular plane*, neck retraction 10 times. The control group (n = 40) received no *stretching pectoralis minor*.	Pain (VAS) and shoulder function (DASH *scale*).	There was a significant effect on shoulder function in the control group and a slight effect on pain. The addition of *stretching the pectoralis minor* does not provide significant benefits of functional improvement, and pain reduction over 12 weeks.

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Title	*Population*	*Intervention*	*Comparison*	*Outcome*
SIS treatment; Platelet-Rich Plasma Or Exercise Therapy Nejati *et al* (2017)	62 patients aged at least 40 years with complaints of shoulder pain for at least 3 months, at least 3 positive tests; jobe, neer, *empty can*, *speed test* & Hawkins-Kennedy test.	Group 1 (n = 31); *platelet-rich plasma* 4ml Group 2 (n = 31); Phase 1: 1. *isometric exercise*; flexion, *lateral rotation*, *abduction*. 2. Passive ROM & pendulum *exercise* 8 – 10 times per day. 3. *Stretching*; neck & cross-body 10 seconds. Phase 2; 1. Active ROM *exercise*; elevation > 60 degrees. 2. *Strength training*; *internal & external rotation rotator cuff* 10 repetitive 3 sets 3. *Stretching* phase 1; 15-20 seconds. Phase 3; *rotator cuff strength training; external & internal rotation* at 90 degrees abduct, *reverse fly*, *shoulder extension & bent-row exercise + elastic band*; 10 reprises 3 sets. Phase 4; *strengthening rotator cuff* & *bicep* using a *medicine ball* for 15 reps, 3 sets. At the beginning of the session, 10-15 minutes of *aerobic* exercise is given and at the end of the session,	Pain (VAS) functional (DASH *scale*), *muscle strength* (MMT).	*Platelet-rich plasma &* exercise therapy effectively reduced pain and *disability* in SIS patients after 6 months of *follow-up.*

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Title	*Population*	*Intervention*	*Comparison*	*Outcome*
		20 minutes of *ice packs* are given.		

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Title	*Population*	*Intervention*	*Comparison*	*Outcome*
Addition of Glenohumeral Adductor Coactivator in the Rotator Cuff Tendinopathy Exercise Program, Boudreau *et al* (2019)	42 patients aged 18-65 years were diagnosed with *rotator cuff pathology* > 1 month, pain in abduction or flexion & resistance to external rotation or humeral abduction. Test positive: neer or Hawkins-Kennedy.	RCEx Group (n = 21); *strengthening*; 1. *Serratus anterior*; *wall push-ups* with outward pressure. 2. *Upper trapezius*; *scapular retraction* (standing arm abducted to 90 degrees scapular plane, then prone position at the end of the intervention). 3. *Glenohumeral*; *external* & *internal rotation* in standing position and arm next to *trunk* + *elastic band* progressively. If you can do everything without pain, then continue to the sitting position with 30 degrees abduction and *elbows* on the table for 10 repetitions. If you can do it without pain, continue *glenohumeral flexor* & *abductor* exercises. RCEX group + *coactivator* (n = 21); 1. *glenohumeral* + *latissimus dorsi*, *pectoralis major* exercises. 2. Understand *latissimus dorsi* & *pectoralis major* activation using EMG; electrodes in the pectoralis major muscle belly (*sternal* above the *costochondral* joint) and *latissimus dorsi* 1 cm below *inferior scapula*. If you experience an increase in pain of 5 – 10 (VAS) during exercise, adjust the load to light.	Functional (DASH *scale* & WORC), Pain (VAS) & AHD.	The addition of a glenohumeral *adductor co-activator* does not show benefits in improving function (DASH *scale*), reducing pain silent after 6 weeks & slight benefit on movement and functional pain (WORC *scale*).
Effectiveness of Physiotherapy Interventions in Non-traumatic Inoperable Shoulder Pain, Tomás *et al* (2017)	74 patients under 80 years of age, no cognitive impairment with either condition; non-traumatic *rotator cuff tears*, *tendinitis (supraspinatus, infraspinatus)*, *capsulitis* and SIS.	Intervention group (n=36); *isometric shoulder strengthening; internal* rotation 5 seconds 5 repetitions, *external* rotation 5 seconds, *shoulder* extension 5 seconds 5 repetitions. *stretching posterior shoulders*; 5 seconds & *neck* (flexion, extension, lateral flexion, rotation); 5 repetitions. Active ROM *exercise*: elevation 3 seconds 5 repetitions. Pendulum *exercise*; forward, backward and *circle* (1-3 minutes),	Pain and function (VAS, DASH *scale*).	There was a significant functional increase (DASH *scale*) in the intervention group. There was no difference in the effect of pain reduction

