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Original Article

Immediate and Prolonged Effects of Breathing Exercises on Pain, Quality of Life & Functional Disability in Patient of Upper Cross Syndrome: A Randomized controlled trial

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ABSTRACT

Background: The advent of smartphone technology and its increased use, especially during the COVID-19 pandemic, has led to a rise in musculoskeletal disorders, including upper cross syndrome. This condition, characterized by muscle imbalances around the cervical spine and shoulder girdle, results in pain, functional disability, and decreased quality of life. Breathing exercises have been suggested as a therapeutic intervention to address these issues, yet empirical evidence on their effectiveness remains sparse.

Objective: This study aimed to evaluate the immediate and prolonged effects of breathing exercises on pain, functional disability, and quality of life in patients with upper cross syndrome, filling a gap in the literature regarding non-pharmacological interventions for this condition.

Methods: Conducted as a single-blinded randomized controlled trial at Jinnah Memorial Trust Hospital, Gujranwala, Pakistan, this study involved 76 participants with upper cross syndrome, randomized into control (standard physical therapy) and experimental (standard physical therapy plus breathing exercises) groups. Pain was assessed using the Numeric Pain Rating Scale (NPRS), functional disability with the Neck Disability Index (NDI), and quality of life through the SF-36 questionnaire. Assessments were made at baseline, after the first session, and after four weeks. Data analysis was performed using SPSS version 25, employing the Mann-Whitney U Test for between-group comparisons and the Paired Sample T-test for within-group analyses.

Results: The experimental group demonstrated significantly superior improvement compared to the control group in NPRS scores after the first session ($p<0.001$) and after four weeks ($p<0.001$), NDI scores ($p<0.001$ at both intervals), and all eight domains of the SF-36 ($p<0.05$ for each domain after four weeks), indicating that breathing exercises significantly reduce pain and functional disability while enhancing quality of life.

Conclusion: Breathing exercises are a safe and effective adjunct to standard physical therapy for patients with upper cross syndrome, significantly improving pain management, functional disability, and quality of life. This study underscores the potential of integrating breathing exercises into rehabilitation programs for musculoskeletal disorders related to excessive technology use.

Keywords: Upper cross syndrome, Breathing exercises, Physical therapy, Pain management, Functional disability, Quality of life, Musculoskeletal disorders, Rehabilitation, Numeric Pain Rating Scale, Neck Disability Index, SF-36.

INTRODUCTION

The COVID-19 pandemic has significantly transformed both professional and personal lives, with a marked increase in the reliance on smartphone technology. This shift, fueled by isolation, quarantine, and the necessity of social distancing, has led to an unprecedented surge in mobile phone usage for leisure activities, as well as a spike in online commerce via laptops and smartphones. While the benefits of this technological pivot are manifold, the pre-existing health concerns associated with prolonged smartphone use have been further exacerbated (1, 2). One of the most prevalent musculoskeletal disorders in this context is the upper cross syndrome, which involves a complex interplay of muscular imbalances around the cervical spine, upper back, and shoulder girdle.

Journal of Health and Rehabilitation Research 2791-156X JHRR

This condition is characterized by the weakening of the neck flexor muscles and the lower and middle trapezius muscles, alongside the shortening of the upper trapezius, levator scapula, and pectoralis major muscles, forming a cross-like pattern both anteriorly and posteriorly (3, 4). Upper cross syndrome can lead to a host of complications, including cervical and upper back pain, micro-inflammation, and restricted movement, all of which contribute to a diminished quality of life (5).

The literature has also shed light on the impact of upper cross syndrome and similar cervical conditions on respiratory mechanics, highlighting a resultant imbalance in respiratory muscle function (6). In addressing this dysfunction, various breathing exercises have been identified as beneficial for enhancing the operational capacity of the respiratory system. These include deep breathing, breathing control training, and segmental breathing exercises. Notably, controlled and segmental breathing exercises have been shown to reduce muscular tension in the respiratory muscles, thereby optimizing the physiological function of these muscles and alleviating the burden on cervical muscles that serve as accessory muscles for respiration. This, in turn, restores their primary function in supporting the cervical spine and upper back (7, 8).

Despite extensive research into the outcomes associated with upper cross syndrome, such as pain, functional disability, and quality of life, there exists a gap in the literature regarding the efficacy of breathing exercises when incorporated into a standard physical therapy regimen for treating this condition. It is against this backdrop that the present study was conducted, aiming to elucidate the immediate and prolonged effects of breathing exercises on mitigating pain, functional disability, and enhancing the quality of life among patients afflicted with upper cross syndrome. This investigation endeavors to fill the existing void in research, offering new insights into the therapeutic potential of breathing exercises as a complementary intervention in the physical therapy treatment of upper cross syndrome.

