Article

CLINICAL REHABILITATION

Clinical Rehabilitation
2016, Vol. 30(1) 64–72

DOI: 10.1177/0269215515575747
cre.sagepub.com
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The effectiveness of a neck and shoulder stretching exercise program among office workers with neck pain: a randomized controlled trial

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Abstract

Objective: To determine the effectiveness of neck and shoulder stretching exercises for relief neck pain among office workers.

Design: Randomized controlled trial.

Setting: An outpatient setting.

Participants: A total of 96 subjects with moderate-to-severe neck pain (visual analogue score ⩾5/10) for ⩾3 months.

Interventions: All participants received an informative brochure indicating the proper position and ergonomics to be applied during daily work. The treatment group received the additional instruction to perform neck and around shoulder stretching exercises two times/day, five days/week during four weeks.

Main outcomes: Pain, neck functions, and quality of life were evaluated at baseline and week 4 using pain visual analogue scale, Northwick Park Neck Pain Questionnaire, and Short Form-36, respectively.

Results: Both groups had comparable baseline data. All outcomes were improved significantly from baseline. When compared between groups, the magnitude of improvement was significantly greater in the treatment group than in the control group (–1.4; 95% CI: –2.2, –0.7 for visual analogue scale; –4.8; 95% CI: –9.3, –0.4 for Northwick Park Neck Pain Questionnaire; and 14.0; 95% CI: 7.1, 20.9 for physical dimension of the Short Form-36). Compared with the patients who performed exercises <3 times/week, those who exercised ⩾3 times/week yielded significantly greater improvement in neck function and physical dimension of quality of life scores ($p = 0.005$ and $p = 0.018$, respectively).

Conclusion: A regular stretching exercise program performed for four weeks can decrease neck and shoulder pain and improve neck function and quality of life for office workers who have chronic moderate-to-severe neck or shoulder pain.

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Keywords
Neck and shoulder pain, exercise program, office workers, stretching

Received: 4 October 2014; accepted: 8 February 2015

Introduction

Nowadays, desk-based office workers are typically exposed to prolonged sedentary behavior associated with computer use. The repetitive strain of the musculoskeletal system associated with inappropriate ergonomic equipment used during daily work is named work-related musculoskeletal disorders.[1–3] This condition increases the risk of chronic neck and shoulder pain among office workers. Moreover, because of its chronic and repetitive nature, the prevalence of work-related musculoskeletal disorders has been increasing rapidly.[4]

These chronic neck and shoulder pains have great socioeconomic impact as they are associated with low work ability and poor quality of life.[5] Approximately 56% of sick leave has been attributed to work-related musculoskeletal disorders.[6] Various therapeutic modalities have been used by patients suffering from work-related musculoskeletal disorders; these include exercises, manual therapy, massage, ergonomics, multidisciplinary treatment, and energized splint and individual treatment vs. group therapy.[7] Among these, stretching exercise is our treatment of interest because it can decrease muscle stiffness by elongating the elastic component of the musculotendinous unit.[8] It can also decrease pain and improve flexibility.[9–10] In most cases, pain associated with work-related musculoskeletal disorders causes some degree of disabilities from limitation of range of motion.

Although a considerable number of studies focusing on the effects of exercise for neck and shoulder pain in office workers have been conducted, there is conflicting evidence of the benefits of exercise. For instance, a Cochrane review in 2007[4] and 2013[11] reported the efficacy of conservative interventions for treating work-related complaints of the arm, neck, or shoulder in adults. They found that exercise did not improve pain in comparison with no treatment standardised mean difference (SMD –0.52, 95% confidence interval (CI); –1.08, 0.03), and the results were similar for recovery, disability, and sick leave. However, these evidences were from very low-quality studies.[4,11]

Another systematic review performed by Sihawong et al. recommended either muscle strengthening or endurance exercise in treating neck pain for office workers with non-specific neck pain. Nevertheless, they concluded that further high-quality studies are still needed before any firm conclusion regarding the most effective exercise programs for office workers can be reached.[12]

Up to now, there are no definite conclusions about types of exercise for relief of pain and to improve neck functions in office workers. Our interest is stretching exercise, owing to its effect in decreasing muscle stiffness and improving flexibility. Therefore, this study aimed to determine the effectiveness of a neck stretching exercise program used in our clinic on pain reduction and neck function, and quality-of-life improvements in office workers.

