SHORT REPORT

Effects of breathing re-education on clinical outcomes in patients with nonspecific chronic neck pain

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Abstract

The present study evaluated the effectiveness of breathing re-education with routine physical therapy. This mixed method study was conducted at the District Headquarter Hospital Faisalabad, Faisalabad from April 2020 to July 2020. Fourteen participants (6men and 8 women) with chronic neck pain were recruited over a 16-week period and were equally divided into breathing re-education and routine physical therapy groups. The mean age of the patients was 38.48±5.92 years. Feasibility outcomes were recruitment, randomisation and retention rates of the participants. Clinical outcomes assessed for full trial were neck pain, cervical ROM, strength and endurance of neck muscles, quality of life and pulmonary functions. Outcomes were measured at baseline, fourth and eighth weeks.

All the participants completed all the treatment sessions. No adverse events were reported. The breathing re-education group showed significant improvement in clinical outcomes. The results of this feasibility study provide supporting evidence for a future large-scale trial. Breathing re-education appears to be an effective treatment for chronic neck pain.

Keywords: Neck pain, Respiration, Re-education

DOI: https://doi.org/10.47391/JPMA.3583

Introduction

Chronic neck pain is accompanied by a number of associated problems in anatomically adjacent areas.[1] Previous studies suggest an association between chronic neck pain, poor posture, lack of sensorimotor control and respiratory dysfunction.[2,3] The myogenic factor is a major precipitating factor in chronic neck pain, as long-term persistent pain leads to muscular imbalance. In patients with chronic neck pain, altered muscle activity pattern is reported in superficial neck muscles(sternocleidomastoid and anterior scalene show hyperactivity), while the deep neck flexors(longus colli and longus capitis)are not fully activated.[4,5]

The diverse cervical kinematics influences involved muscles during the open chain and closed chain movements by altering their force length curve.[6] It is well documented that sternocleidomastoid, scaleni and, to some extent, trapezius also play a role in inspiration, rib's elevation and thoracic stability.[7] In addition, reduced strength and endurance of the neck muscles, altered cervical proprioception, reduced mobility of the cervical spine, psychological state as well as pain, influence respiratory function.[8,9]

It has been shown that patients with chronic neck pain can assume forward head posture which can lead to decreased respiratory muscle strength.[10] According to a recent review, maximal voluntary ventilation, strength of respiratory muscles, chest mechanics and partial pressure of arterial carbon dioxide are affected in patients with chronic neck pain.[11] Thus, it is reasonable to believe that in the presence of chronic neck pain the respiratory function of the patient is compromised; hence, a multimodal treatment approach is needed to treat long-term neck pain and its associated disorders.

Breathing techniques have been part of chronic pain syndrome treatment programme as one of the relaxation techniques. Breathing exercises can help to prevent compensation in superficial and deep cervical muscles, and thus inhibit the use of accessory muscles and stimulate primary muscles of respiration. A recent study investigated the effects of breathing exercises in neck pain patients and noted significant differences between the control and experimental groups.[12]

The present study was conducted to check the feasibility of a full scale trial with the aims(a)to analyse collected data, regarding participants' enrolment, participants' adherence with the intervention and participant losses to follow-up; (b)to suggest the line of action, for implementation of a definitive study; and (c) to check the effects of breathing re-education on selected outcome measures related to neck pain and cervical range of motion.

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Patients/Methods/Results

This mixed method study was approved by the University of Lahore internal review board (IRB-UOL-FAHS-697-2020). The duration of study was four months from April 2020 to July 2020.Thirty-six patients with chronic neck pain presented to the Physiotherapy Department, District Headquarter Hospital Faisalabad, Faisalabad between April 2020 to July 2020. After screening, based on inclusion and exclusion criteria, 14 patient*s were recruited for the study. The inclusion criteria were: male or female patients having nonspecific neck pain for more than three months; age between 25-50 years, with no history of respiratory disease, having FEV1/FVC ratio of not less than 60%. Whereas patients with upper cervical symptoms, such as dizziness, dysphagia or dysarthria, with post-traumatic neck pain, allergic asthma, and depression were excluded. Written informed consent was obtained from all patients and the details of research process were explained to them.