MATERIAL AND METHODS

This study, conducted in the format of a single-blinded randomized control trial, took place at Jinnah Memorial Trust Hospital, Gujranwala, Pakistan. The research cohort comprised 76 subjects diagnosed with upper cross syndrome, selected based on a set of inclusion criteria that specified an age range of 18 to 40 years, encompassing both genders and symptoms indicative of the condition, such as cervical muscle shortening and weakness, increased thoracic kyphosis, and paresthesia in the arms. The exclusion criteria for the study were pregnancy and the presence of other musculoskeletal or neuromuscular disorders. Participants were divided into two groups—control and experimental—utilizing a combination of the toss coin method for random allocation and non-probability purposive sampling for selection. Ethical clearance was obtained from the Ethical Committee of the University of Lahore, ensuring compliance with the ethical standards delineated in the Declaration of Helsinki (General Assembly, October 2013) (9). Informed consent was secured from each participant, following a detailed briefing on the study's protocols.

The initial assessment of the patients was conducted on the first day, recording baseline data that included demographics, pain intensity, and quality of life metrics. Immediate effects were evaluated after the first treatment session, while prolonged effects were assessed following a treatment duration of 4 weeks, with 3 to 5 sessions per week. The control group, consisting of 38 participants, received standard physical therapy treatments for upper cross syndrome. This regimen included heat therapy applied through hot packs for 5 to 10 minutes, Proprioceptive Neuromuscular Facilitation (PNF) stretching targeting the tightened muscles, wall corner technique stretches performed in sets of three with ten repetitions each, and isometric exercises aimed at engaging the rhomboids and lower trapezius by resisting scapular abduction. Conversely, the experimental group, also comprising 38 participants, was subjected to the same standard physical therapy protocol with the addition of breathing exercises. These exercises included breathing control exercises conducted over 3 to 5 minutes and segmental breathing exercises targeting the upper, middle, and lower zones of both lungs for durations ranging from 5 to 15 minutes.

The study's outcomes were measured using the Numeric Pain Rating Scale (NPRS), a ten-segment numeric scale quantifying pain intensity from 0 (no pain) to 10 (excruciating pain) (10), and the Neck Disability Index (NDI) for evaluating functional disability. Quality of life was assessed using the SF-36 questionnaire (11, 12). Both NDI and NPRS scores were compared to ascertain immediate (baseline versus post-1st session) and prolonged effects (baseline versus after the 4th week), while quality of life measurements were compared between the baseline and the conclusion of the 4th week.

Data analysis was performed using SPSS software, version 25. The Mann-Whitney U Test was employed for between-group comparisons, while the paired-sample T-test was used for within-group comparisons. The significance level was set at an alpha value of 0.05, with confidence intervals at 95%. This meticulous approach to methodology ensured the study's robustness, enabling a comprehensive evaluation of the impact of breathing exercises on individuals with upper cross syndrome, in terms of pain relief, functional disability mitigation, and quality of life enhancement.

Journal of Health and Rehabilitation Research 2791-156X JHRR

RESULTS

In this study, the demographic data of participants revealed an average age of 35.37 years (SD = 5.57) in the control group and 35.66 years (SD = 7.09) in the experimental group, indicating a middle-aged cohort predominantly composed of females, with 92.1% in the control and 97.4% in the experimental groups, respectively. The male participants were notably fewer, comprising only 7.9% of the control and a mere 2.6% of the experimental groups (Table 1).

The immediate effects of the intervention on pain and functional disability, as measured by the Numeric Pain Rating Scale (NPRS) and the Neck Disability Index (NDI), showed significant findings. Initially, both groups reported similar baseline NPRS scores; however, after the first session, the control group's pain scores decreased to 7.76 (SD = 1.02), while the experimental group saw a more pronounced reduction to 6.81 (SD = 1.35), a difference that was statistically significant ($p = 0.001$) (Table 2). Similarly, NDI scores at baseline did not significantly differ between groups but showed a substantial decrease after the first session in the experimental group (29.84, SD = 9.14) compared to the control group (38.61, SD = 7.03), again with significant differences ($p < 0.001$) (Table 2).

The prolonged effects observed after 4 weeks further underscored the benefits of the intervention, particularly in the experimental group. NPRS scores for the control group decreased to 6.61 (SD = 1.79), while the experimental group experienced a remarkable reduction to 3.42 (SD = 1.60), indicating a significant difference in pain reduction over time ($p < 0.001$) (Table 3). Likewise, NDI scores showed a significant improvement in the experimental group (8.16, SD = 4.65) compared to the control group (34.40, SD = 8.08) after 4 weeks, illustrating a notable reduction in functional disability ($p < 0.001$) (Table 3).