Methods

The present study was a randomized trial performed at the outpatient setting of the Rehabilitation Medicine Department, Faculty of Medicine Siriraj Hospital, Mahidol University. The study protocol was conducted in accordance with the ethical principles stated in the most recent version of the Declaration of Helsinki. After the protocol was approved by the Institutional Review Board, we recruited participants by advertising a poster in our hospital. Anyone interested in participation in the study was screened by one of our authors, who is a rehabilitation doctor. The inclusion criteria were office workers who rated themselves of moderate-to-severe neck or shoulder pain (visual analogue scale $\geqslant$5 of 10 cm) for more than three months. As a visual analogue scale $\geqslant$5 represents moderate-to-severe pain,[13,14] we recruited them for treatment.

The ones who performed regular stretching exercise, had a history of severe neck injury, or neck or shoulder contracture (defined by a limitation range of motion in all directions), and a history of neck or shoulder surgery, or abnormal neurological signs, were excluded.

Participants, who fitted to the inclusion criteria, were randomly assigned to either the treatment or control groups using computer-generated random numbers. The study codes were placed in sealed opaque envelops, which were serially opened by an assistant nurse who was only involved in participant enrollment. The demographic characteristics including age, sex, marital status, body mass index, dominant hand, sitting time/day, computer using time/day, comorbidities, history of muscle injury, and regular pain medication, were assessed at baseline.

All participants received a brochure indicating the proper position and ergonomics to be applied during daily work. Only the treatment group was additionally instructed to perform stretching exercises of the neck and shoulder by one rehabilitation doctor. The stretching exercise program included 20–30 repetitions/session of neck stretching, shoulder stretching, shoulder rolling, trunk stretching, and back extension exercises (presented in Appendix, available online), with a duration of approximately 10–15 minutes per session. Two sessions were prescribed per day, five days a week for a four week duration. Participants were asked to record the frequency of exercise in a logbook and bring them to a researcher at the end of study to ensure the exercise compliance.

Rescue therapy was tramadol (50 mg) taken orally according to patient discretion in case of intolerable pain, and the number of pills taken was recorded by each patient. All subjects were asked to refrain from performing exercises other than the stretching exercise prescribed and to avoid the use of pain relief therapy, including pain medication, physical therapy, massage, or acupuncture.

The outcomes were assessed by one of the coauthors (RK) who was unaware of the patient's assigned treatment condition. All participants were not blinded. The primary outcome was the pain score, measured using the visual analogue scale.[15] The visual analogue scale ranges from 0 to 10 cm, and a higher score indicates more severe pain. The secondary outcomes were neck function and quality of life scores. The neck function was assessed using the Northwick Park Neck Pain Questionnaire, which measures neck pain and consequent disabilities. It is composed of 10 questions, with scores ranging from 0 to 36, and were then transformed into percentages.[16] The higher percentage represents the severe disability. The quality of life was evaluated using Short Form-36,[17] a questionnaire for the evaluation of health and well-being status, which is composed of two main dimensions (physical and mental). All outcomes were evaluated at baseline and at the end of the study.

Adverse events were recorded if patients developed new or deteriorating symptoms during the study period. The study was stopped if patients developed serious adverse events, that is, intolerable pain, or if patients wanted to withdraw from the study. The compliance with the exercise program in the treatment group was determined according to the frequency of exercise reported by the participants.

The sample size was calculated by using nQuery Advisor program (Statistical Solutions, Cork, Ireland), based on the pain scores reported in the study by Savolainen et al.,[18] with 5% type I error and 20% type II error. The estimated sample size for each group was 37 participants. In case of a 30% drop-out rate, the sample size was calculated at 48 participants per group. All data were analyzed using SPSS version 14. The continuous data were presented in mean ± standard deviation (SD), and number (n) and percentage (%) for categorical data. Unpaired t-test was used to compare continuous data and chi-square or Fisher's exact test for categorical data. Mean differences from baseline scores of visual analogue scale, Northwick Park Neck Pain Questionnaire score, and Short Form-36 were compared between groups using analysis of covariance. A p-value of less than 0.05 was considered statistically significant. The primary and secondary outcomes were analyzed using both per protocol and the intention-to-treat population with last observation carried forward. No interim analysis was performed.

