DOI: *10.22122/jrrs.v15i3.3405*

Published by Vesnu Publications

The Effect of Neck Movement Pattern Modifications on Pain and Function in Employed Women with Nonspecific Chronic Neck Pain: A Randomized Clinical Trial

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Original Article

Abstract

Introduction: Uncontrolled movement has a significant impact on the development of movement disorders and pain. The purpose of this research was to investigate the effect of neck movement pattern modifications on pain and function in women with nonspecific chronic neck pain.

Materials and Methods: For this purpose, women (36.5 ± 5.7 years) with nonspecific chronic neck pain were randomly assigned in the experimental (n = 15) and control (n = 15) groups. Pain and function of the participants were measured before and after the intervention, using visual analog scale (VAS) and Progressive Isoinertial Lifting Evaluation, respectively. The repeated measure analysis of variance and paired t tests were used for data analysis.

Results: The neck movement pattern modifications had significant effects on pain (P = 0.001) and function (P = 0.004) in the experimental group.

Conclusion: Due to the high reported effect size for neck movement pattern modifications, it is suggested to be used as a supplementary method in improvement of pain and function in women with nonspecific chronic neck pain.

Keywords: Nonspecific chronic neck pain; Exercise therapy; Function

Citation: Khosrokiani Z, Letafatkar A, Sokhanguei Y. **The Effect of Neck Movement Pattern Modifications on Pain and Function in Employed Women with Nonspecific Chronic Neck Pain: A Randomized Clinical Trial.** J Res Rehabil Sci 2019; 15(3): 123-9.

Received: 05.06.2019 Accepted: 16.07.2019 Published: 06.08.2019

Introduction

The prevalence of neck pain has increased in the last two decades and is currently the second most musculoskeletal disorder (MSD) following low back pain (LBP) (1). The disease often tends to heal spontaneously over time, but it does not improve in some cases, leading to long-term disability (2) and dysfunction, and is associated with negative personal and socioeconomic effects (3). If the neck pain persists for three months or more, it is known as chronic neck pain (4). Neck pain is more common in women compared to men (5). In addition, changes in neuromuscular control and increased levels of disability have been reported in women with chronic neck pain (6). The incidence of neck pain increases from the age of 40 to 60, and then decreases slightly (5). The prevalence of MSDs has been reported to increase with age (7).

Individuals with chronic neck pain have altered muscle activation (8). Changes in the recall of the scapulothoracic muscles (9) and tissue changes in the upper trapezius muscles have been reported in subjects with neck pain (10). The results of a study by Falla and Farina showed that changes in the control of neck and neck muscle surrounding movements in people with neck pain led to limited endurance and coordination, high fatigue, less strength, and altered proprioception (11).

Today, due to the low-mobility jobs, employees are exposed to musculoskeletal pain caused by repetitive strains in the workplace (12). This recurrent and chronic condition increases the risk of neck and

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shoulder pain in employees (13). Therefore, in order to reduce the absence of the employees with the work-related musculoskeletal pain, many therapeutic interventions have been studied aiming to improve and treat these disorders (14), among which the most important individual and group interventions can be exercise therapy, manual therapy, massage, ergonomic interventions in the workplace, multidisciplinary treatment, and splinting (15).

One of the effective interventions in the treatment of patients with chronic neck pain is training to correct the pattern of movement (8). Low-threshold movement pattern correction exercises focus on recovering optimal and natural recall methods and thresholds and are not directly based on function recovery (11). These exercises often require highly cognitive, non-functional motor skill exercises. Finally, these movement activation methods become familiar and natural to the individual and require little effort by the individual during the function (16).

