

Review Article

Effects of Exercises Therapy on Chronic Non-Specific Neck Pain: A Systematic Review

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Abstract: Background: Neck pain is a highly prevalent condition among the general population, where more than 3/4 of individuals around the world have experienced neck pain at some time in their life. Nonspecific neck pain is defined as pain in the posterior neck between the superior nuchal line and the spinous process of the first thoracic vertebra. **Objectives:** To determine recent research evidences for the effectiveness of exercise therapy interventions for treatment of chronic non-specific neck pain patients. **Method:** This systematic review mainly includes randomized controlled trials. Searching done by Medline, Embase, CINHAL Centre for Reviews and Dissemination, OAIster, PEDro and the Cochrane Database of Systematic Reviews from 2007 to 2014. We used terms like-neck, pain, muscle spasm, physiotherapy, physical therapy, non-specific, resistance exercise, endurance exercise and strengthening exercises. **Result:** Present outcomes shows that exercise treatment is effective technique in reducing pain and increasing ROM in patients with chronic non-specific neck pain without adverse effects. The search resulted in 353 articles but only 09 articles were selected for the study based on criteria. **Conclusion:** Exercise therapy program designed for treating chronic non-specific neck pain patients proved to reducing pain and improving ROM increasing function during exercise.

Keywords: Neck pain, Exercise, Physiotherapy.

Introduction

Neck pain is a highly prevalent condition among the general population, where more than 3/4 of individuals around the world have experienced neck pain at some time in their lives [1, 2]. Moreover, 1/3 of neck pain patients will get permanent chronic symptoms for more than six months [3], and half of these cases had persistent pain and disability at the 5-year follow-up [4].

In the large majority of these cases, the pathological basis for the neck pain is unclear, and the complaints are labeled as “non-specific” or “mechanical” neck pain [5]. This nonspecific neck pain is defined as pain in the posterior neck between the superior nuchal line and the spinous process of the first thoracic vertebra [6].

There are no sufficient studies describe the incidence, prevalence and therapeutic intervention of neck pain in Saudi Arabia. However, Al Wazzan's et al. [7] study showed that 54% of the subjects complained of neck pain among 204 dentists and dental assistants [7].

Another study showed that 54% of undergraduate female students in Taif University experienced neck pain during the previous one-year [8]. In addition during validation of Arabic version of neck disability index the authors reported that males had higher incidence of neck pain than female [9].

The physical impacts of chronic neck pain include limited ROM, neck and shoulder muscle spasm and tenderness, light-headedness, dizziness, blurred vision, depression and anxiety. These can lead to some degree of disability and diminished quality of life, with considerable social and economic impact [10, 11].

There are different interventions that can be used for the treatment of chronic nonspecific neck pain, such as electrical stimulation, exercise, manipulation therapy, acupuncture and kinesio taping. It is found that the exercises, joint mobilization and manipulation are effective in the treatment of acute and chronic mechanical neck disorders.

Recently, Falla et al. [12] and Andersen et al. [27], demonstrated the benefit of strengthening exercises in the reduction of pain in the patients with chronic nonspecific neck and shoulder pain. While Evans et al. [29] concluded that high-dose supervised exercises with, and without spinal manipulation performed similarly reporting less pain. In addition, one high quality randomized controlled trial in the patient with chronic neck pain has found no effect of dynamic exercise's training compared with advice to continue ordinary physical activity.

The overall conclusion from these studies [12, 27, 29] demonstrated low evidence for strengthening exercises with no definite statements on the efficacy and clinical usefulness of these interventions [15].

Therefore, the aim of this study was to review the literature systematically and discussed the quality of evidence of commonly used strengthening exercise aiming to improve pain, function, and quality of life in patients with chronic non-specific neck pain.

Materials and Methods

Literature Search

The literature search was restricted to English language publications from 1990 through 2011. Seven databases were searched to find relevant studies, including Medline, Embase, CINAHL Centre for Reviews and Dissemination, OAIster, Physiotherapy Evidence Database (PEDro), and the Cochrane Database of Systematic Reviews. The following search terms were used to identify appropriate articles: neck, pain, muscle spasm, physiotherapy, physical therapy, non-specific, resistance exercise, endurance exercise and strengthening exercises. A review of references listed in the articles was also performed, for additional articles that met our criteria.

