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Possibility of the Modified Wall-stretching Exercises to Improve Shoulder Flexibility

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KEYWORDS
Shoulder limitation; Stretching exercise; Self-management; Rehabilitation; Physical therapy.

ABSTRACT
The shoulder joint frequently faces the risk of joint injury affecting its flexibility due to a large range of motion. Current managements usually require several poses and expert guidance that could affect their clinical application. The present study developed a practical strategy, as the so-called modified wall-stretching exercise, and preliminary investigated its possibility to improve shoulder flexibility in order for the findings to estimate the suitable number of sample size required to confirm the effectiveness of this technique. This quasi-experimental design was conducted in 10 pilot participants (5 females, and 5 males) who had limited flexibility in both shoulders as determined using the back scratch test. Participants performed a modified wall-stretching exercise by placing both hands on the wall and bending their upper trunks downward. They executed this exercise in three hand positions, including turning both hands upward, sideward, and downward with holding for 15 seconds in each hand position. The outcomes of the back scratch test were measured immediately before and after the exercise. Participants demonstrated significant reduction in the distance between both hands of the back scratch test immediately after completing a modified wall-stretching exercise (p-value < 0.01). The preliminary findings suggested the possibility of using a modified wall-stretching exercise as an alternative practical strategy to improve shoulder flexibility. In addition, the finding further suggested that a future study required at least 31 participants to confirm the effectiveness of this stretching protocol.

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Introduction

The shoulder joint has a large range of motion (ROM), enabling the ability to execute daily activities, such as overhead reaching, combing hair, and placing a hand behind the back[1,2]. However, the large ROM also increases the risk of injury affecting joint flexibility, a crucial factor in reducing joint mobility through an unrestricted and pain-free range[3,4]. However, many factors can decrease joint flexibility (e.g., improper joint use, a sedentary lifestyle leading to muscle weakness, poor posture, and age-related systemic decline) that could affect the ability to conduct daily activities[5-7]. Therefore, exercise protocols play crucial roles to maintain and optimize shoulder flexibility.

Currently, many exercise protocols, either active or passive exercises, have been prescribed to maintain and enhance shoulder flexibility[8-11]. However, many of these protocols are challenging for their clinical applications due to the requirement of expert guidance and numerous specific poses that are difficult to remember and time-consuming for their effectiveness[12,13]. With the emphasis on self-care management nowadays, further exploration for a practical and self-administrating strategy may offer an alternative protocol to promote shoulder flexibility.

From the literature review, the researchers found a method of wall stretching exercise that requires an individual to stand facing the corner or the doorway, place both hands on the wall, and lean the trunk forward. However, this exercise protocol can stretch mainly for pectoralis muscles[2,14,15]. When considering particular characteristics of the shoulder, the surrounding soft tissues travel, covering the joint with the attachment between the upper trunk and upper arms. The researchers hypothesized that developing an exercise protocol—as the so-called modified wall-stretching exercise—with fixing the arms on the wall would help fix the distal end (insertion) of the soft tissues. Then, turning the hand positions by leaning the upper trunk downward would alter the soft tissues surrounding the joint to be exposed to the stretching forces of the body weight. Therefore, this study preliminary assessed the possibility of a modified wall-stretching exercise to improve shoulder flexibility. Furthermore, the findings of the present study would be used to estimate the suitable number of sample size required to further confirm the effectiveness of this exercise protocol.

Material and methods

Study design and participants

This quasi-experimental study was conducted with 10 pilot participants, both males and females. All of them had limited shoulder flexibility on both sides, as determined using the back scratch test—both hands could not touch each other—a score less than zero[16,17]. In addition, the eligible participants did not have significant painful shoulder(s) (visual analog scale < 5 out of 10)[18], general joint laxity, or hypermobility, determined through a hyperabduction test[19]or any musculoskeletal or neuromusculoskeletal abnormalities, such as arthritis, cervical radiculopathy, impingement, fractures, frozen shoulder, joint dislocation, or subluxation. This study is part of a research project aiming to preliminary explore an effective and practical strategy to improve shoulder flexibility for caregivers working with individuals with movement impairments (HE662206). Eligible participants signed a written informed consent that had been approved by the Khon Kaen University Ethics Committee for Human Research before participation in the study.

