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Immediate and Prolonged Effects of Breathing Exercises on Pain, Quality of Life and Functional Disability in Patients of Upper Cross Syndrome: A Randomized Controlled Trial

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Author`s Contribution

[1-3]Conception and design, [2-3] Collection and assembly of data, [2-1]Analysis and interpretation of the data, [3-1]Critical revision of the article for important intellectual content, [2-3] Statistical expertise,[1-1-5]Final approval and guarantor of the article.

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ABSTRACT

Background: Upper cross syndrome is a relatively prevalent musculoskeletal disorder among the general population due to increased usage of smart gadgets and poor postural habits.

Objective: To determine the immediate and prolonged effect of breathing exercise on pain, functional disability, and quality of life parameters in the population with the upper cross syndrome.

Methodology: A randomized control trial study was conducted at Jinnah Memorial Trust Hospital Gujranwala. The duration of the study was 15 months (Feb-2021 to Jan-2022). A sample of 76 upper cross syndrome enrolled and equally (n=38) randomized into the control group (regular physical therapy treatment) and experimental group (regular physical therapy treatment + breathing exercises). The treatment effect was investigated on the outcomes including pain (NPRS), functional disability (NDI), and Quality of life (SF-36). Treatment time was a total of 4 weeks; outcomes variables were compared at baseline vs after 1st session, for immediate effects, and Baseline vs after 4th week for prolonged effects. Data was analyzed with SPSS 21.

Results: The mean age of 76 participants was 32.51 + 6.33 years (4 males (5.3%) and 72 females (94.7%)). For both, immediate effects NPRS, NDI, and SF-36 domains (general health, general health perception, physical functioning, role limitation due to physical health, emotional health, role limitation due to emotional health, energy, and bodily pain) were significantly improved ($p<0.05$), in the experimental group received breathing exercises added into regular physical therapy plan as compared to control group. Within group analysis revealed both interventions are effective in improving the mentioned outcomes ($P<0.05$)

Conclusion: Breathing exercises are safe and effective intervention in cervical pain management and functional disability of upper cross syndrome in terms of both immediate effects and long-term effects. Furthermore, inculcating the breathing exercises in the management program of the upper cross syndrome can enhance the parameters of the quality of life.

Key words: Breathing exercises, cervical pain, disability, forward head posture, upper cross syndrome

Introduction

The COVID-19 pandemic has altered professional and personal life in numerous aspects especially related to the increased use of smartphone technology.[1,2] Isolation, quarantine, and implementation of social distancing have diverted people to

spend leisure time using mobile phones and likewise, online E-commerce on laptops and mobile phones have settled new trends that have never seen before. Despite the numerous beneficial concerns of smartphone technology the already determined associated health consequences have been exaggerated too.[2] Among such health-related disorders occurring due to the increased use of smartphones; the upper cross syndrome is very common.[3]

The upper cross syndrome is a musculoskeletal disorder related to the cervical spine, upper back, and shoulder griddle complex. The upper cross syndrome occurs due to weakness of neck flexor muscles, lower and middle trapezius muscles, shortening of the upper trapezius muscle, levator scapula, and pectoralis major muscles in across pattern; anteriorly and posteriorly.[4] The upper cross syndrome can lead to cervical and upper back pain, micro-inflammation, and movement restrictions due to muscles imbalances. Consequently causing poor quality of life.[5]

In literature, the evidence has been reported about the effect of the upper cross syndrome and certain cervical conditions affecting the respiratory mechanics due to causing the imbalance of respiratory muscles.[6] Vikram Mohan et al conducted a study to examine the efficacy of designed breathing exercise on the outcomes including endurance of respiratory muscle, range of motion on cervical spine, cervical pain, and chest expansion in patients with chronic neck pain. The experimental group receiving breathing exercise showed statistical significant difference for the outcomes of cervical pain ($p<0.05$), and the cervical range of motion ($p<0.05$).[7] Sadudee Thongtipmak et al conducted a randomized control trial to evaluate the acute effects and suitability of a Neck Protector; a smartphone mobile app to indorse self-treatment of neck pain with stretching of muscles and integrating slow and deep breathings among smartphone using individuals having neck pain. The instant effects showed that pain and muscular tensions were significantly lowered ($p<0.05$), while cervical range of motion and pain pressure threshold was statistically improved in the experimental group ($p<0.05$).[8] Lim CG et al (2020) conducted a randomized control trial to investigate the efficacy of different interventions including joint mobilization, training on gym ball, and breathing exercises in patients having chronic back pain. Results of the study showed overall significant difference in AVONA in all variables ($p<0.05$). The group differences were statistically significant in the gym ball group and group receiving the breathing exercises in ETCO2 and respiratory rate ($p<0.05$).[9]

