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The Effect of Six Weeks of Functional Cognitive Training on Cognitive Factors among the People with Non-Specific Chronic Neck Pain; A Clinical Trial Study

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Original Article

Abstract

Introduction: Neck pain is a common problem in human societies. The purpose of this study was to investigate the effect of six weeks of functional cognitive training on the cognitive factors of people with non-specific chronic neck pain.

Materials and Methods: In this clinical trial study, 24 patients with chronic neck pain were randomly divided into two groups of cognitive functional exercise and control. Cognitive factors were assessed before and immediately after six weeks of cognitive training using pain self-efficacy questionnaire, pain catastrophizing scale, fear-avoidance believes inventory, and depression, anxiety, and stress-21 questionnaire. Data were analyzed using repeated measures ANOVA and paired t tests.

Results: Comparison of two groups after treatment showed a significant difference in all cognitive variables; so that all factors were improved in the intervention group (P = 0.001). Paired t-test results also showed a significant difference in all variables in the intervention group, before and after the test (P = 0.001); but no significant difference was observed for the control group.

Conclusion: The findings suggest that functional cognitive training can be used as a novel method to improve the cognitive factors among the people with chronic neck pain.

Keywords: Neck pain, Self efficacy, Pain catastrophizing

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Introduction

Neck pain is one of the most common problems in human societies, with 67-70% of adults experiencing it throughout their lives. Many factors are involved in the etiology of the neck pain and the pain-related cognitive impairments are among the most important factors contributing to non-specific neck pain (NSNP) (1).

Given the findings of some studies, the cognitive capacity of individuals with chronic pain is declined and this change is dependent on the emotional factors associated with pain rather than the pain itself (2). In issues related to chronic pain, considering factors such as pain, beliefs and attitudes of the patient to pain, fear of pain, and how to manage chronic pain is of paramount importance (2). Negative beliefs and emotions can affect the level of fear of movement and motor disability in the patient. Anxiety and fear are the common characteristics among the individuals with chronic pain, particularly when they do not receive a clear explanation of their disease (3). Motor-related anxiety and fear of pain, as well as psychological factors including depression, anxiety, and stress among patients with chronic pain are stronger predictors of motor disability compared to the severity of pain caused by the disease itself (3).

Variables such as fear and avoidance are the best variables to predict chronic musculoskeletal pain over a 6-month period (4). Catastrophizing pain and fear of pain, distress, depression, anxiety, cognitive functions of patients, and the extent and severity of behaviors indicating pain and physicalizing are associated with the formation and development of some

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musculoskeletal pain and the persistence of such pain (5). If non-adaptive cognitions of pain, such as catastrophizing, are accompanied by emotional and behavioral responses (such as fear and avoidance), they will predict depression, functional disability, and future pain (6). Studies suggest that chronic neck pain is associated with psychological states such as depression, anxiety, stress, fear of pain, and pain catastrophizing (7). Multidimensional biological psychological interventions have been increasingly recommended in individuals with chronic neck pain to modify maladaptive thoughts and behaviors, improve disability, and increase the use of self-management skills (8,9). Based on the above issues and taking into account the prevalence of neck pain among the population as well as the limited functional cognitive training on neck pain, the present study is carried out aiming to examine the effect of six weeks of functional cognitive training on cognitive factors among subjects with chronic NSNP.

Materials and Methods

This study was a single blind (evaluator) randomized clinical trial of the applied type. The study population consisted of 25-40 year old men with chronic neck pain in Tehran Province, Iran. The samples were selected based on the inclusion criteria using the purposive sampling method and were randomly divided into the intervention and control groups. The sample size was calculated through a pilot study on 7 subjects at the significant level of 0.05 in G*Power software. The preliminary study showed an effect size of 0.54. With a power of 0.80 and two times of measurement, the sample size was estimated to be 22, and taking into account a 10% drop, 24 individuals were selected as the study subjects.

The study inclusion criteria included individuals suffering from neck pain for at least three months, receiving a score of 3-7 in the visual analogue scale (VAS), a neck pain without a specific cause diagnosed by the physician, no disc protrusion or prolapse associated with neurological symptoms, lack of a spine surgery, lack of specific structural damage to the neck, no history of rheumatic, inflammatory, and autoimmune diseases, lack of osteoporotic compression fractures, lack of spinal stenosis, and lack of severe mental illnesses. Moreover, the irregular participation in the training programs for two consecutive sessions and three non-consecutive sessions as well as unbearable pain during rehabilitation were also considered as the exclusion criteria. The inclusion and exclusion criteria were evaluated by two physiotherapists separately and in case of a disagreement between the two physiotherapists, the third physiotherapist, who was unaware of the opinions of the two other specialists, conducted the examinations. To examine the randomization methods, a list of numbers each of which was randomly assigned to a treatment type, was prepared. Then, the participants were assigned to the two groups based on the instructions. The randomization was conducted by hiding the random allocation with a 1:1 ratio. In this study, the evaluators and statistical analysts were blinded.