Comerford and Mottram reported that improving the function of individuals with chronic neck pain after performing low-load exercises can be the indirect result of recovery of the slow-twitch motor unit's call threshold and better recall patterns (16). Chung and Jeong found the use of craniocerebral flexion exercises to be effective in improving pain and function in subjects with chronic neck pain (17). In their study, Khosrokiani et al. reported that the significant effect of movement control exercises with an emphasis on the normal condition of the neck, chest and back, on the variables of pain and function in subjects with neck pain (18). In a study, Shiravi et al. investigated the effect of scapular stabilization exercises on the neck pain of women with forward head, round shoulder postures, and neck movement impairment, and concluded that the scapular stabilization exercises were effective on pain relief and function of the participants (19).

The results of regular review studies with an emphasis on exercise as the main factor in the treatment of disability and pain-related dysfunction indicated that different treatment methods have different effects on neck disorders (15). Given the increasing prevalence of neck pain in different societies and the lack of systematic knowledge in this area, if the movement pattern correction exercises are effective in relieving pain and function of women with chronic non-specific neck pain, the present study may be an effective step in supporting exercise in the treatment of neck pain and introduction of these new exercises.

The present study is conducted with the aim to investigate the effect of the movement pattern correction exercises on pain and function of women with chronic non-specific neck pain and the effect of these exercises and daily situation recommendations on reducing pain and improving the function of these patients. It was assumed in this study that the movement pattern modification exercises could reduce pain and improve function in women with non-specific chronic neck pain.

Materials and Methods

This was a randomized trial study which was approved with the ethics code of IR.KHU.REC.1398.023 in the ethics committee of Kharazmi University, Tehran, Iran. The clinical randomized control trial (RCT) was registered on UMIN-RCT website with code UMIN000034930. The research community consisted of female employees aged 25 to 45 with similar working hours and suffering from chronic neck pain (introduced by a physiotherapist). The target community was called from the physiotherapy centers and the university.

The study inclusion criteria included a neck pain score of 3 to 8 based on the visual analogue scale (VAS), neck disability index (NDI) above 25, neck pain for at least three months, and female employees (working with computers for at least four hours per day). A history of neck surgery, neurological and orthopedic diseases affecting the neck, and receiving massage as a treatment method were also considered as the exclusion criteria (16,17).

All clients were examined separately by a specialist to diagnose neurological and orthopedic diseases. Moreover, a skilled physiotherapist evaluated individuals according to the date and mechanism of injury, clinical symptoms, and response to active movements. In order to perform the pre- and post-test measurements, the evaluator was not aware of the individuals assigned to the two groups.

First, a pilot study with about 10% of the sample size and a pain variable was conducted for one week. Then, the data were entered in relation 1 and the number of subjects required for the study was obtained to be 11.77; however, to overcome the effect of possible fall of the subjects on the statistical results, more number of subjects was considered for each group. In this relation, M1, M2, S1, and S2 were the mean of the experimental group in the posttest, the mean of the control group in the posttest, the standard deviation (SD) of the experimental group in the posttest, and SD of the control group in the posttest, respectively.

$$N = \left[\left(\frac{Z_{1-alpha}}{2} + Z_{1-alpha}\right)^2 (S_1^2 + S_2^2)\right] / (M_1 - M_2)^2$$

$\frac{Z_{1-alpha}}{2}$ for sig 0.05 = 1.96
$Z_{1-alpha}$ for power 80% = 0.84
$(M_1 = 0.70)$
$(M_2 = 0.48)$
$(S_1 = 0.25)$
$(S_2 = 0.09)$

$$N = [(1.96 + 0.84)^2(0.06 + 0.00)]/(0.22)^2 \rightarrow N=11.76 \quad (1)$$

Finally, the 30 subjects selected were randomly assigned to the control and test groups (15 subjects in each group) (18). The random design followed a fixed size with a 1: 1 hidden allocation ratio. The training program on the experimental group ran for eight weeks, three sessions a week, and every other day under the supervision of a physiotherapist and instructor trained in movement pattern correction exercises. The exercises and the method of performing the movements were selected as simple to low difficult with a low intensity. The training sessions of each session included 5 minutes of warm-up, 25 to 30 minutes of movement pattern correction exercises, and 5 minutes of cooling-down exercises. Recommendations for appropriate positions during working were presented to the control group as a brochure.