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Title	*Population*	*Intervention*	*Comparison*	*Outcome*
Progressively High Dose Strength Training Compared to Light Doses in Rotator Cuff Tendinopathy Ingwersen *et al* (2017)	100 patients aged 18 -65 years, complaints of proximal lateral pain in the upper arm for at least 3 months, worsened by abduction movements and one of the signs verified by US; tendon *swelling*, *hypoechoic area*, *supraspinatus neovascularization*. Positive test; full can jobe, neer or Hawkins- Kennedy.	*movement on the table*: elbow flexed arm on the *table*, forward movement; 5 repetitions. The control group (n=38) received similar interventions at their own time and subgroups. 2 *exercise scapula-stabilizing muscle; protraksi, retraksi& stretching posterior shoulder. 2 specific exercise rotator cuff strengthening (deltoid activation), 2 mobility exercise rotator cuff & scapula thoracic + elastic band, dumbbell;* 3 times a week and maximum pain 5 (VAS). Light (n = 51) & heavy (n = 49) doses of exercise had the same training. Light doses of exercise; 20-25 reps 3 sets and *rest* 30 seconds, Progressive heavy dose training; 15 reps weeks 1, 12 Repetitions week 2-3, 10 repetitions Week 4-5, 8 repetitions weeks 6-8 & 6 reps weeks 9-12.	Pain (VAS), Functional (DASH *scale*), ROM (HALO digital *goniometer*), US.	(VAS) / almost none between the intervention and control groups after 5 weeks of *follow-up*. Progressive and light dose exercise resulted in a general improvement in functional (DASH *scale*), & pain (motion, nocturnal, maximum pain), at 12 weeks - *follow up*, except for silent or resting pain (VAS).

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Table 4. Journal Synthesis Results

Study	Journal Synthesis
Haik *et al* (2015)	Providing *stretching* and *strengthening* (*elastic bands*) targeting the *trapezius, serratus anterior, pectoralis minor* and *posterior* muscles showed an increase in shoulder functionality on the DASH *scale* and changes in pain (VAS) in the short term.
Gutiérrez *et al* (2019)	The addition of *stretching pectoralis minor "unilateral cornel stretch"* in the short term does not provide any clinical effect or benefit for pain or function. The *strengthening (glenohumeral, scapular control)* and *stretching (upper trapezius, posterior capsule)* exercise program without *stretching pectoralis minor* showed a significant effect on function (DASH *scale*) and decreased pain (VAS).
Moslehi *et al* (2020)	*Scapular-focused treatment + EMG biofeedback* (SFTF) and *Scapular-focused treatment* (SFT); *muscle strength & tight shoulder muscle flexibility/stretching rotator cuff* can reduce *subacromia*l inflammation and *soft tissue impingement*, and have a significant effect on reducing pain and improving shoulder functionality in the short term.
Nejati *et al* (2017)	*Stretching* and *strengthening* + active/passive ROM exercises in the *rotator cuff & scapular* muscles during 1, 3 and 6-month *follow-up* showed a significant effect on reducing pain (VAS) and functional improvement (DASH) in the short term.
Boudreau *et al* (2019)	The addition of *glenohumeral + coactivation* (*pectoralis major, latissimus dorsi*) to *strengthen*ing exercises (*serratus anterior, trapezius, glenohumeral*) or *strengthen*ing exercises themselves did not show any effect on functional improvement (DASH *scale*) and silent pain, had little effect on motion pain (VAS).
Tomás *et al* (2017)	*Stretching (posterior shoulder, neck), strengthening (eccentric & isometric) with elastic bands* and active/passive ROM *exercise* showed a significant effect on improving shoulder function ($P < 0.001$), but not for pain (0.723).
Ingwersen *et al* (2017)	Light or high dose training *strengthening isometric internal, external rotation* focuses on activating the deltoid muscle with resistance, *scapula-stabilizing muscle, strengthening, mobility exercise rotator cuff, scapula thoracic complex* plus

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corticosteroid injection can increase functional muscle strength (DASH *scale*) significantly compared to who did not have *corticosteroid* injection added during the 12-week follow-up.