The patients were divided in two groups, Group A and B. The first group consisted of 7 patients (3 males and 4 females) with mean age 38.54±6.72 years. They received routine physical therapy treatment that included infrared radiation (IRR) at cervical region in prone position for 10 minutes, and isometric exercises for flexors and extensors of cervical spine in supine position with 10 second hold, for each muscle group, 20 repetitions were given. The other group also comprised 7 patients (3 males, 4 females), with mean age 38.42±5.12 years, who received both routine physical therapy treatment and supervised breathing exercises, focusing on proper inhalation, exhalation and chest expansion for 15 minutes. Patients in both the groups received the intervention thrice a week, on alternate days, for eight consecutive weeks. Patients of both the groups were advised to continue their exercises at home once a day on days they were not visiting the Physiotherapy Department.

Pain and ROM were assessed by using visual Analogue scale and Cervical range of motion (CROM basic device, USA), Functional disability was measured through Neck Disability Index (Urdu Version).[13] Cervical muscle strength and endurance were measured through handheld neck dynamometer (Baseline Lite 200lb) and bio pressure feedback(USA), respectively.

For all subjects, spirometry was conducted through Spirolab4(USA), in which two pulmonary tests were performed: (1) VC manoeuver, (2) FET (Forced expiratory technique). These manoeuvers included measurement of FEV1, FVC, FEV1/FVC.

Data Analysis: The data were analysed using the Stat Soft software SPSS 21.0 (SPSS Inc., Chicago, USA). The Shapiro-Wilk test was used to test the normality of the data distribution. For descriptive statistics, quantitative variables were computed using mean and standard deviation. The feasibility was described through a consort diagram. The two-way repeated-measures analysis of variance (ANOVA) design was used to analyse the effect of breathing re-education on pain, cervical range of motion, quality of life and respiratory function. The significance level was $p < 0.05$.

Results

Out of the 36 patients, 14 (38%), 8 females and 6 males, were eligible for the study. Their mean age was 38.48±5.92 years and mean BMI was 25.60±5.60. They were divided into two groups, A & B: group A was the intervention group, and group B was the control group. No participant was lost to follow-up. All participants from both the groups completed the eight-week treatment programme. No adverse events were reported. (Figure-1)

There were no differences between the groups in mean age and BMI (Body Mass Index). For breathing re-education group, the mean age and BMI were 38.54±6.72 and 25.84±1.51 respectively. For routine physical therapy, the corresponding values of mean age and BMI were 38.42±5.12 and 25.37±8.26, respectively. The baseline

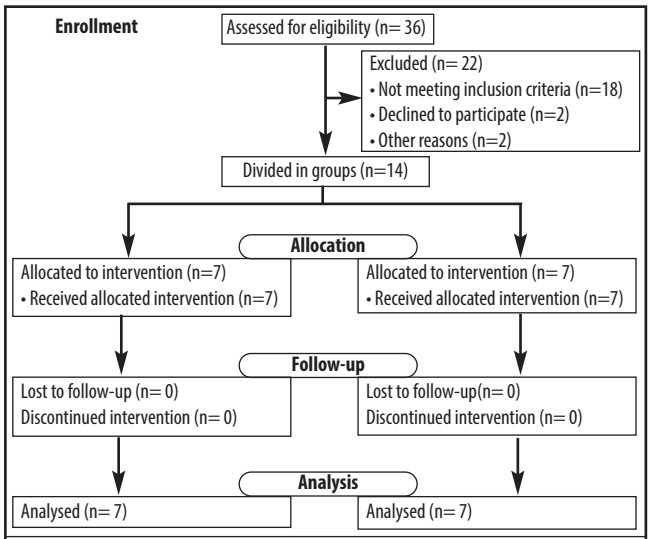

Figure-1: Steps involved from patient's enrollment to completion of study CONSORT Flow Diagram

Table-1: Baseline characteristics of patients (n=14)

	Breathing Group Mean±SD	Routine Group Mean±SD
Age (years)	38.54±6.72	38.42±5.12
Gender Men/Women	3/4	3/4
Height (centimetres)	158.1±6.33	156.71±8.26
Weight (kg)	64.85±8.15	62.57±8.14
BMI	25.84±1.51	25.37±8.26

SD =Standard Deviation, BMI=Body Mass Index.

Table-2: Cervical Ranges of Motion.