As far as the dysfunction of respiratory is concerned the literature supports the use of various breathing exercises to improve the functioning of the respiratory system including deep breathing, breathing control training, and segmental breathing exercises. Particularly the controlled breathing exercises and segmental breathing exercises lower the muscular tension in respiratory muscles ending in improved physiology of respiratory muscles and unloading the cervical muscles involved as accessory muscles of respiration thus performing their primary function at the cervical spine and upper back.[10, 11]

As previously it is known that the consequences of upper cross syndrome are pain, functional disability, and quality of life that have been studied extensively in the literature. However, no study has been found that has studied the treatment effect of breathing exercises added to standard physical therapy treatment regime. Therefore, the current study was conducted to determine the immediate and long-term effects of breathing exercises in lowering pain, functional disability and quality of life among patients with upper cross syndrome.

Methodology

It was a single-blinded randomized control trial study conducted at Jinnah Memorial Trust Hospital Gujranwala, Pakistan. The calculated sample size using VAS as outcome measure is 34 in each group after adding 20% dropout the sample size will become 34+4=38 in each group. The sample of the study consisted of 76 subjects with upper cross syndrome enrolled in the study based on inclusion criteria consisted of age 18 to 40 years, both genders, having symptoms including cervical muscle shortening and weakness, increased thoracic kyphosis, score of NDI > 15 point, and paresthesia in arms. Patients with pregnancy and other musculoskeletal and neuromuscular disorders were excluded from the study. Patients with history of upper limb fractures and dislocations were also excluded. The selected subjects were equally randomly allocated to the two groups including control and experimental through the toss coin method. The sampling technique was non-probability purposive sampling. Before conductance of the study approval from the Ethical Committee of the University of Lahore was taken. Moreover, informed consent from each participant was taken and all treatment protocols of the study were explained. Furthermore, the ethical concerns of the Declaration of Helsinki (General Assembly, October 2013) were followed.[12]

Patients were assessed at day zero (baseline) with demographics, pain intensity, and quality of life. For immediate effects, the outcomes were then recorded after 1st session and for prolonged effects, the treatments were continued for 4 weeks and subjects were assessed after the last session of 4th week (3 to 5 sessions per week). The treatment protocols of the groups are as follow:

Control Group: In the control group (n=38) the participants received standard physical therapy treatment of upper cross syndrome including heating therapy (hot packs) for 5 to 10 minutes, PNF stretching of tightened muscles (pectoralis major, upper trapezius, and sub-occipitalis muscles), stretches with wall corner technique (3X10 repetitions), isometrics of rhomboids and lower trapezius with resisting the scapular abduction.

Experimental Group: In the experimental group (n=38) the participants received standard physical therapy treatment of upper cross syndrome as above added with breathing exercises including breathing control exercise for 3 to 5 minutes and segmental breathing exercises at upper, middle, and lower zones of both lungs for 5 to 15 minutes.

Study outcomes were pain (measured with NPRS) which is a horizontal 10 segments numeric scale representing pain intensity from 0 (no pain) to 10 (excruciating pain).[13] To assess the functional disability the Neck Disability Index (NDI) was used and for quality of life SF-36 questionnaire was used.[14, 15] NDI and NPRS were measured and compared for immediate effects (baseline vs post-1st session) and prolonged effect (baseline vs after 4th week), and quality of life was measured and compared at baseline and after 4th week.

Data was analyzed with SPSS 21 version. The normality testing through Shapiro Wilk Test revealed non-normal distruciton of NPRS and NDI (P<0.05). Therefore between groups comparison was done by Mann-Whitney U Test and within group comparison was done by Wilcoxon test. The Shapiro Wilk P value for SF-36 showed normal distribution therefore, Independent T Test and paired- T test were applied. Alpha value was determined as 0.05 with 95% CI.