Results

A total of 118 patients were screened; 22 were excluded because they presented with a pain score of less than 5 (16 subjects), refused to participate

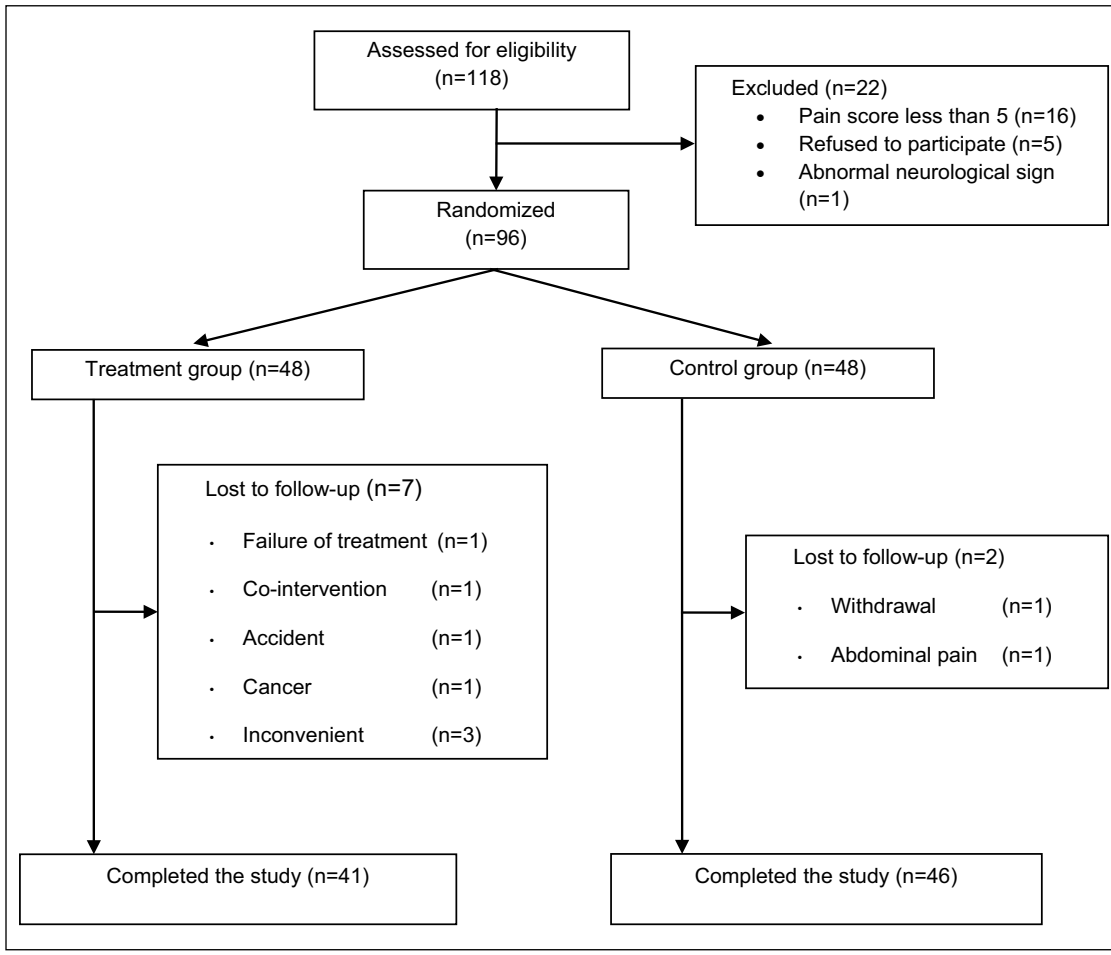

Figure 1. Disposition of study participants.

(five subjects), or had an abnormal neurological sign (one subject). As will be seen in the flow diagram (Figure 1), we eventually recruited 96 patients, of whom 87 completed the trial. Seven participants in the treatment group and two in the control group were lost to follow-up. The participant disposition is detailed in Figure 1. Demographic characteristics, including sex, marital status, dominant hand, comorbidities, history of muscle injury, and regular pain medication were presented as a number with percentages; while others, including age, body mass index, sitting time/day, computer using time/day, were presented in mean and standard deviation. All demographics data were comparable in the treatment and control groups at baseline (Table 1).

Table 2 presents mean and SD of the visual analogue scale, Northwick Park Neck Pain Questionnaire, and Short Form-36 scores at Week 0 and Week 4, and mean difference of the scores between the two groups using the per-protocol analysis. There were improvements from baseline in all scores for both groups except Short Form-36 (physical dimension) of the control group. When compared between groups, the mean differences of all outcomes showed significantly different except the mental dimension of Short Form-36. The magnitudes of improvements were significantly greater in the treatment group than in the control group (–1.4; 95% CI: –2.2, –0.7 for visual analogue scale; –4.8; 95% CI: –9.3, –0.4 for the Northwick Park Neck

Table 1. Baseline demographic characteristics of the study participants.