The data collection tools are described in the following in details.

Pain self-efficacy questionnaire (PSEQ): This questionnaire consists of 10 items to assess the efficacy and adequacy of the individual in living with pain. The items are scored on a 7-point Likert scale from 0 (I am not sure at all) to 6 (I am completely sure), with the maximum and minimum scores being 60 and 0, respectively, and the higher scores indicate a strong belief in daily activities while suffering pain (10). This scale has desirable psychometric features and it has been reported to have a high level of validity and reliability (10). Furthermore, the Persian version of the scale has exhibited a good reliability (11).

21-item Depression Anxiety Stress Scale (DASS-21): This instrument consists of 21 expressions related to the symptoms of negative emotions (depression, anxiety, and stress), each of the three scales of which comprising of 7 items. The items are scored on a 4-point Likert scale ranging from 0 to 3 for the options of *not at all* and *very much*, respectively, with the higher scores indicating a worse situation. In accordance with the findings of various studies, the DASS-21 subscales includes desirable psychometric features (12). Besides, the Persian version of the scale showed a good validity and reliability (13).

Fear-Avoidance Beliefs Questionnaire (FABQ): This tool consists of two parts. The first part or the physical activity part is composed of 5 items which examine pain-induced avoidance views in physical activity and the second part or the work part contains 11 items to measure the pain-induced avoidance views in the workplace. This scale has 16 items with a 6-point Likert scale and the scores range from 0 to 96 (14), with the higher scores indicating a worse situation. A high level of validity and reliability has been reported for this questionnaire (14). Furthermore, its Persian version has good validity and reliability (15).

Pain Catastrophizing Scale (PCS): This scale consists of 13 items ranging from 0 to 4 for the options of *not at all* and *all times*, respectively. The

tool has demonstrated a good reliability and validity in both clinical and non-clinical populations (16), with the lower scores suggesting less catastrophizing. According to the findings of a study by Rahmati et al., the Persian version of PCS had an acceptable level of validity and reliability (17).

Functional Cognitive Exercises: The exercises were performed under the supervision of a clinical psychologist 3 days a week for 6 weeks. The functional cognitive training phase was focused on the pain creation mechanisms and the factors obtained by identifying the record of illness and examinations of the subjects. This phase addresses the multidimensional nature of the persistent pain reported by each subject, and examines the effect of cognitive factors, attitudes, emotions, and personality of the individuals on the creation and exacerbation of annoying pain and disability cycles (18). The controlling and rebuilding the concept of pain is a key component of the exercises so that subjects were trained to function naturally and change the concept of creation of pain in their minds in some way to accept that pain is not equivalent to injury. Initially, the physiology of chronic pain was presented, and that chronic pain indicates the sensitivity of the nervous system to a structural damage and a wide range of biological psychological factors contribute to the development and management of chronic pain. In this report, explanations were given on the impact of the incorrect behavior and recognition of the physical status as part of the chronic neck pain problems. In this session, negative beliefs about pain, fear of movement, avoidance, excessive focus on pain, shyness, weak steps, conservative motor behaviors, and muscle spasms that can feed a faulty cycle of pain (19), was presented to each subject through a diagram.

The special factors discussed were different for each participant and included psychosocial factors such as pain interpretation, beliefs about neck pain, anxiety, worry, stress, hypnosis, guilt, grief, anger, sadness, and life damaging events (18). The fear-avoidance cycle as well as training and explanation of the necessity of treatment were explained based on the fear-avoidance model (20). The patients' unreasonable expectations of treatment and inadequate thoughts about pain were challenged and explanations were given on the chronic pain and its consequences. Unreasonable attitudes resistant to therapeutic change were identified and modified. Then, the subjects focused on functional patterns they avoided in their daily activities due to pain, in addition to focusing on physical activity and lifestyle of the subjects (21). The patients performed sensory and visual imagery and postural exercises leading to their behavioral changes and rehabilitation, as well as relaxation of postures causing stress (18,19). Finally, some strategies were trained to the subjects to improve their body awareness (using verbal, auditory, and mirror feedback) during corrective exercises.

The normal distribution of the variables was investigated using the Shapiro-Wilk test. In addition, the repeated measures analysis of variance (ANOVA) test and paired t-test were employed to examine the inter-group and intra-group changes, respectively. Moreover, the significance level was considered 95% and $P \leq 0.05$ and the data were analyzed in SPSS software (version 20, IBM Corporation, Armonk, NY, USA). The study power was calculated with $\alpha = 0.05$ and $B = 0.80$ in G*Power software (G*Power 3.1.5 freeware University of Düsseldorf, Düsseldorf, Germany).