Results

The mean age of 76 participants was 32.51 ± 6.33 years. Gender distribution is shown in figure 1.

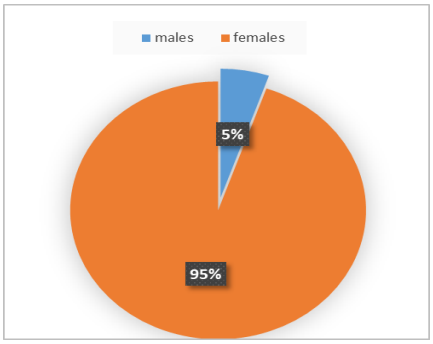

Figure 1: Gender distribution (n=76)

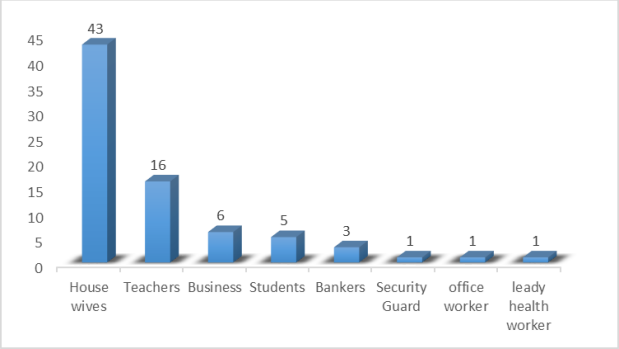

Figure 2: Occupation of Participants (n=76)

Mean age in control group was 35.37 ± 5.57, and mean age of experimental group was 35.66 ± 7.09. Majority of the sample consisted of housewives (n=43), occupation details are shown in figure 2. For baseline comparison both groups were similar (p>0.05) in terms of all outcomes including NPRS, NDI, and SF-36 eight parameters.

For the immediate effects, the experimental group showed statistically significant difference when compared with the control group for NPRS (P<0.001), and NDI (P<0.001) as shown detail in table II. Similarly, when these outcomes were compared for prolonged effect the experimental group showed statistically significant improvement when compared with the control group for NPRS (P<0.001), and NDI (P<0.001) as shown detail in table III.

Table I: Descriptive data (Groups wise)

Variables		Control Group (n=38)	Experimental Group (n=38)
Age (mean ± SD)		35.37 + 5.57	35.66 + 7.09
Gender	Males	3 (7.9%)	1 (2.6%)
	Females	35 (92.1%)	37 (97.4%)

Table II: Groups Comparison for immediate effects (Mann Whitney-U Test)

Variables		Median (IQR)	Mean Rank	P value
NPRS Baseline	Control Group	8.87 (1)	40.91	0.266
	Experimental group	8.71 (1)	36.09	
NPRS After 1st session	Control Group	7.76 (2)	46.45	0.001*
	Experimental group	6.81 (1)	30.55	
NDI Baseline	Control Group	45.21 (0.5)	42.70	0.095
	Experimental Group	42.66 (3)	34.30	
NDI After 1st session	Control Group	38.61 (2)	50.28	< 0.001*
	Experimental Group	29.84 (1)	26.72	

Table III: Groups Comparison for prolonged effects (Mann Whitney-U Test)

Variables		Median (IQR)	Mean Rank	P value
NPRS Baseline	Control Group	8.87 (1)	40.91	0.266
	Experimental group	8.71 (3)	36.09	
NPRS After 4th week	Control Group	6.61 (1)	53.50	< 0.001*
	Experimental group	3.42 (3)	23.50	
NDI Baseline	Control Group	45.21 (2)	42.70	0.095
	Experimental Group	42.66 (1)	34.30	
NDI After 4th week	Control Group	34.40 (1)	57.18	< 0.001*
	Experimental Group	8.16 (2)	19.82	

Table IV: Baseline and 4th week group comparison of SF-36 QoL (Mann Whitney-U Test)