Neck Range of motion	Study Group	Baseline	4th week	8th week	*p*-value within Group at 8th week	*p*-value Between Group at 8th week
Flexion	Breathing	36.14±1.57	39.57±2.76	43.85±1.06	0.000	0.000
	Routine	36.28±2.21	38.28±2.21	39.57±2.50		
Extension	Breathing	52.14±3.38	55.28±1.11	58.14±1.46	0.000	0.037
	Routine	54.42±2.14	56.14±2.03	57.85±1.06		
Rt Flexion	Breathing	39.71±1.60	42.71±0.95	43.71±0.55	0.000	0.196
	Routine	39.42±1.81	41.28±2.69	42.57±1.90		
Lt Flexion	Breathing	40.71±1.79	43.71±0.48	43.71±0.48	0.000	0.052
	Routine	39.42±0.95	40.85±0.89	41.42±0.97		
RtRotation	Breathing	52.14±3.38	54.85±3.12	58.28±2.69	0.000	0.039
	Routine	54.42±2.14	56.14±1.95	57.42±1.90		
LtRotation	Breathing	51.14±3.13	54.14±1.57	56.71±2.28	0.000	0.000
	Routine	53.82±2.36	55.14±2.26	56.71±1.79		

Table-3: Strength and Endurance of Neck Muscles.

	Study Group	Baseline	4th week	8th Week	*p*-value Within Group at 8th week	*p*-value Between Group at 8th week
Strength of Neck Flexors	Breathing	12.02±0.81	14.85±1.21	17.81±1.06	0.000	0.001
	Routine	11.42±0.53	13.28±0.48	14.85±0.69		
Strengthof Neck Extensors	Breathing	11.71±0.48	13.71±0.48	15.14±0.37	0.000	0.395
	Routine	11.57±0.97	13.42±0.78	14.83±0.75		
Endurance of Neck Flexors	Breathing	19.14±1.21	21.14±1.21	23.57±0.78	0.000	0.310
	Routine	18.85±1.06	20.57±0.97	22.85±1.06		

Table-4: Pain and Disability.

	Study Group	Baseline	4th week	8th week	*p*-value within Group at 8th week	*p*-value Between Group at 8th week
VAS Score	Breathing	5.71 ±0.75	3.57 ±1.39	1.85 ±1.67	0.000	0.004
	Routine	5.71 ±0.75	4.42 ±0.53	3.42 ±0.78		
NDI Score	Breathing	15.00 ±1.63	10.00 ±1.29	5.28 ±1.11	0.000	0.193
	Routine	13.28 ±2.21	11.57 ±1.61	8.00 ±1.73		

VAS: Visual Analogue Score NDI: Neck Disability Index.

Table-5: Pulmonary Function Test.

Spirometry	Study Group	Baseline	4th week	8th week	*p*-value within Group at 8th week	*p*-value Between Group at 8th week
FEV I/s	Breathing	2.164±0.124	3.37±0.099	3.84±0.127	0.000	0.830
	Routine	2.185±0.06	3.46±0.073	3.75±0.113		
FVC	Breathing	3.25±0.18	3.74±0.25	4.12±0.19	0.000	0.020
	Routine	3.25±0.22	3.45±0.22	3.52±0.205		
FEV/FVC%	Breathing	64.17±2.56	71.28±5.55	79.28±3.98	0.000	0.602
	Routine	66.10±3.46	68.10±3.16	69.85±2.85		

FEV: Force Expiratory Volume, FVC: Force Vital Capacity.

characteristics of the study are illustrated in Table-1.

Effects of intervention in both the groups: The mean changes after the intervention is shown in Table-2. There were significant improvements in outcomes for breathing re-education groups for all cervical measurements at fourth and eighth week (Table-2).

The strength and endurance of neck muscles improved in both the groups at fourth and eighth week, respectively, but significant improvement was observed in breathing re-education group (Table-3). Visual analogue score for pain level showed significant improvement for both the groups; however, more improvement was observed in the breathing re-education group. Similarly, the NDI score significantly improved in both the groups, but more improvement was observed in breathing re-education group(Table-4).The pulmonary function test showed significant improvement in FVC,FEV1 and FEV/FVC ratio in breathing re-education group, while it was insignificant in routine physical therapy group (Table-5). The changes in the outcome measures for both the groups before and after the treatment are illustrated in figure-2 and figure-3.