Research protocols

The eligible participants were interviewed and assessed for their demographics, including age, body weight, height, history of shoulder injury, and dominant and non-dominant arms, using the Edinburgh Handedness Inventory[19]. Subsequently, participants were assessed for their shoulder flexibility using the back scratch test for both arms[16,17]. After sufficient rest, participants

performed a modified wall-stretching exercise, with the assessment of the back scratch test thereafter. Details of stretching exercises and outcome measures are as follows.

Modified wall-stretching exercise

In general, a stretching protocol can be done by fixing one end and moving the other end of the soft tissue[20]. Therefore, in this study, participants stood facing the wall at a distance of their arm length. Then, they were instructed to place both hands on the wall firmly at their shoulder level with the elbow extension and the distance between the hands slightly wider than their shoulder width (Figure 1A). The stretching protocol was executed while participants placed their hands in three directions, including upward, sideward, and downward. In each hand position, they were instructed to lean the upper trunk downward as far as they could (Figure 1), but without any discomfort, and hold for 15 seconds[15,21]. Then, they repeated the exercise protocol with the remaining hand positions (sideward and downward, Figure 1C and 1D), and thus, the total stretching duration took approximately 45 seconds.

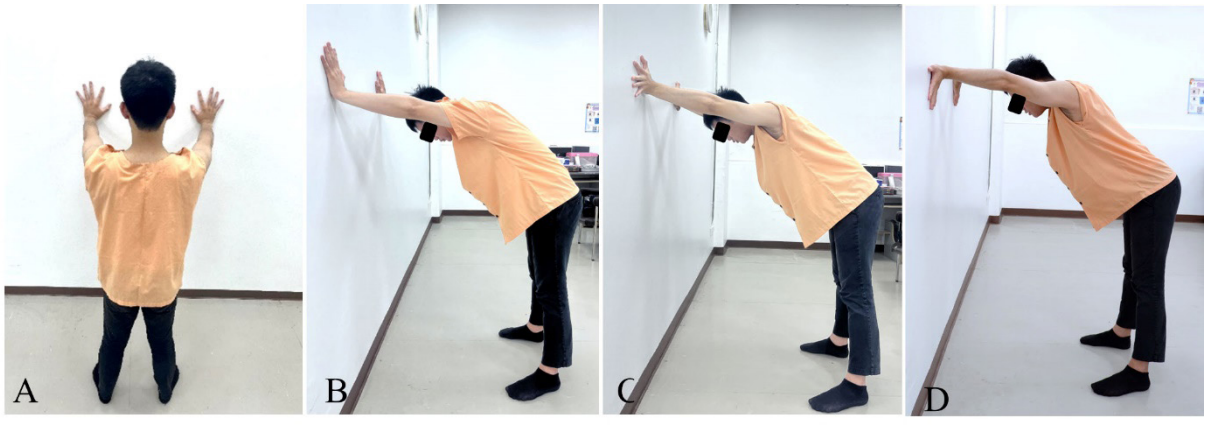

Figure 1 A modified wall-stretching protocol.
(A) Starting position.
(B) Stretching while hands in upward position.
(C) Stretching while hands in sideward position.
(D) Stretching while hands in downward position.

Back scratch test

The back scratch test is practical with excellent reliability measure (ICC: 0.98, 95% CI: 0.97 to 0.98) for assessing the upper limb and upper trunk flexibility[16,17]. In a standing position, participants attempted to touch both hands behind their backs, with one hand reaching downward from over the shoulder and the other hand reaching upward from behind their back. The distance between the fingertips was then measured. Scores (in cm) were assigned for the top arm as zero if the fingertips of both hands could contact each other, a negative value if they were unable, and positive if they overlapped each other. The average result from two attempts was recorded for each hand[16,17]. A previous study reported a minimal detectable change of this test at 1.41 cm[16].