Study Criteria

Study design: The review included randomized controlled trial (RCT) or Quasi-RCT restricted to published in English language.

Types of Participants: This review included adults (male and female) subjects, aged 18 or older (≤ 70 years) who had history of chronic neck pain (≥ 3 months) with or without radiating symptoms.

Studies are excluded if any surgical intervention was used, neck pain caused by other pathological entities, use of pharmacological treatment or any orthotic supportive devices.

Types of Interventions: The considered studies were those that included conservative interventions such as various forms of exercise regardless of intensity and duration. The programs included strengthening; resistance and endurance exercise program. These were contrasted against the following comparisons:

- ✓ Control
- ✓ No treatment or wait list, and
- ✓ Exercise plus another intervention versus that same intervention (for example exercise plus manual therapy vs manual therapy).
- ✓ All other comparisons were excluded.

Types of Outcome Measures: A study was included if it used at least one of the three outcome measures of interest: pain, measures of function/disability and quality of life. [16-17].

Review Criteria

The studies were categorized according to Sackett's rules of evidence [18]. Sackett's five levels of evidence are as follows: (1) level I, large randomized controlled trial with a low false-positive or false-negative errors (high power); (2) level II, small randomized controlled trial with high false-positive or false-negative errors; (3) level III, nonrandomized, concurrent cohort comparisons between contemporaneous subjects who did and did not receive the intervention; (4) level IV, nonrandomized, historical cohort comparisons between current subjects who received the intervention and former subjects who did not receive the intervention; and (5) level V, case series without controls.

In studies with level V evidence, the clinical outcome of a group of subjects is described, but no control group or condition is included, and thus, no control of extraneous variables is undertaken. As suggested by previously published critical reviews, Sackett's levels of evidence I through V can be modified because in certain conditions a pure control group can pose potential ethical conflicts [19, 20].

Assessment of Methodological Quality

The methodological quality of each trial was rated with the PEDro scale, based on the Delphi list [21]. The PEDro scale is based on 11 items which includes specified eligibility criteria, random allocation, concealed allocation, baseline comparability, blinded subjects, blinded therapists, blinded assessors, adequate follow-up, intention-to-treat analysis between-group comparisons, and point estimates and variability. The eligibility criterion is related to external validity and is not used to calculate the PEDro score. The PEDro scale scores range from 1 to 10; higher PEDro scores indicated higher method quality. Because there were no published validated cutoff scores for the PEDro scale, the following criteria were used to rate method quality: PEDro score of less than 5 indicates low quality and PEDro score of 5 or higher indicates high quality. However, the reliability of the PEDro scale has been evaluated previously and showed good reliability (ICC=0.68) among raters [22].

Results

Description of Studies and Level of Evidence

Considering all sources, 353 records were identified through database searches from 2007 to 2014. Following screening nine full-text articles that used exercise therapy for non-specific chronic neck pain were selected for this review based on the inclusion and exclusion criteria. Nine trials evaluated neck pain: two evaluated acute/ sub-acute/chronic neck pain; [23, 28], one evaluated sub-acute neck pain [25]; one evaluated sub-acute/chronic neck pain [24]; four trials evaluated chronic neck pain [12, 26, 29, 30] and one trial did not specify the duration of neck pain [27].

No study reported on neck disorder with radicular signs. Studies varied in sample size from 46 to 537 (in final analyzed), and 5 of 9 studies [12, 23, 26, 28, 30] were considered small (less than 70 participants) per intervention group.

Inter-rater agreement between three independent reviewers on the level of evidence was attained for 4 of nine studies (45%). We discussed the five studies on which there was disagreement in

determining Sackett's level of evidence, and consensus decision was achieved for these studies. Based on Sackett's level of evidence, 4 of the studies were classified as a level I [24, 25, 27, 29], three studies as a level II [12, 23, 26, 28, 30]. The characteristics and level of evidence of the included trials are summarized in Table 1.

Methodological Quality

Quality assessment of the included studies according to the PEDro scale is listed in Table 2. Eight papers already had their methodological quality previously assessed using the PEDro scale and scored 5 points or more [12, 23-29]. Two reviewers independently assessed the quality of one article using the same instrument and scored 5 [30]. These are indicating high quality of rigor. The nine studies with scores ranging from 5 to 8 were classified as a level I [24, 25, 27, 29], and level II [12, 23, 26, 28, 30].