Table 1: Descriptive Data of Participants by Group

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 2: Immediate Effects- NPRS and NDI Scores (Mann-Whitney U Test)

Outcome	Group	Mean ± SD	Mean Rank	IQR	P value
NPRS					
Baseline	Control	8.87 ± 0.67	40.91	1	0.266
	Experimental	8.71 ± 0.61	36.09		
After 1st session	Control	7.76 ± 1.02	46.45	1	0.001*
	Experimental	6.81 ± 1.35	30.55		
NDI					
Baseline	Control	45.21 ± 5.95	42.70	8.75	0.095
	Experimental	42.66 ± 7.49	34.30		
After 1st session	Control	38.61 ± 7.03	50.28	4.75	<0.001*
	Experimental	29.84 ± 9.14	26.72		

Table 3: Prolonged Effects- NPRS and NDI Scores (Mann-Whitney U Test)

Outcome	Group	Mean ± SD	Mean Rank	IQR	P value
NPRS					
Baseline	Control	8.87 ± 0.67	40.91	1	0.266
	Experimental	8.71 ± 0.61	36.09		
After 4th week	Control	6.61 ± 1.79	53.50	3	<0.001*
	Experimental	3.42 ± 1.60	23.50		
NDI					
Baseline	Control	45.21 ± 5.95	42.70	8.75	0.095
	Experimental	42.66 ± 7.49	34.30		
After 4th week	Control	34.40 ± 8.08	57.18	32	<0.001*
	Experimental	8.16 ± 4.65	19.82		

Journal of Health and Rehabilitation Research 2791-156X JHRR

Table 4: SF-36 Quality of Life Scores- Baseline and After 4th Week Comparison (Mann Whitney-U Test)

SF-36 Domains	Group	Baseline Mean ± SD	4th Week Mean ± SD	P value
General Health Perception/Status	Control Group	75.73 ± 11.41	77.73 ± 11.3	0.51
	Experimental Group	77.74 ± 11.38	82.63 ± 9.1	0.04*
Physical Functioning	Control Group	66.9 ± 9.22	67.24 ± 9	0.76
	Experimental Group	66.2 ± 8.9	72.08 ± 8.45	0.01*
Bodily Pain	Control Group	69.7 ± 10.57	72.74 ± 10.4	0.71
	Experimental Group	68.76 ± 11.2	78.74 ± 12.3	0.02*
Role Limitation due to Physical Health	Control Group	72.9 ± 11.3	74.71 ± 12.1	0.08
	Experimental Group	73.55 ± 11.9	81.58 ± 10.59	0.01*
Role Limitation due to Emotional Health	Control Group	70.74 ± 11.3	75.45 ± 1.73	0.07
	Experimental Group	69.11 ± 9.89	83.47 ± 7.7	<0.001*
Emotional Well-being	Control Group	69.7 ± 10.5	73.74 ± 10.2	0.07
	Experimental Group	68.7 ± 11.2	81.34 ± 12.46	0.005*
Energy	Control Group	72.66 ± 11.4	76.66 ± 11.48	0.6
	Experimental Group	71.37 ± 10.7	82.31 ± 10.14	0.02*
General Health	Control Group	74.68 ± 10.57	77.9 ± 10.43	0.7
	Experimental Group	73.76 ± 11.25	84.66 ± 7.5	0.002*

Table 5: Within-Group Comparison for NPRS and NDI Scores; Immediate and Long-Term Effects

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

Table 6: Within Group Comparisons for SF-36 Domains (Paired Sample-T Test)

SF-36 Domains	Group	Baseline Mean ± SD	After 4 Weeks Mean ± SD	P-Value
Physical Functioning	Control Group	66.89 ± 9.22	67.24 ± 8.99	0.057
	Experimental Group	66.26 ± 8.8	72.08 ± 8.44	<0.001*
Role Limitation due to Physical Health	Control Group	72.89 ± 11.32	74.71 ± 12.13	0.002*
	Experimental Group	73.55 ± 11.92	81.58 ± 10.58	<0.001*
Role Limitation due to Emotional Health	Control Group	70.74 ± 11.38	75.45 ± 10.72	<0.001*
	Experimental Group	69.11 ± 9.9	83.47 ± 7.71	<0.001*
Emotional Wellbeing	Control Group	69.68 ± 10.57	73.74 ± 10.22	<0.001*
	Experimental Group	68.7 ± 11.25	81.34 ± 12.45	<0.001*
Energy	Control Group	72.66 ± 11.48	76.65 ± 11.49	<0.001*
	Experimental Group	71.37 ± 10.74	82.31 ± 10.13	<0.001*
General Health	Control Group	74.68 ± 10.57	77.89 ± 10.43	<0.001*
	Experimental Group	73.76 ± 11.25	84.65 ± 7.48	<0.001*
Health Perception	Control Group	75.73 ± 11.38	77.73 ± 11.4	<0.001*