After completing the data collection form, the approved subjects completed the written consent form for participation in the study. After performing the pain and function pretest, the experimental group underwent movement pattern correction exercises. 48 hours after the last training session, the post-test was performed similar to the pre-test conditions and the information was analyzed.

Pain assessment: VAS was employed to assess pain. The validity and reliability of this scale to measure pain have been confirmed (20). The VAS consists of a 100 mm horizontal straight line with numbers 1 to 10, with numbers 1 and 10 indicating pain relief and peak pain, respectively (21).

Function evaluation: In the present study, function was measured using the Progressive Isoinertial Lifting Evaluation (PILE) test. The validity of this test has been confirmed in the evaluation of the neck functional endurance ($P \leq 0.001$) (22). In the PILE test, the subjects were asked to move weights in a plastic box from the waist level to shoulder (0.76-1.37 m). After four lifting movements, the weight of the weights increased (22). The subjects began the exercise with a weight of 3.600 kg. In 20 seconds, four lifting movements were performed, followed by the overload. The test continued until the person failed to perform the next step (22).

Movement pattern correction exercise protocol: In these exercises, first the location and direction of uncontrolled movements were identified by a competent physiotherapist, and then the optimal movements were retrained to the person. The main goal was to change the call pattern of these people and achieve an efficient implementation of movements, in addition, the movement in the place and direction of the stability disorder was actively controlled. A slow repetition of 20 to 30 seconds or a maximum of two minutes was recommended for each movement (11). In the training protocol, the ratio of 1:1 between the maintenance of each movement and the intervals between the movements and the ratio of 1:2 between the maintenance of movement and the intervals between the sets were considered (16). The overload principle was observed by adding weekly movements and repetitions. These movements included raising the back head by controlling bending of the lower cervical vertebrae, bending the chest by controlling the bending of the lower vertebrae and the natural curvature of the neck, raising hands by controlling the bending of the lower cervical vertebrae, and bending the neck from the lower cervical vertebrae by controlling bending of the upper cervical vertebrae (16).

Descriptive statistics were utilized to describe the data obtained from the pretest and posttest. In the inferential statistics section, using the Shapiro-Wilk test, the normal distribution of the raw data was examined ($P > 0.050$). To investigate the interactive effect of time on the groups, the repeated measures analysis of variance (ANOVA) test was used and to examine the intragroup and intergroup differences, paired-t and independent-t tests were employed, respectively. $P < 0.050$ was considered as the significance level.

Results

The call and drop specifications of the subjects are demonstrated in figure 1.

The data in table 1 indicated that there was no significant difference between the demographic characteristics of the groups studied (Table 1).

The results of the Shapiro-Wilk test showed that the data had a normal distribution (Table 2). The mean of the dependent variables of the experimental and control groups in the pre-test and post-test stages are presented in table 2.

The results of the repeated measures ANOVA test showed that the interactive time effect on the group was significant in the pain variable ($F = 32.12$, $P \leq 0.004$) and function ($F = 27.53$, $P \leq 0.008$). Therefore, paired-t and independent-t tests were used to respectively evaluate the intragroup and intergroup differences.