	Control ($n=48$)	Treatment ($n=48$)	p-value
Age (year)	36.5 ± 8.7	34.2 ± 9.0	0.210
Female	43 (89.6)	44 (91.7)	1.000
Marital status			
Single	20 (41.6)	27 (56.3)	0.091
Married	24 (50.0)	21 (43.7)	
Divorced	4 (8.4)	–	
BMI (kg/M^2)	25.5 ± 8.4	23.8 ±4.7	0.235
Dominant hand: right	46 (95.8)	47 (97.9)	1.000
Sitting time (hour/day)	6.8 ± 1.7	6.9 ± 1.7	0.807
Computer using time (hour/day)	5.9 ± 2.1	5.7 ± 1.8	0.574
Comorbidities: *n* (%)	17 (35.4)	18 (37.5)	0.832
Chronic joint inflammation	1 (2.1)	2 (4.2)	1.000
Hyperlipidemia	6 (12.5)	4 (8.3)	0.504
Neuromuscular diseases	4 (8.3)	4 (8.3)	1.000
Hypertension	3 (6.3)	2 (4.2)	1.000
Others	8 (16.7)	14 (29.2)	0.225
History of muscle injury			
No	39 (81.3)	35 (72.9)	0.622
Regular pain medication	17 (35.4)	15 (31.3)	0.665

Data are expressed as mean ± SD or number (%). Data were analyzed using unpaired *t*-test, chi-square test, or Fisher's exact test.
BMI: body mass index.

Table 2. Mean, SD of the visual analogue scale pain, Northwick Park Neck Pain Questionnaire, and SF–36 score at Week 0 and Week 4 with mean difference between groups (per-protocol analysis).

Outcomes	Study ($n=41$)		Control ($n=46$)		Mean difference[a] (95% CI)	p-value
	Week 0	Week 4	Week 0	Week 4		
VAS (0–10)	6.7 ± 1.2	4.5 ± 1.8	6.2 ± 1.0	5.6 ± 1.8	−1.4 (–2.2, –0.7)	<0.001[b]
NPNPQ (0–100)	28.0 ± 12.1	21.0 ± 10.9	28.2 ± 11.9	25.9 ± 13.9	−4.8 (–9.3, –0.4)	0.034[b]
SF–36						
Physical	52.5 ± 19.8	65.3 ± 19.2	62.8 ± 17.9	57.7 ± 19.6	14.0 (7.1, 20.9)	<0.001[b]
Mental	61.6 ± 19.4	70.0 ± 19.6	66.6 ± 18.0	67.9 ± 18.3	5.4 (–0.7, 11.6)	0.084

[a]Mean difference between study and control at week 4 adjusted for week 0 using analysis of covariance.
[b]Statistical significance at p-value <0.05.
VAS: visual analogue scale; NPNPQ: Northwick Park Neck Pain Questionnaire; SF–36: Short Form-36; CI: confidence interval.

Pain Questionnaire score; 14.0; 95% CI: 7.1, 20.9 for physical dimension of Short Form-36).

The analysis using intention-to-treat population with the last observation carried forward method, presented in Table 3, showed similar outcomes, except the Northwick Park Neck Pain Questionnaire score, which had nearly significant differences ($p=0.055$). The magnitudes of improvements were also greater in the treatment group (–1.2; 95% CI: –1.8, –0.5 for visual analogue scale; –4.1; 95% CI: –8.2, 0.1 for the

Table 3. Mean, SD of the visual analogue scale pain, Northwick Park Neck Pain Questionnaire, and SF–36 at Week 0 and Week 4 with mean difference between groups (intention-to-treat analysis: last observation carried forward method).