Statistical analysis

The Shapiro-Wilk test was used to assess the normality of the data distribution. Descriptive statistics were employed to explain the demographics

and findings of the study. The paired samples t-tests were utilized to analyze the changes before and after the stretching exercise. The level of significant difference was set at *p*-value < 0.05.

Results

Ten participants (five females and five males), with an average age of 36.20±8.27 years and a body mass index of 28.48±5.74 kg/m^2, completed this study. All of them did not have any previous shoulder injury and did not report any noticeable shoulder pain during exercises.

All participants had limited flexibility as measured using the back scratch test, especially in the non-dominant arm, approximately 15 cm (Figure 2). After exercise, they showed significant improvement for both arms, about 3 cm (*p*-value < 0.01, Figure 2). Then, the researchers took these data to estimate the appropriate number of sample size to further confirm the exercise's effectiveness, with the test's power at 0.9. The data indicated that a future study would require at least 31 participants.

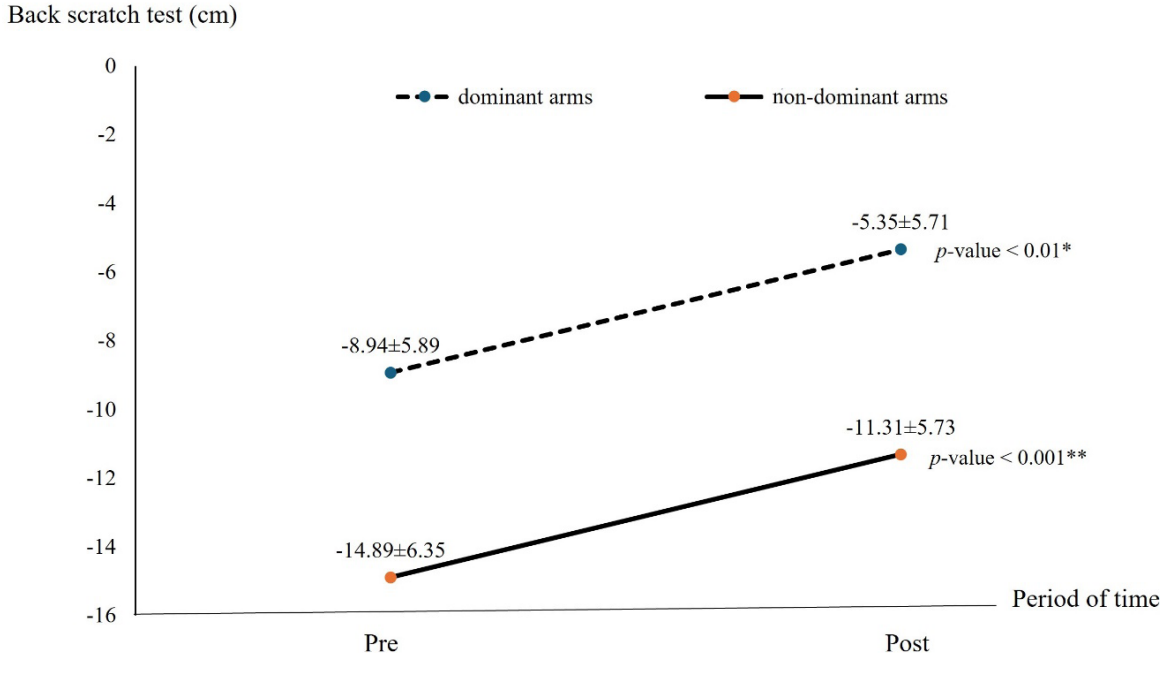

Figure 2 The change of back scratch test of the dominant and non-dominant arms before and after the modified wall-stretching exercise.

Note: The data are presented using the mean±standard deviation with the *p*-value from the paired t-test.

Discussion

This study developed a self-administering stretching exercise protocol, as the so-called modified wall-stretching exercise, and investigated its possibility to promote shoulder flexibility in 10 pilot participants. The findings would also be used to estimate the suitable number of sample size required to further confirm the exercise effectiveness. The results revealed a significant improvement in the back scratch test, approximately 3 cm for both arms, immediately after the modified wall-stretching exercise (Figure 2). This improvement was greater than the level of minimal detectable change of the test (1.41 cm)[16].