In these studies, the criteria satisfied were most often related to statistical issues, such as the "similarities of the groups at baseline are reported for all outcomes," "results of between-group comparisons are reported," and "study provides both point measures and measures of variability for at least 1 key outcome" [12, 23-30].

All of the trials used random allocation to assign participants into intervention groups and used concealed allocation [12, 23-29, 30]. In 6 of the studies [12, 23, 26, 28-30] the use of blinded outcome assessors was explicitly described.

In the remaining 3 studies [24, 25, 27], none of the therapists performing the assessment were blinded to group assignment. In six of the 9 studies [12, 23, 26, 28-30], adequate follow-up was described (85.5–100 %), and intention-to-treat analysis has been reported in 78% of the studies [12, 23-25, 27-29].

All studies provided sufficient details to allow repetition of the intervention protocol. However, there was no consistent agreement about duration, frequency and types of exercises, (isometric, dynamic, endurance, stretching) as well as types of intervention used in the comparison group such as patient's education and advices, spinal manipulation, modalities.

Of the nine studies reviewed, four different methods were used to assess pain included numerical pain scale [23, 30], Nordic questionnaire [25, 26] and neck pain questionnaire reported in one study [24], while one study used 11-box numerical rating scale [29].

Health-related quality of life was evaluated in 33% of studies [12, 26, 29]. Functional/ disability of neck and upper limb was evaluated in 56% of reported studies included verities of instruments such as disability of arm shoulder and hand (DASH) in two studies [24, 27] neck disability index were used in three studies [12, 29, 30].

All studies reported mild to moderated significant difference in pain between exercise groups and control group immediately post treatment [12, 23-25, 27-29, 30]. There were significant differences in function between groups immediately post treatment [12, 27, 29, 30], while no significant reported immediately post treatment in one study [24].

All exercises groups reported improvement in function compared to control. Moreover, there was deterioration in physical function in one control group [24]. Three studies showed significant evidence of benefit (exercise versus control) on health reeated quality of life immediately post treatment and at short-term follow-up [12, 26, 29].

Table 1. Level of evidence and characteristics of the reviewed studies

Authors	Experimental design/Level of evidence	Subjects	Interventions	Length of study/ follow-up	Outcome measures	Results
Andersen et al. ^[23]	RCT/Level 1	N=189, F=124, M=24 with frequent neck shoulder pain	2-minute group (n =66), 12-minute group, (N=66) received 5 session per week each session last for 10-60 minutes, Control group (n=66)	10 weeks follow-up-No	Neck/shoulder pain (numerical pain scale 0-10), Tenderness of neck/ shoulder muscles (0-32 point scores), Shoulder maximal torque value strength	Compared with the control group, muscle strength increased neck/shoulder pain (1.4 & 1.9) & tenderness (4.2 & 4.4) decreased in 2 min. and 12 min. training groups respectively. No difference (p<0.05) between training groups.
McLean et al. 2013 ^[24]	Multi-center randomized controlled trial/level I	151 subjects (M/F) with non-specific-neck pain (sub-acute, chronic)	Graded exercise treatment group (GET; n=75), received 6-12 sessions for (30-60 minutes) /6-week. Each session consisted of warm up & ROM exercises, endurance training Usual physiotherapy group (UP; n=76) received manual therapy, modalities & educations	6 weeks/6-12 months	Neck pain disability (NPQ) to measure neck pain (5 likert scale) Disability of the Arm, Shoulder and Hand (DASH) to measure upper limb disability	Modest significant and clinically improvements on the NPQ score with a change score of 9% between baseline and 12 months in both groups. DASH scores was significant at 6 week, 6 and 12 months in UP group while deteriorated significant at 6weeks, and return to baseline at 6 and 12 months in GET. No significant (P>0.05) between groups at 6 weeks, 6 and 12 months in neck pain and function.
Zebis et al. ^[25]	RCT single blinded level 1	537 subjects with neck/shoulder pain	Strength training (n=282), 3 sessions/ weeks each session lasting 20 min. Control group (n=255)	20 weeks	Nordic questionnaire to measure neck shoulder pain. The intensity of pain were rated on a scale ranging from (0-9).	Neck pain intensity decreased significantly (-0.6, 95% CI -1.0 to -0.1) and shoulder pain intensity tended to decrease (-0.2, 95% CI -0.5 to 0.1, P=0.07) in the training group compared with the control group.
Salo et al. ^[26]	RCT, single blinded controlled trial/level II	180 women of office worker with chronic neck pain	Strength training group (STG, n =60), an endurance training group (ETG, n=60), and a control group (CG, n= 60) all the three groups were encouraged to perform aerobic exercise three times a week for	12 months	Generic self-administered questionnaire 15 D to measure quality of life	Improvement in the 15D total scores for both training groups, whereas no changes occurred for the (control group) CG (P = 0.012). The STG improved significantly in five of 15 dimensions, while the ETG improved significantly in two dimensions (sleep and