DISCUSSION

The research of Haik *et al* (2015), Gutiérrez *et al* (2019) and Moslehi *et al* (2020) is also strengthened by *valid* and *reliable* measurements, as well as good research quality based on the PEDro *scale* so that the effect can be ascertained (table 2). Gutiérrez *et al* (2019), Moslehi *et al* (2020) and Nejati *et al* (2017) did not mention in detail the target muscles involved in the intervention. Haik *et al* (2015) and Gutiérrez *et al* (2019) did not clearly state the order of intervention provided. Meanwhile, Moslehi *et al* (2020) provided *isometric stretching* exercises in the middle and end of the meeting between *strengthening* exercises, namely weeks 4 and 8. Nejati *et al* (2017) provided a *stretching*, *strengthening* plus *aerobic* training program at the beginning of each training session and the final session with *ice packs*. *Stretching* is given in phases 1 and 2 of the exercise program, but the sequence is not explained in detail (table 3).

Nejati *et al* (2017)'s research are of sufficient quality, this is because there is no control group for *intention to treat analysis*, so there is bias in determining the effectiveness of *treatment*. There was *adequate follow-up* because as many as 11 of the total 31 patients in the exercise therapy group did not follow or failed to complete 6 months of *follow-up* for certain reasons. Monitoring stopped after 3 months of *follow-up*, so there is a possibility that the patient did not continue the exercise protocol given. There was no *concealed allocation* in this study because the MRI condition of the patient's shoulder was considered a confounder, so patients were randomly assigned to intervention groups in certain *stages* (table 2).

These four studies show the effectiveness of *stretching* and *strengthening* exercises on changes in pain and functional disorders in *subacromial pain syndrome* using the functional scale (DASH) and pain measurement (VAS) in the acute phase (table 4). *Strengthening* exercises are designed to increase muscle strength and movement function without symptoms, while *stretching* can increase flexibility, and ROM and reduce pain.

Visual analogue scale (VAS) is a psychometric measurement instrument designed to document disease-related symptom severity characteristics in patients and use it to achieve rapid (statistically measurable and reproducible) classification of symptom severity, as well as disease control. VAS scores range from 0–10, higher scores indicate greater pain intensity (Klimek *et al*., 2017).

The reliability of the VAS for measuring acute pain as assessed by the ICC was high. Ninety per cent of the pain ratings were reproduced in 9 mm. These data indicate that the VAS is reliable enough to be used to assess acute pain (Bijur *et al*., 2001).

The Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire is a 30-item questionnaire that looks at a patient's ability to perform certain upper extremity activities. This questionnaire is a self-report questionnaire that patients can rate difficulties and interference in daily life on a 5-point Likert scale (Franchignoni *et al*., 2014).

In contrast to the four previous researchers, Tomás *et al* (2017) and Ingwersen *et al* (2017) only suggested a significant effect on shoulder function, but not pain. Boudreau *et al* (2019) stated that *rotator cuff* and *glenohumeral strengthening* exercises, either with or without the addition of *co-activators* (*serratus anterior*,

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latissimus dorsi) showed smaller changes in movement pain (VAS), but there was no effect on the DASH *scale* (table 4). Boudreau *et al* (2019) made changes to the measurement time protocol which was originally based on RCT registration from 24 weeks to 6 weeks because no changes were found.

There was *adequate follow-up* bias in Tomás *et al* (2017) because the control group in the study received a similar intervention and 13 people in the control group did not complete it until the end (table 2). The sample in this study was heterogeneous regarding shoulder problems, namely tendinitis (*supraspinatus*, *infraspinatus*), *capsulitis* and *subacromial impingement syndrome*. *Capjualitis* has several characteristic symptoms and causes that are different from *subacromial pain*/*impingement*/*rotator cuff syndrome*. The exercise procedures are not explained in this study or are listed separately with the link provided and the sequence is not explained. Tomás *et al* (2017) did not fully state the target muscles involved in the intervention (table 3).

Ingwersen *et al* (2017) were lacking in the effects obtained between intervention groups. This could be because the intervention time given was not long enough to improve tendon health. (Ingwersen *et al* (2017) added *corticosteroid injection* to *strengthening* exercises to maximize the effectiveness of these exercises, but there are shortcomings related to the *secondary outcome* of pain. Giving *corticosteroid injections* can create bias in assessing the effect of changes in pain from these exercises. Ingwersen *et al* (2017) do not fully state the target muscles being intervened (table 3).

CONCLUSION

Based on the *literature review* from the seven RCT journals, providing *strengthening* and *stretching* exercises that focus on the *posterior shoulder* and *rotator cuff* or *scapular* can have an effective influence on changes in pain and functional disorders. This exercise can be used as an option for providing physiotherapy intervention so that the shoulder is free from symptoms in cases of *subacromial pain syndrome*.

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