Discussion

This study was conducted to assess the feasibility of a breathing re-education programme in patients with chronic neck pain. A small sample size was used to observe the effects of breathing re-education on chronic neck pain before conducting a full scale trial. The results of this study are comparable with the results of a previous study exploring the effects of breathing re-education combined with chest mobilisation in reducing pain and respiratory muscles' over-activity in patients with neck pain.[14] Although chest mobilisation was not part of the current study's protocol, conclusions of the study support the results. Another study, on male young adults with poor posture, showed that dynamic stabilising breathing exercises result in improved respiratory indices.[15] In our study, respiratory function of patients of both the genders

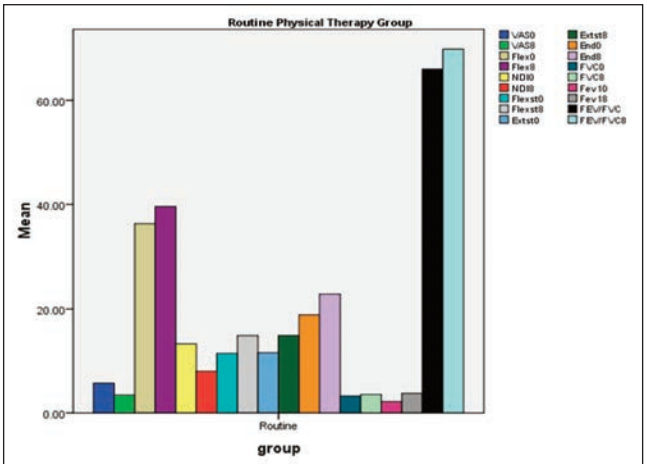

Figure-2: Changes in variables at baseline and 8th week for routine group.

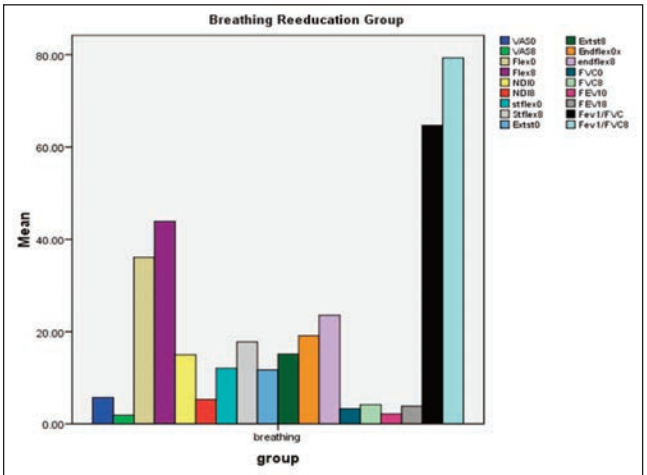

Figure-3: Changes in variables at baseline and 8th week for breathing reeducation group.

with neck pain significantly improved after breathing re-education.

A mobile app-based study to evaluate self-management of neck pain revealed that incorporation of deep, slow breathing with stretching of neck muscles resulted in significant improvement in pain intensity, muscle activation pattern and pain threshold.[16] It was a self-management programme; however, in the present study supervised breathing re-education along with routine physical therapy treatment for consecutive eight weeks resulted in improved endurance of deep neck flexors and increase in respiratory function measures.

The rate of recruitment in this feasibility study was modest to good, with 14 out of 36(38%) prospective subjects participating. A simple and effective strategy was used to recruit patients, yielding on average two participants per week. The patients were directed to the OPD through an opt-in strategy by advertising through posters and social media advertisement. This strategy can be used in a large-scale trial where potential participants can be directed to the particular OPD.

Adequately powered and well-planned studies are required to demonstrate effectiveness of breathing re-education on pain, quality of life, and pulmonary function of patients with chronic neck pain. This comprehensive treatment approach will add to the assessment and treatment of chronic neck pain.

Limitations: As common in feasibility studies, the results cannot be generalised as it was a small study with limited sample size. Moreover, the total treatment time was 30-40 minutes which is a short time period for a combination of treatment.

Conclusion

This study demonstrated that a full scale RCT is feasible for eight weeks breathing re-education programme in patients with chronic neck pain. Breathing re-education combined with routine physical therapy treatment improves pain, cervical range of motion, endurance and strength of neck flexors. Whereas there is also a marked improvement in the patients' pulmonary function.

Acknowledgement: We acknowledge the participants of the study for their cooperation.

Disclosure statement: None.

Conflict of interest: None.

Funding Sources: None.

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