Results

The percentage of drop of the participants was zero, and all of them completed all stages (Figure 1).

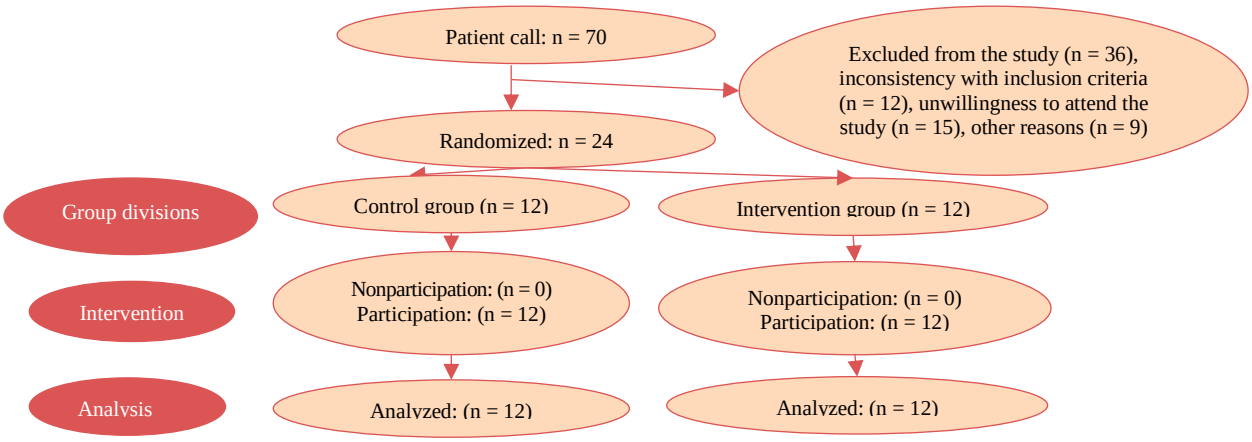

Figure 1. Study process

Table 1. Demographic characteristics of subjects

Variable	Functional cognitive exercise group (n = 12)	Control group (n = 12)	P value
Age (year)	30.25 ± 6.01	28.71 ± 4.77	0.67
Weight (kg)	79.08 ± 6.00	79.83 ± 6.05	0.63
Height (cm)	177.00 ± 5.28	177.00 ± 4.68	0.76
BMI (kg/m^2)	24.30 ± 2.26	24.16 ± 2.05	0.87
Duration of pain (year)	3.95 ± 3.85	4.40 ± 4.10	0.73
Pre-test pain intensity (VAS)	58.00 ± 7.95	57.91 ± 9.94	0.86

VAS: Visual analogue scale; BMI: Body mass index
Data are reported as mean ± standard deviation (SD).

The demographic characteristics of the subjects are given in table 1. The independent t-test results showed no significant difference in the demographic variables between the two groups ($P > 0.05$). Additionally, all data had a normal distribution.

The repeated measures ANOVA test results with the intergroup factor showed significant differences in all cognitive variables. Furthermore, given the paired t-test results, there was a significant difference in all variables of the intervention group in the pretest and posttest stages, however no significant difference was observed in the control group (Table 2).

The actual power of the study was obtained as 0.81 with $\alpha = 0.05$ and $\beta = 0.80$ in G*Power software.

Discussion

The present study was conducted with the objective to investigate the effect of six weeks of functional cognitive exercises on the cognitive factors of individuals with chronic NSNP. The findings suggested that the functional cognitive exercises had a significant effect on cognitive factors including pain self-efficacy, pain catastrophizing, avoidance beliefs, anxiety, stress, and depression, so that these variables improved after six weeks of treatment. This finding is consistent with the results of the studies by Jensen et al. (8), Lindell et al. (9), O'Sullivan et al. (18), O'Sullivan et al. (19), and Caneiro et al. (22), which examined the impact of cognitive-functional exercises on the individuals with chronic pain.

Functional cognitive exercises are multidimensional and individual-centered exercises in which psychological factors are considered as an important part of exercises in addition to emphasis on motor control exercises. These exercises affect the subject's mind and appearance (18). For example, cases like positive attitude, fear reduction, increased awareness, progress in pain control, and changing the nature of pain in the individual's mind, are effective in the adaptation endurance, increased self-confidence, and mental well-being, ultimately leading to reduced pain, disability, and fear of movement (23).

One of the key factors in functional cognitive training is the proportionality of the characteristics of each individual with the exercise specifically assigned to them. These specific exercises are designed by targeting each individual's physical behaviors.