			30 minutes			vitality).
Andersen et al. ^[27]	RCT/level 1	449 subjects (M/F) with & without neck and/or shoulder pain	1 WS-group (n = 116, exercise for 1 hour once/week) 3 WS-group (n=126, trained 20 minutes 3 times/week (9 WS-group (n=106, exercised 7 minutes 9 time/week) REF-group (n=101)	20 weeks/5 months	Modified version of Nordic questionnaire to measure neck/shoulder pain intensity. Disability in Arms, shoulder and Hands (DASH) questionnaire scale, (0-100) to measure disability of upper limb, Muscle strength maximum weight carried 10 repetitions.	Reduced neck and right shoulder pain in the training groups after 20 weeks compared with REF. Among those with pain ≥ 3 at baseline (n=256), all three training groups achieved significant reduction in neck pain compared with REF (p<0.01). DASH was reduced in 1WS and 3WS only.
Lange et al. ^[28]	RCT/single-blinded controlled trial/level II	54 pilots subjects (M/F) with neck /shoulder pain.	Exercise group (n=27) received warming up exercise strengthening exercise endurance exercise 3 times, 20 minutes of training/week for 24 weeks. Control group (n=28)	24 weeks/13 months	Systematic manual palpation of cervical spine/neck and shoulder. Nordic questionnaire for to measure neck/shoulder pain intensity, Craniocervical flexion test (CCFT) to evaluate the activation and endurance deep cervical flexors.	Tenderness of either the right or the left levator scapulae was significantly indicative of self-reported neck pain within the last 3 months. There is a clinically significant decrease from 2.0 to 1.0 in neck pain during the previous 3 months in the training group compared with the control group.
Evans et al. ^[29]	RCT/single blinded controlled trial/level I	266 subjects with chronic neck pain.	Exercise therapy (ET; n= 87), included warm up 95 min) & stretching exercises, 3sets of 15 repetitions of dynamic neck extension, flexion and rotation. Exercise therapy combined with spinal manipulation therapy (ET + SMT; n=90), received 20 sessions of ET, preceded by 15- 20 minutes of SMT. Home exercise & advice (HEA; N=89) were instructed to do 5 to 10 repetitions of each exercise in the series, up to 6 to 8 times per day.	12 weeks/ 13 months	11- box numerical rating scale, NDI, Health related quality of life SF-36 questionnaire	There was a significant difference in patient-rated pain between ET +SMT and HEA (1.3 points, P<0.001) and ET and HEA. Although there were smaller group differences in patient-rated pain at 52 weeks (ET +SMT vs. HEA, 0.2 points, P>0.05; ET vs. HEA, 0.3 points, P > 0.05), linear mixed model analyses incorporating all time points yielded a significant advantage for the 2 supervised exercise groups (ET +SMT vs. HEA, P= 0.03; ET vs. HEA, P = 0.02). Similar results were observed for global perceived effect and satisfaction.
Falla et al. ^[12]	RCT/single-	46 female between	Control group	8 weeks/7 months	NDI, FABQ,	Significant between-groups in the