Outcomes	Study ($n=48$)		Control ($n=48$)		Mean difference[a] (95% CI)	p-value
	Week 0	Week 4	Week 0	Week 4		
VAS (0–10)	6.6 ± 1.2	4.8 ± 1.8	6.2 ± 1.0	5.6 ± 1.8	−1.2 (–1.8, –0.5)	0.001[b]
NPNPQ (0–100)	28.2 ± 12.0	22.2 ± 11.3	28.9 ± 12.5	26.7 ± 14.5	−4.1 (–8.2, 0.1)	0.055
SF–36:						
Physical	53.3 ± 19.5	64.3 ± 18.9	61.7 ± 18.5	56.8 ± 19.8	12.9 (6.6, 19.2)	<0.001[b]
Mental	61.6 ± 19.1	68.9 ± 19.5	66.6 ± 18.0	67.9 ± 18.2	4.4 (–1.3, 10.1)	0.127

[a]Mean difference between study and control at Week 4 adjusted for Week 0 using analysis of covariance.
[b]Statistical significance at p-value <0.05.
VAS: visual analogue scale; NPNPQ: Northwick Park Neck Pain Questionnaire; SF–36: Short Form-36; CI: confidence interval.

Table 4. Change scores and mean differences of the visual analogue scale, Northwick Park Neck Pain Questionnaire, and SF–36 in the treatment group according to exercise frequency.

Outcomes	Exercise ⩾3 times/week ($n=31$)		Exercise <3 times/week ($n=10$)		Mean difference[a] (95%CI)	p-value
	Week 0	Week 4	Week 0	Week 4		
VAS (0–10)	6.6 ± 1.2	4.3 ± 1.8	6.8 ± 1.4	5.1 ± 1.9	−0.7 (–1.9, 0.5)	0.264
NPNPQ (0–100)	28.8 ± 11.4	19.1 ± 8.5	25.5 ± 14.6	27.0 ± 15.3	−9.5 (–15.9, –3.1)	0.005[b]
SF–36:						
Physical	51.7 ± 19.1	68.3 ± 17.5	55.1 ± 23.0	55.9 ± 21.9	14.2 (2.6, 25.8)	0.018[b]
Mental	59.2 ± 18.6	69.1 ± 19.5	68.8 ± 21.1	72.8 ± 20.8	2.6 (–9.1, 14.2)	0.659

[a]Mean difference between exercise ⩾3 times/week and exercise <3 times/week groups at Week 4 adjusted for Week 0 using analysis of covariance.
[b]Statistical significance at p-value <0.05.
VAS: visual analogue scale; NPNPQ: Northwick Park Neck Pain Questionnaire; SF–36: Short Form-36; CI: confidence interval.

Northwick Park Neck Pain Questionnaire score; 12.9; 95% CI: 6.6, 19.2 for physical dimension of Short Form-36). Three patients in the treatment group and five in the control group took tramadol (data not shown). None of the patients reported adverse events during the study period.

Table 4 shows the effect of frequency of exercise on the improvement of the visual analogue scale pain, Northwick Park Neck Pain Questionnaire score, and quality of life score in the treatment group. It was found that score improvements of the Northwick Park Neck Pain Questionnaire and quality of life scores (physical dimension) were significantly higher among patients who performed exercise of ⩾3 times/week than among those who performed the exercises less frequently ($p=0.005$, mean differences of –9.5; 95% CI: –15.9, –3.1 and $p=0.018$, mean difference of 14.2, 95% CI: 2.6, 25.8, respectively), but not for the visual analogue scale.

Discussion

Our study demonstrated that stretching exercise targeting the neck and shoulder areas twice/day, five

days/week, during four weeks significantly reduced neck pain and increased neck and shoulder functions among office workers with moderate-to-severe neck or shoulder pain. Our results were in line with previous studies showing the benefit of stretching exercise for this condition. For example, Irmak and colleagues reported the results of a randomized control trial using a software program that reminded 39 office workers to perform 10-week exercises, including strengthening, stretching, and posture exercise for all body parts.[19] Their results support that exercise reminder software programs may help to reduce pain among office workers. This randomized controlled trial was comprised of small number of subjects, so they suggested that further long-term studies with more subjects are needed to describe the effects of these programs.

Another study, performed by Hakkinen et al., revealed that manual therapy, twice a week, as well as stretching exercise five times per week, during four weeks, was effective for reducing pain in women with chronic neck pain, but not for improving neck muscle strength.[20] The duration of exercise are similar to our study. Nevertheless, their study compared stretching exercise with manual therapy, while ours compared with medical advice, which was common in our daily practice.