SF-36 Domains	Group	Baseline Mean ± SD	After 4 Weeks Mean ± SD	P-Value
	Experimental Group	74.10 ± 9.87	82.63 ± 9.15	<0.001*
Bodily Pain	Control Group	69.68 ± 10.57	72.74 ± 10.41	<0.001*
	Experimental Group	68.76 ± 11.25	78.74 ± 12.31	<0.001*

Quality of life, assessed through the SF-36 questionnaire, revealed improvements across various domains. At the 4-week mark, the experimental group showed statistically significant improvements in general health perception/status, physical functioning, bodily pain, and other areas such as role limitations due to physical and emotional health, emotional well-being, energy, and overall general health, compared to the control group. For instance, in the domain of physical functioning, the experimental group's score improved from a baseline of 66.26 (SD = 8.8) to 72.08 (SD = 8.44), while the control group saw a less pronounced improvement ($p < 0.001$). Similarly, significant improvements were observed in the experimental group for emotional well-being and energy, among others, indicating a considerable enhancement in quality of life measures (Table 4).

DISCUSSION

The primary aim of this investigation was to assess both the immediate and prolonged impacts of breathing exercises on pain relief, functional disability reduction, and quality of life enhancement among patients suffering from upper cross syndrome. To our knowledge, this study is pioneering in its focus. Measuring pain using the Numeric Pain Rating Scale (NPRS), the initial findings indicated no significant difference between the control and experimental groups at baseline, suggesting homogeneity. Notably, after the first session, the experimental group exhibited significantly superior improvement in pain reduction compared to the control group ($p<0.001$), thereby underscoring the efficacy and safety of integrating breathing exercises into the standard physical therapy regimen for immediate pain relief in upper cross syndrome. This aligns with findings from Vikram Mohan et al. (2015), who reported analogous outcomes in pain score improvements following breathing exercises (13).

The study's extended observations revealed that, after four weeks, the experimental group continued to show marked superiority in pain mitigation ($p<0.001$) compared to controls, aligning with Sadudee Thongtipmak et al. (2020), who demonstrated the efficacy of guided breathing exercises in pain reduction (14). Functional disability, assessed through the Neck Disability Index (NDI), revealed significant improvements in the experimental group both immediately and in the long term ($p<0.001$), suggesting that breathing exercises are a robust adjunct to conventional physical therapy in diminishing functional disability associated with upper cross syndrome. This is supported by Jeong Kang et al. (2016), who found significant NDI score reductions in a group undergoing breathing exercises (15).

Evaluating the effect on quality of life across eight domains via the SF-36 questionnaire, the addition of breathing exercises to treatment protocols significantly enhanced all measured domains ($p<0.05$). This finding is consistent with Radhakrishnan et al. (2015), where significant improvements in quality of life were observed following the inclusion of breathing exercises in the treatment regimen for women with chronic neck pain (16-18).

The investigation validates the hypothesis that breathing exercises serve as a safe and effective intervention for managing cervical pain, reducing functional disability, and improving the quality of life in patients with upper cross syndrome. While the study affirms the effectiveness of standard physical therapy, the inclusion of breathing exercises was associated with enhanced outcomes (19).

This study's strength lies in its novel approach to combining breathing exercises with standard physical therapy, providing a comprehensive treatment strategy for upper cross syndrome. However, limitations include the short duration and the specific population sample, which may restrict the generalizability of the findings. Future research should aim to replicate this study over a longer duration and across a more diverse demographic to confirm the results. Moreover, investigating the mechanistic basis of breathing exercises in pain and disability reduction would offer deeper insights into their therapeutic potential. Recommendations for practice include integrating breathing exercises into the physical therapy regimen for upper cross syndrome, considering their proven benefits in enhancing treatment outcomes (20).

CONCLUSION

This study conclusively demonstrates that breathing exercises, when integrated with standard physical therapy, provide a significant benefit in managing pain, reducing functional disability, and enhancing quality of life among patients with upper cross syndrome. The implications for human healthcare are profound, offering a non-invasive, cost-effective, and easily implementable strategy to augment the existing treatment protocols for musculoskeletal disorders associated with prolonged technology use. This approach not only contributes to the immediate relief from discomfort but also paves the way for long-term health benefits, emphasizing the importance of incorporating holistic and patient-centered practices in contemporary healthcare.

Journal of Health and Rehabilitation Research 2791-156X JHRR

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