	blinded controlled trial/level II	18 to 45 years with chronic neck pain	(n=23) Training group (n=23): 30 min, once a week for 8 weeks.		Short-Form 36 (SF-36), Visual Analogue Scale (VAS). Electromyography activities of neck muscles.	change in NDI. A reduction in NDI was observed following training (pre: 18.2±7.4; post: 14.1±6.5; p<0.01) but not for the control group (pre: 17.5±6.3; post: 16.6±7.4). The training group showed higher specificity of muscle activity post intervention (pre: 18.6±9.8%; post: 24.7±14.3; p<0.05), whereas no change occurred for the control group (pre: 19.4±11.9%; post: 18.2±10.1%). No change in FABQ between groups. Both groups had significant improvement in the total scores of SF-36 with training group threefold than control (8.3 versus 2.6). Maximum voluntary muscle strength increased significantly (p<0.05) in training group with higher specificity for muscle activity.
Karlsson et al. [30]	RCT/ single-blinded controlled trial/level II	57 women with age from 20 to 60 with pain in shoulder and neck area more than six months	Strength training group (n= 34) performed 3sets/ 20 repetitions for 8 weeks. Stretch group (n=23) strength group performed exercise 1.5-2.5 time per week. Stretch group performed two exercises per week).	4-6 months/12 months	Numerical pain scale to measure neck and shoulder pain. Swedish version of neck disability index to measure neck function. Range of motion of cervical spine in two-degree increment. Hand held dynamometer to measure flexor and extensor neck muscle strength.	Strength reported a significant improved function (NDI). Stretch showed an overall increase of neck ROM, whereas STRETCH only improved neck extension and lateral flexion to the right. Both groups showed significant increases in neck and shoulder strength.

Table 2. Quality assessment of the included studies according to the PEDro scale

Authors	Eligibility criteria	Random allocation	Concealed allocation to group	Baseline comparability	Blinded subjects	Blinded therapists	Blinded assessors	Adequate follow-up	Intention-to-treat analysis	Between-group analysis	Point estimate of variability	Total scores
Andersen et al. [23]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
McLean SM, et al. 2013	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	6
Zebis et al. [25]	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	6
Salo et al. [26]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	7
Andersen et al. [27]	Yes	Yes	No	Yes	No	No	No	No	Yes	es	Yes	5
Lange et al. [28]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	7
Evans et al. [29]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Falla et al. [12]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Karlsson et al. [30]	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	yes	5
Total Scores	9/9	9/9	7/9	9/9	0/12	0/12	6/9	6/9	7/9	9/9	9.9	

Discussion

This review has provided more detailed information with respect to the degree of evidence and the types of exercise that have an impact on neck pain. For non-specific chronic neck pain, limiting the eligible trials to those with single interventions that compared exercise with a control or comparative group maximized the opportunity to evaluate the treatment effect of exercise interventions. Moreover, selecting a prior an exercise classification system allowed us to use a clinical rationale for selecting studies with similar interventions for interpretation and inclusion particularly for the outcomes of pain, quality of life and function. Although there were only 9 studies eligible for this systematic review, these two new strategies provided greater clarity in our conclusions about the effectiveness of exercise therapy.

Exercise is a fundamental treatment modality used in most rehabilitation for a variety of health conditions. The rehabilitation literature has emphasized the need to examine the role that exercise plays within the treatment strategies that include other modalities [31-34]. However, there is also limited evidence on optimal dosage requirements [35, 36] for exercise therapies, duration and frequency used to treat neck disorders.

The results of this study were in agreement with Ylinen [38] who found moderate evidence supporting the effectiveness of both long-term dynamic as well as isometric resistance exercises of the neck and shoulder musculature and contradicted with three reviews including stretching, strengthening, endurance training, balance/coordination, cardio and cognitive/ affective elements [37-39] showed no evidence of benefit in the short term, but [39] found exercise effective on pain in the short term for chronic neck pain.

This review provide high to moderate evidence favors specific neck strengthening exercises for chronic neck pain relief, improved function and quality of life with care post treatment to long term. However, one of the major methodological difficulties inherent to studies evaluating exercise interventions is blinding of therapists and patients. None of the trials in this review blinded the care provider, as this is not possible in an exercise trial. Patient blinding can minimize expectation bias by ensuring the treatments are equally credible and acceptable to patients; patients have limited experience or expectations for either the index treatment or control condition. However, the nature of exercise interventions makes it difficult to blind the patient and care provider. Therefore, it is very important to control for measurement bias by blinding the outcome assessor and the data analyst.

Conclusion

Neck strengthening exercises were of benefit in patients with chronic neck pain and neck for reducing pain, improving function in the short term and long term. However, it was not possible to determine which technique or dosage was more beneficial from one form of care than another. Therefore, additional single intervention studies in all categories of exercise therapies and with adequate sample sizes are needed to confirm the findings of this systematic review. Additionally, future studies should pay close attention to evaluating the dosage of the applied exercise therapies as an important determinant of treatment effect.

Conflicts of interest

There is no conflict of interest of any kind.

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