Table 2. Repeated measures analysis of variance (ANOVA) test results

Variable	Score range	Group	Pre-test (mean ± SD)	Post-test (mean ± SD)	Time effect			Group-time interaction			Groupeffect		
					P value	F	Effect size	P value	F	Effect size	P value	F	Effect size
Self-efficacy	0-60	Intervention	29.54 ± 6.34	49.90 ± 6.01	0.001	50.64	0.70	0.001	37.80	0.78	0.008	6.19	0.37
		Control	32.66 ± 8.03	32.16 ± 7.23									
Pain catastrophizing	0-52	Intervention	24.45 ± 6.75	11.90 ± 3.25	0.001	61.30	0.74	0.001	75.60	0.87	0.001	12.79	0.54
		Control	21.91 ± 5.60	25.00 ± 5.87									
Fear-avoidance beliefs	0-96	Intervention	54.18 ± 9.23	21.06 ± 6.36	0.001	117.89	0.84	0.001	0.93	0.94	0.001	53.23	0.83
		Control	50.50 ± 11.23	55.08 ± 10.30									
Anxiety	0-21	Intervention	14.00 ± 2.68	5.18 ± 2.04	0.001	104.23	0.83	0.001	67.35	0.86	0.001	8.87	0.45
		Control	13.25 ± 2.17	12.41 ± 1.88									
Depression	0-21	Intervention	10.81 ± 2.95	4.63 ± 1.91	0.001	29.56	0.58	0.001	47.80	0.82	0.002	8.49	0.44
		Control	10.58 ± 2.06	11.08 ± 2.10									
Stress	0-21	Intervention	12.27 ± 1.95	4.81 ± 1.60	0.001	54.60	0.72	0.001	52.41	0.83	0.001	22.70	0.68
		Control	12.50 ± 2.06	12.50 ± 1.98									

SD: Standard deviation

Physical posture, physical activity, occupation, specific exercise, and personal habits are among these physical behaviors that are performed by modifying the motor pattern, avoiding wrong movements, and continuously performing movements properly (22).

These specific exercises are even observed in the cognitive field and factors such as the individual's personal experiences of pain, thoughts, feelings, attitudes, and events occurring throughout their life are included (19). The functional cognitive training is one of the exercises that not only works on the individual's functional activities, but also challenges him psychologically. Thus, it seems that by influencing the individuals' minds and attitudes, these exercises are trained to them who are able to perform tasks such as walking and daily activities without pain. Therefore, individuals with neck pain face their fears, which prevent them of performing their tasks, and by changing their attitudes, performing functional exercises, and modifying their daily activities, they gain the confidence that they can resume their activities.

Therefore, given the characteristics of the functional cognitive exercises that address the patient's disability and cognitive pattern, measuring the effect of these exercises on walking in individuals with chronic pain seems rational and necessary.

The functional cognitive training is an approach that can be applied to manage pain-related fears and is a combination of physiotherapeutic rehabilitation and cognitive and behavioral interventions. The difference between this training and other interventions lays in its multidimensional nature, so that a multidimensional clinical etiology framework is exploited to explain these exercises in order to identify the various factors that may cause individual pain (24). In cognitive-functional exercises, functional behavioral approaches such as the individual's awareness of his body (conscious control), relaxation of the contracted muscles, normalization, and retraining of wrong motor patterns, and self-image reconstruction of the body through tools such as mirrors or video are aimed (22).

Limitations

The follow-up period was short and only limited to one day after treatment, which was one of the limitations of the study. In addition, all the participants were men.

Recommendations

It is recommended that similar studies be carried out with a longer follow-up period and larger sample size. Furthermore, it is recommended to compare other treatment methods with the cognitive-functional training method or in combination with it on patients with chronic neck pain.

Conclusion

The study findings suggested that the cognitive-functional training method can be used as a new method to improve the cognitive factors of individuals with chronic neck pain.

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Authors' Contribution

Noorollah Javdaneh: Study design and ideation, data collection, analysis and interpretation of results, manuscript preparation, provision of study equipment and samples, specialized statistics services, responsibility to maintain the integrity of the study process since beginning to publishing, and responding to the referees' comments; Amir Letafatkar: Study design and ideation, data collection, data analysis and interpretation, manuscript preparation, supportive, executional, and scientific services of the study, specialized statistics services, specialized manuscript evaluation in terms of scientific concepts, final manuscript approval for submission to the journal office, and accountability for all sections and aspects of the manuscript; Sadredin Shojaedin: Study design and ideation, data analysis and interpretation, manuscript preparation, supportive, executional, and scientific services of the study, specialized statistics services, specialized manuscript evaluation in terms of scientific concepts, final manuscript approval for submission to the journal office, and accountability for all sections and aspects of the manuscript;

Maliheh Hadadnejad: Study design and ideation, data analysis and interpretation, manuscript preparation, supportive, executional, and scientific services of the study, specialized statistics services, specialized manuscript evaluation in terms of scientific concepts, final manuscript approval for submission to the journal office, and accountability for all sections and aspects of the manuscript.

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Conflict of Interests

The authors declare no conflict of interest.

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