The improvement found in the study may preliminary reflect the clinical benefit of the modified wall-stretching exercise. By fixing their hands against the wall and leaning the upper trunk downward (Figure 1), the protocol enabled effective and self-controlled stretch of both ends of the soft tissues in the arms and upper trunk, utilizing the body weight. Then, turning the hands in three directions (upward, sideward, and downward, as depicted in Figure 1) altered the soft tissues surrounding the shoulders, arms, and upper trunk to the stretching force from the body weight. This explanation may be the possible reason for the significant improvement immediately after the exercises (p-value < 0.01, Figure 2).

The back scratch test measures combined shoulder movements, including internal rotation, extension and adduction of the lower arm, external rotation, flexion, and upper arm abduction. Outcomes of the test, therefore, can be used as a quick screening measure for shoulder limitations[22]. In addition, the back scratch test can be used to reflect the flexibility of the anterior compartment of the trunk due to its involvement as the origin of shoulder muscles[23]. Therefore, the improvement in the outcomes of this test preliminary suggested the benefit of a modified wall stretching exercise for the upper limb, particularly the shoulder and upper trunk flexibility.

Previously, some studies have reported the benefit of exercise protocols on the outcomes using the back scratch test. Stanziano et al[24] reported the improvement of the back scratch test for 0.83-1.76 cm after an 8-week static stretching exercise using rope loops. Another study also found significant improvement in the back scratch test after a 12-week Nordic Walking training program in postmenopausal female office workers[25]. A recent study additionally found a significant improvement in the back scratch test after 12-week resistance exercises with low-intensity elastic bands and full body stretching exercise program[26]. With its practicability and self-administration protocol, the present findings suggest the possibility of using a modified wall stretching exercise to promote upper limb and upper trunk flexibility.

Limitations

This single-group pre-and post-test design involved 10 pilot participants who did not have any other problems accompanying joint limitation, such as pain, history of joint injury, or inflammation, with the outcome assessment only using the back scratch test. Thus, the findings may not clearly confirm the clinical utility of this technique for the general population. Therefore, a future study of at least 31 participants who have other problems relating to joint limitation using a randomized controlled trial covering other variables relating to joint functions would clearly confirm the effectiveness of this practical stretching strategy, namely a modified wall-stretching exercise.

Conclusion

This study preliminary supported the effectiveness of a modified wall-stretching exercise for 45 seconds on shoulder flexibility (p-value < 0.001). However, a further randomized controlled trial with at least 31 participants is needed to clearly confirm the effectiveness of this practical and self-administrating exercise protocol.

Take home messages

A modified wall-stretching exercise may be applied as an alternative practical strategy to promote upper limb and upper trunk flexibility.

Conflict of interest

The authors declare no conflict of interest.