SF-36 Domains	Control Group	Experimental Group	P value
General Health Perception/status (Baseline)	75.73 ± 11.41	77.74 ± 11.38	0.51
General Health Perception/status (After 4th week)	77.73 ± 11.3	82.63 ± 9.1	0.04*
Physical Functioning (Baseline)	66.9 ± 9.22	66.2 ± 8.9	0.76
Physical Functioning (After 4th week)	67.24 ± 9	72.08 ± 8.45	0.01*
Bodily Pain (Baseline)	69.7 ± 10.57	68.76 ± 11.2	0.71
Bodily Pain (After 4th week)	72.74 ± 10.4	78.74 ± 12.3	0.02*
Role limitation due to physical health (Baseline)	72.9 ± 11.3	73.55 ± 11.9	0.08
Role limitation due to physical health (After 4th week)	74.71 ± 12.1	81.58 ± 10.59	0.01*
Role limitation due to emotional health (Baseline)	70.74 ± 11.3	69.11 ± 9.89	0.07
Role limitation due to emotional health (After 4th week)	75.45 ± 1.73	83.47 ± 7.7	<0.001*
Emotional well-being (Baseline)	69.7 ± 10.5	68.7 ± 11.2	0.07
Emotional well-being (After 4th week)	73.74 ± 10.2	81.34 ± 12.46	0.005*
Energy (Baseline)	72.66 ± 11.4	71.37 ± 10.7	0.611
Energy (After 4th week)	76.66 ± 11.48	82.31 ± 10.14	0.02*
General health (Baseline)	74.68 ± 10.57	73.76 ± 11.25	0.723
General health (After 4th week)	77.9 ± 10.43	84.66 ± 7.5	0.002*

For the eight components of the SF-36 questionnaire; the data was compared at baseline and after the 4th week of intervention. At baseline both the groups (control vs experimental) were similar as the p-value was >0.0.5 for each domain such as; general health status (P = 0.51), physical functioning (P = 0.76), Bodily pain (P = 0.71), role limitation due to physical health problems (P = 0.08), role limitation due to personal or emotional problems (P = 0.5), emotional well-being (P = 0.07), energy (P = 0.6), and general health (P = 0.7). as shown in table IV.

Table V: Within Group Comparison for NPRS and NDI; immediate and long term effects

Variables	Control Group (Mean ± SD)	P-Value	Experimental Group (Mean ± SD)	P-Value
NPRS Baseline	8.87 ± 0.67	<0.001*	8.71 ± 0.61	<0.001*
NPRS After 1st session	7.76 ± 1.02		6.81 ± 1.35	
NPRS Baseline	8.87 ± 0.67	<0.001*	8.71 ± 0.61	<0.001*
NPRS After 4th week	6.6 ± 1.77		3.42 ± 1.6	
NDI Baseline	45.21 ± 5.95	<0.001*	42.65 ± 7.48	<0.001*
NDI After 1st session	38.1 7.03		29.85 9.14	
NDI Baseline	45.21 ± 5.95	<0.001*	42.65 ± 7.48	<0.001*
NDI After 4th week	34.39 ± 8.08		8.16 ± 4.65	

After the 4 weeks of the interventions experimental group in all the domains showed statistically significant improvement; such as, general health status (P = 0.04*), physical functioning (P = 0.01*), Bodily pain (P = 0.02*), role limitation due to physical health problems (P = 0.01*), role limitation due to personal or emotional problems (P <0.001*), emotional well-being (P = 0.005*), energy (P = 0.02*), general health (P = 0.002*) as shown in table IV.

Within-group comparison for pain revealed that both the groups showed significant differences in terms of pain (NPRS), when compared to baseline vs after 1st session (P<0.001*) and baseline vs after the 4th week (P<0.001*) (Table 5). Similarly, both the interventions were found to be significantly effective in reducing the neck disability (NDI), when compared baseline vs after 1st session (P<0.001*) and baseline vs after the 4th week (P<0.001*) (Table V).

Likewise, the eight parameters of quality of life (SF-36) were significantly improved in both the groups except in the physical function (P = 0.057), bodily pain (p<0.001*), general health (p<0.001*), role limitation due to physical health (P = 0.002*), role limitation due to emotional health (p<0.001*), emotional wellbeing (p<0.001*), general health perception/status (p<0.001*) (Table IV).