In addition, Blangsted and colleague. reported that the effect of one-year resistance training of the neck–shoulder region was more effective in reducing the duration and intensity of neck and shoulder symptoms than all-around physical exercises. However, this type of exercise did not improve work ability or mean sick leave.[21] The outcomes might be explained by the initially high-work ability (90%) and low mean sick leave (five days per year) in their study population. Their study was a long-term study of exercise for one year, using resistance training, while ours was a four-week duration of stretching exercise. However, we can demonstrate the effect of stretching exercise as early as four weeks of treatment.

Most studies interested in strengthening or resistance exercises, including the study of Anderson et al,[22–24] and Zebis et al.[25] They emphasized that strengthening exercises and specific resistance training of the shoulder, arm, and hand muscles for office workers can relieve musculoskeletal pain symptoms in several regions of the upper body, as well as neck/shoulder symptoms. However, our interest was the effect of stretching exercises and we can demonstrate that stretching exercise can relieve pain, improve neck functions, and quality of life (physical dimension of Short Form-36). Therefore, the better combination should be stretching exercise during an acute to sub-acute phase of musculoskeletal pain, followed by strengthening exercise when pain subsides, in order to gain maximal benefits from these exercises.

Although our study duration was shorter than those of Irmak et al.[19] and Blangsted et al.,[21] we demonstrated the effectiveness of stretching exercises on the improvement of neck and shoulder pain, and this effect was detected as early as four weeks of treatment. A previous study, performed by Weerapong and colleagues, was a before-and-after study to determine the efficacy of a computerized stretching exercise program for four weeks to reduce neck and shoulder pain in office workers.[26] However, they could not demonstrate the improvement in either the visual analogue scale nor Northwick Park Neck Pain Questionnaire scores. This result was caused perhaps by the small sample size (11 subjects) and very low pain scores at baseline (1.8 ±2.1) in their study.

We also found that the frequency of exercise was directly correlated to the improvement of neck function scores and physical dimension of quality of life score, but not for pain score. However, Tsauo et al. demonstrated the dose–response effect of exercise intensity in reducing neck and shoulder symptoms in sedentary workers.[27] Additionally, Hush and colleagues performed a one-year longitudinal study in office workers and found that those who exercised more than three times per week were 1.5 times less likely to develop neck pain (hazard ratio (HR) 0.64; 95% CI: 0.27, 1.51).[28] Another study performed by Korhonen and colleagues was a longitudinal study. They found that office workers who exercised less than two times per week had 1.4 times greater risk of neck pain (odd ratio (OR) 1.4; 95% CI: 0.7, 2.7).[29]

As chronic pain has a detrimental effect on quality of life, pain relief treatment can therefore improve quality of life. A previous study by Salo et al. demonstrated the benefit of combined strength training and stretching group, or stretching group alone, on quality of life improvement after a 12-month period.[30] However, our study demonstrated that the improvement of quality of life could be detected as early as four weeks of treatment.

There are some limitations in our study. (1) The length of the observation period. The study should be repeated with a longer follow-up to confirm the findings and the longer term effects. (2) The frequency of exercise was self-reported, so patients may have overstated their compliance of the prescribed program. (3) The small sample size in the treatment group may preclude conclusions on dose–effect relationship of exercise. (4) Technique for dealing with missing data in intention-to-treat (ITT) analysis should be multiple imputation. However, we only use the last observation carried forward technique, which is a bit old fashioned. (5) Proportion of missing (more patients missing in the treatment group). However, there was only one patient missing with the reason of failure of treatment. (6) Lack of blinding. The interventions in rehabilitation are difficult to blind. However, we tried as best to assess the patients with one doctor who was unaware of the patient's assigned treatment condition. (7) The subjective assessments were made from this study. Further studies should include other objective outcomes.

Clinical message

- Stretching exercises of the neck and shoulder area can reduce pain, and improve neck function and quality of life of office workers.
- Frequency of exercise $\geqslant$3 times/week may correlate to the improvement of neck functions and quality of life.
- The effect of stretching exercises could be detected as early as four weeks of treatment.

Acknowledgements

The authors would like to thank the Routine to Research Project of Siriraj Hospital for providing funding support for the conduct of this study. The authors would also like to thank Mr Suthiphol Udompunturak and Ms Julaporn Pooliam for their assistance with the statistical analysis.

Conflicts of interest

The authors declare no conflicts of interest.

Contributors

PT helped in trial design, allocated participants, and collected the data.

RK performed the literature search and evaluated the outcomes (blind assessor).

VK designed the clinical trial, analyzed the interpreted data, and wrote the manuscript.

Funding

This study was supported by the Routine to Research Project of Siriraj Hospital.

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