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References

1. Gasibat Q, Bin Simbak N, Abd Aziz A. Stretching exercises to prevent work-related musculoskeletal disorders – A review article. Am J Sport Sci Med 2017; 5(2): 27–37.
2. Nuzzo JL. The case for retiring flexibility as a major component of physical fitness. Sport Med 2020; 50(5): 853–70.
3. Bouguezzi R, Sammoud S, Markov A, Negra Y, Chaabene H. Why flexibility deserves to be further considered as a standard component of physical fitness: A narrative review of existing insights from static stretching study interventions. Youth 2023; 3(1): 146–56.
4. Lugo R, Kung P, Ma CB. Shoulder biomechanics. Eur J Radiol 2008; 68(1): 16–24.
5. De Oliveira Medeiros HB, De Araújo DSMS, De Araújo CGS. Age-related mobility loss is joint-specific: An analysis from 6,000 Flexitest results. Age 2013; 35(6): 2399–407.
6. Weerapong P, Hume PA, Kolt GS. Stretching: Mechanisms and benefits for sport performance and injury prevention. Phys Ther Rev 2004; 9(4): 189–206.
7. Kang MH, Oh JS. Effects of self-stretching with mobilization on shoulder range of motion in individuals with glenohumeral internal rotation deficits: a randomized controlled trial. J Shoulder Elb Surg 2020; 29(1): 36–43.
8. Bryant J, Cooper DJ, Peters DM, Cook MD. The effects of static stretching intensity on range of motion and strength: A systematic review. J Funct Morphol Kinesiol 2023; 8(2): 1-16.
9. Konrad A, Stafilidis S, Tilp M. Effects of acute static, ballistic, and PNF stretching exercise on the muscle and tendon tissue properties. Scand J Med Sci Sport 2017; 27(10): 1070–80.
10. Behm DG, Blazevich AJ, Kay AD, McHugh M. Acute effects of muscle stretching on physical performance, range of motion, and injury incidence in healthy active individuals: A systematic review. Appl Physiol Nutr Metab 2015; 41(1): 1–11.
11. Behm DG, Alizadeh S, Daneshjoo A, Anvar SH, Graham A, Zahiri A, et al. Acute effects of various stretching techniques on range of motion: A systematic review with meta-analysis. Sport Med - Open 2023; 9(1): 1–16.
12. Knudson D. The biomechanics of stretching the biomechanics of stretching. J Exerc Sci Physiother 2006; 2: 3–12.
13. Vetter S, Schleichardt A, Köhler HP, Witt M. The effects of eccentric strength training on flexibility and strength in healthy samples and laboratory settings: A systematic review. Front Physiol 2022; 13: 1–13.
14. Stecco C, Pirri C, Fede C, Yucesoy CA, De Caro R, Stecco A. Fascial or muscle stretching? A narrative review. Appl Sci 2021; 11(1): 1–11.
15. Olenich S, Waterworth G, Badger GJ, Levy B, Israel E, Langevin HM. Flexibility and strength training in asthma: A pilot study. J Asthma 2018; 55(12): 1376–83.
16. Bhattacharya PK, Deka K, Roy A. Assessment of inter-rater variability of the Senior Fitness Test in the geriatric population: A community based study. Int J Biomed Adv Res 2016; 7(5): 208–12.
17. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. J Aging Phys Act 1999; 7(2): 129–61.

18. Cote JN, Hoeger Bement MK. Update on the relation between pain and movement: Consequences for clinical practice. Clin J Pain 2010; 26(9): 754–62.
19. Veale JF. Edinburgh handedness inventory - short form: A revised version based on confirmatory factor analysis. Laterality 2014; 19(2): 164–77.
20. Page P. Current concepts in muscle stretching for exercise and rehabilitation. Int J Sports Phys Ther 2012; 7(1): 109–19.
21. Thomas E, Bianco A, Paoli A, Palma A. The relation between stretching typology and stretching duration: The effects on range of motion. Int J Sports Med 2018; 39(4): 243–54.
22. Kang M-H. Relationship of Scratch Test and Glenohumeral Internal Rotation and Horizontal Adduction Range of Motion. J Musculoskelet Sci Technol 2018; 2(2): 29–32.
23. Kang F-J, Lin K-Y. Observing the effect of physical activity on forward head posture and rounded shoulder posture in young healthy adults. J Phys Ther Sci 2023; 35(8): 564–7.
24. Stanziano DC, Roos BA, Perry AC, Lai S, Signorile JF. The effects of an active assisted stretching program on functional performance in elderly persons: A pilot study. Clin Interv Aging 2015; 4(1): 115–20.
25. Kocur P, Pospieszna B, Choszczewski D, Michalowski L, Wiernicka M, Lewandowski J. The effects of nordic walking training on selected upper-body muscle groups in female-office workers: A randomized trial. Work 2017; 56(2): 277–83.
26. Sanchez-Lastra MA, Varela S, Cancela JM, Ayán C. Upper versus lower body resistance exercise with elastic bands: effects on cognitive and physical function of institutionalized older adults. Eur Geriatr Med 2022; 13(4): 907–16.