Discussion

Our literature searching the study is first to evaluate the effectiveness of breathing exercises in upper cross syndrome in terms of immediate and long-term effects. In our study, the first outcome was pain; which was measured with NPRS, and on the baseline both the group control and experimental were homogenous; mean comparable to each

Table VI: Within Group Comparison for SF-36 (Paired Sample-T Test)					
SF-36		Control Group (Mean ± SD)	P-Value	Experimental Group (Mean ± SD)	P-Value
Physical Functioning	Baseline	66.89 ± 9.22	0.057	66.26 ± 8.8	<0.001*
	After 4 weeks	67.24 ± 8.99		72.08 ± 8.44	
Role limitation due to Physical Health	Baseline	72.89 11.32	0.002*	73.55 ± 11.92	<0.001*
	After 4 weeks	74.71 ± 12.13		81.58 ± 10.58	
Role limitation due to Emotional Health	Baseline	70.74 ± 11.38	<0.001*	69. 11 ± 9.9	<0.001*
	After 4 weeks	75.45 ± 10.72		83.47 ± 7.71	
Emotional Wellbeing	Baseline	69.68 ± 10.57	<0.001*	68.7 ± 11.25	<0.001*
	After 4 weeks	73.74 ± 10.22		81.34 ± 12.45	
Energy	Baseline	72.66 ± 11.48	<0.001*	71.37 ± 10.74	<0.001*
	After 4 weeks	76.65 ± 11.49		82.31 ± 10.13	
General Health	Baseline	74.68 ± 10.57	<0.001*	73.76 ± 11.25	<0.001*
	After 4 weeks	77.89 ± 10.43		84.65 ± 7.48	
Health Perception	Baseline	75.73 ± 11.38	<0.001*	74.10 ± 9.87	<0.001*
	After 4 weeks	77.73 ± 11.4		82.63 ± 9.15	
Bodily Pain	Baseline	69.68 ± 10.57	<0.001*	68.76 ± 11.25	<0.001*
	After 4 weeks	72.74 ± 10.41		78.74 ± 12.31	

other. A study by Vikram Mohan et al showed the same results that our study group receiving breathing exercises showed significant improvement related to pain scores (Z value = -2.03; P value = 0.041).[7] The physiological aspects describes the effect of breathing exercise in pain and deep breathing procedures imitates the parasympathetic tone causing decrease in muscle tension leading to analgesic effect.[16]

After the last session of 4th week the outcomes were compared to determine the prolonged effects of treatment and experimental group (breathing exercise) showed significant superior improvement (p<0.001), in reducing the pain as compare to the control group. Another study by Sadudee Thongtipmak et al declared the efficacy of breathing exercises in pain on pain and other outcomes of breathing exercises guided via mobile application. [17]

In our study the next objective was functional disability; which was measured with NDI and for both immediate and prolonged effect the experimental group showed significant superior improvement (p<0.001), in reducing the functional disability as compare to the control group; indicating that breathing exercises added to standard physical therapy program is safe and effective to reduce functional disability in upper cross syndrome for immediate and prolonged effects. In a previous study by Jeong Kang et al (2016) the breathing exercise group showed significant reduction in NDI score (experimental group 17.6 ± 1.8 vs 12.3 ± 1.1, p<0.05*, control group 17.1 ± 1.5 vs 14.9 ± 1.1 p<0.01**).[18] The connection between breathing exercises and functional disability is well studied in the literature; that deep breathings improves core muscle activation and diaphragm functioning which collectively enhance muscle functioning. [19]

In the present research the treatment effect of segmental breathing and control breathing exercises intervention was studied on the eight domains of health quality including general health, general health perception, physical functioning, role limitation due to physical health, emotional health, role limitation due to emotional health, energy, and bodily pain measured by SF-36 questionnaire. In the study the experimental group received breathing exercise showed statistically significant improvement (p<0.05) in each domain that shows addition of breathing exercises in treatment protocol of upper cross syndrome is safe and effective intervention to improve the outcomes related to quality of life. Previously in the study by Radhakrishnan et al (2015) the significant improvement (p<0.01) was observed in quality of life (SF 36 questionnaire) in the group with addition of breathing exercise in their treatment plan in population of women with chronic neck pain.[20]

Conclusion

The study concluded that breathings exercises are safe and effective intervention in cervical pain management of upper cross syndrome in terms of both immediate effects and long-term effects. Similarly, breathing exercises are effective to reduce the functional disability associated with the upper cross syndrome. Furthermore, inculcating the breathing exercises in management program of upper cross syndrome can enhance the parameters of the quality of life. The regular physical therapy was also found effective in above mentioned outcomes but the breathing exercise group showed enhanced improvement.

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