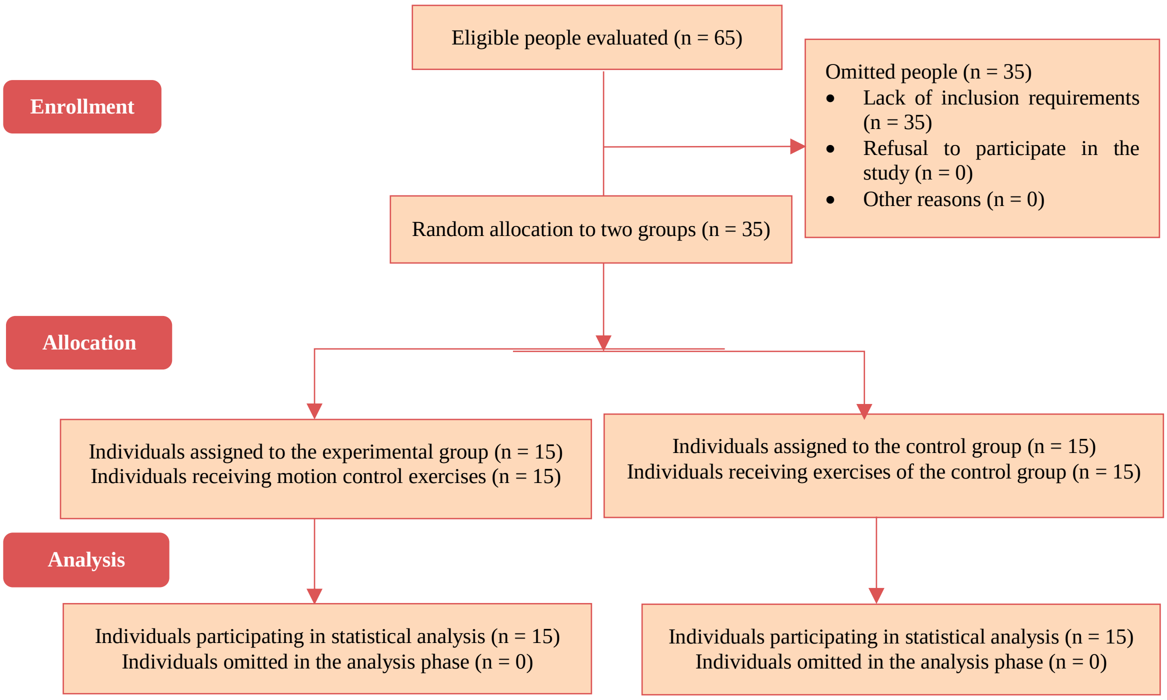

Figure 1. Process of allocating individuals and analyzing data

Table 1. Demographic characteristics of experimental and control groups

Variable	Group	
	Experimental (n = 15)	Control (n = 15)
Age (year)	36.07 ± 5.59	37.60 ± 5.85
Height (cm)	160.07 ± 7.15	161.13 ± 9.52
Weight (kg)	63.20 ± 6.57	67.87 ± 5.78
Body mass index (kg/m^2)	24.80 ± 5.85	26.33 ± 1.71

Data were reported as mean ± SD.

The results of the independent-t test were also indicative of the intergroup changes in pain ($P \leq 0.007$) and function ($P \leq 0.011$) variables of the two groups.

Discussion

The current study was accomplished with the aim to evaluate the effectiveness of neck and shoulder movement pattern correction exercises on the dependent pain and function variables in subjects with chronic neck pain. The findings suggested that after eight weeks of the movement pattern correction exercises, the pain and neck function index improved significantly in the experimental group.

In their study, Chung and Jeong reported a positive effect of craniocerebral flexion exercises in improving pain, cervical lordosis, and function in individuals with chronic neck pain (17). In a study by Ris et al., the exercise group (pain education, neck/shoulder exercises, eye balance and function, and graded exercise training) showed significant improvement in the variables of pain, range of motion (ROM), and cervical muscle function compared to the control group. (23). In a study, Shiravi et al. explored the effect of scapular stabilization exercises on the neck pain of women with forward head and round shoulder postures, and concluded that the scapular stabilization exercises had a significant effect on improving pain and function of the participants (18).

Table 2. Descriptive data of dependent variables in pre- and post-test stages

Variable	Shapiro-Wilk test results	Experimental group			Control group		
		Pre-test	Post-test	Paired t	Pre-test	Post-test	Paired t
Pain (cm)	0.101	5.27 ± 1.98	2.87 ± 1.68	0.001*	4.47 ± 2.03	5.20 ± 1.68	0.210
Function (time)	0.213	1.27 ± 0.704	2.27 ± 0.70	0.004*	1.13 ± 0.83	1.27 ± 0.704	0.123

*Intragroup significant changes
Data were reported as mean ± SD.

They also suggested the use of abdominal muscle control exercises in order to make the scapular exercises more significant. In their study, investigating the effect of postural exercises with an emphasis on the natural condition of the neck, chest, and waist on subjects with neck pain, Khosrokiani et al. reported a significant effect of these exercises on the pain and function variables (18).

Retraining the right and controlled movements at the level of the cervical vertebrae by correcting the recall of sensory-motor patterns and coordinating the collaborating muscles in order to eliminate the load of the injury reduces the harmful mechanical stimulation on pain sensitive structures (16,23). Given the above and the significant changes in the pain index in the experimental group after the intervention, it may be concluded that movement pattern correction exercises can reduce pain in patients with chronic neck pain.

Observations indicate functional impairment, including increased levels of disability in women with chronic neck pain (5). Comerford and Mottram reported that improvements in the function of individuals with chronic neck pain after low-load training could be an indirect consequence of recovery of the slow-twitch motor unit's call threshold and better recall patterns (16). Movement control (24) and pain reduction (25) may lead to the integration of neuromuscular control and, ultimately, appropriate sensory feedback, central nervous system (CNS) processing, and coordination of movements. The optimal movements used in these exercises ensure function and postural control activities with minimal stress and maximum physiological control (16). Based on the above, the exercises used in the present study are likely to improve motor function in the study subjects.

Decreased activity of the deep cervical flexor muscles in people with chronic neck pain interferes with their normal state and reduces their function. The exercises used in the present study, such as craniocerebral flexion exercises, by improving the ability to control the normal neck position (26), neck flexion power (27) and pain (17,18), can improve function (17,19,23) in subjects with chronic neck pain.

Limitations

Although chronic neck pain affects most women, selection of women only as the study samples is a limitation for the present study. Moreover, the short-term study, lack of investigation of the effect of the exercises on disability, which shows the severity of the effect of neck pain on work, daily life, and mood of the individuals, and the size of the cervical spine arch, can be considered as other limitations.

Recommendations

People with chronic neck pain may be at risk for forward head complication (28). It is recommended that the effect of these exercises be examined on the disability and the cervical spine arch size in individuals with chronic neck pain. Furthermore, in order to ensure the long-term effect of these exercises, future studies are recommended to examine this effect.

Conclusion

The findings of the present study revealed that the movement pattern control exercises, as a supplement to other common treatments, may have a positive effect on pain relief, ROM, and function in women with chronic non-specific neck pain.

Acknowledgments

The authors would like to appreciate all the participants and all those who contributed to this study.

Authors' Contribution

Zohreh Khosrokiani: Attracting financial resources for the study, providing study equipment and samples, data collection, manuscript preparation, specialized manuscript evaluation in scientific terms, conducting exercises, and responding to the referees' comments; Amir Letafatkar: study design and ideation, attracting financial resources for the study, supportive, executive, and scientific study services, providing study equipment and samples, analysis and interpretation of results, specialized statistics services, manuscript preparation, specialized manuscript evaluation in scientific terms, confirmation of the final manuscript to be sent to the journal office, responsibility to maintain the integrity of the study process from beginning to publication, monitoring the implementation of the exercises and responding to the referees' comments, Yahya Sokhanguei: evaluating the participants in the study based on the inclusion and exclusion criteria, attracting financial resources for the study, and monitoring the implementation of the exercises.

Funding

The present study was based on the analysis of the results of an independent study, which was approved with the ethics code of IR.MODARES.REC.118.1398 in the Ethics Committee, School of Medicine, Tarbiat Modares University. The university did not comment

on data collection, analysis, of and reporting, compilation of the manuscript, and final approval of the study for publication.

Conflict of Interest

The authors declare no conflict of interest. They paid the budget required for basic studies related to this study.

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