

Impact Of Diaphragmatic Breathing On Psychological Stress And Quality Of Life In Individuals With Cervical Stiffness.

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ABSTRACT

Background: Neck tension and pain is a musculoskeletal disorder which have a significant consequences on functions and quality of life. Increased neck stiffness is commonly reported in individuals suffering from acute psychological stress. Sympathetic system is activated as a result of exposure to acute stress and cause neck muscle stiffness (upper trapezius, sternocleidomastoid (SCM) and scalenes) and compromised quality of life. Diaphragmatic breathing reduces stress as a result of which, muscle tension is reduced and overall quality of life is improved significantly. It provides a simple, non pharmacological treatment of stress induced neck stiffness. Aims and Objectives: This study aimed to reduce cervical muscle stiffness, decreasing stress, and improving quality of life through deep diaphragmatic breathing in 18-40 years adults. Material and Methodology: This quasi-experimental study used purposive sampling technique for sample selection. Participants aged 18-40 from were selected from physical therapy and orthopedic OPD of Allied hospital, DHQ hospital Faisalabad and baseline characteristics were assessed using Goniometer to measure range of motion for assessment of cervical muscle stiffness, perceived stress scale (PSS-10) for evaluation of stress, and Quality Of Life (QOL) questionnaire for functional assessment. Selected participants performed diaphragmatic breathing exercise 10-15 minutes, 4 days a week, followed by controlled 4 second inhale and 6 second exhale pattern for 6 weeks. After 4 weeks of treatment first post treatment assessment is done and final assessment is done after 6 weeks of treatment using same tools to compare changes within the group. Results: By using repeated measure ANOVA test analysis there is statistically significant improvement in cervical range of motions and quality of life with p-value of <0.05 . Stress score is also improved significantly, p value <0.05 . Conclusion: this study concluded that diaphragmatic breathing is an effective intervention in patients suffering from neck stiffness due to acute psychological stress.

Keywords: Neck Stiffness, Psychological Stress, Perceived Stress Scale (PSS-10) Quality of Life (QOL), Psychological Stress, Diaphragmatic Breathing, Cervicalgia, Relaxation Techniques, Musculoskeletal Pain, Neck Muscle Tension.

INTRODUCTION:

Alteration in cervical muscle activation pattern, specifically in superficial muscles of neck and shoulder region (Upper trapezius, Sternocleidomastoid SCM, and Scalenes) is one of significant signs of prolonged psychological stress. This abnormal cervical muscle activation pattern causes numerous cervical muscle complaints encountered in physical therapy practice worldwide. It became a subject of considerable clinical and research importance. (Tatsios et al., 2022) Some of the significant causes of psychological stress are academic pressure, lifestyle changes and environmental demands, cause psychological as well as physiological consequences. (Laborde et al., 2022; Zaccaro et al., 2018) 30-50% of adult population suffer from persistent neck pain while 17% suffer from episodic neck pain. (Colman et al., 2025) Elevated sympathetic activity, hyperventilation and respiratory changes are some of the physiological changes of psychological stress. (Stephen, 2020) Energy demand is increased in times of intense psychological stress which causes increased activity of respiratory muscles. (Beyoglu, 2021) Breathing Pattern Disorders (BPDs) are diverse group of respiratory dysfunctions cause altered rate, rhythm, depth or pattern of breathing (shifting from quiet deep breathing to upper thoracic breathing). Psychological stress is most potent trigger of acute hyperventilation, establishing a bidirectional association between stress and shallow breathing pattern. Dysfunctional breathing was associated to elevated levels of stress. (Stephen et al., 2022) Some muscles of shoulder region, upper back, and chest act as accessory muscles of breathing. Main accessory muscles are trapezius, sternocleidomastoid, and scalenes. (Sekiguchi et al., 2020) The sternocleidomastoid (SCM) and scalenes includes other accessory muscles of respiration. (Webster & Karan, 2020) The anterior, middle, and posterior scalene muscles laterally flex the neck assist to inspire by lifting the first and second ribs. While these three muscles connect at their superior aspect to the transverse processes of vertebrae of cervical spine. (Greenhagen et al., 2026) In non-stressed healthy person SCM is considered silent during quiet breathing. Only the regular tonic discharge threshold is maintained in upper trapezius for regular postural maintenance. However, scalene muscles remain active at low level during regular quiet breathing. (Tatsios et al., 2022) A popular exercise for persons with or without medical issues is deep diaphragmatic breathing (DDB). (Hamasaki, 2020; Ma et al., 2017) Psychological stress elevate sympathetic activity which can alter depth of breathing (from deep breathing to shallow breathing) and increase muscle tension in superficial neck muscles, which results in compromised cervical range of motion and overall quality of life. (Stephen, 2020) One of most important muscle of body is diaphragm because of its significant role in deep breathing. (Liu et al., 2024) It is a dome shaped muscle. (Kocjan et al., 2017) Deep diaphragmatic breathing affects stress induced cervical muscle activation. Slow deep breathing for 10-15 minutes of session immediately reduces sympathetic arousal. (Laborde et al., 2022) The shifting of accessory muscles dominant breathing to deep diaphragmatic breathing reduces the respiratory mechanical stress on SCM, scalenes, and upper trapezius allowing them to

remove stored metabolic by products, and promotes relaxation by reducing stiffness hence, cervical range of motions and cervical comfort is significantly increased. (Jeong & Lee, 2024) The use of deep diaphragmatic breathing as targeted treatment for stress related cervical muscles over activation is highly recommended due to low equipment requirement. (Cefali et al., 2025) The peripheral approaches to treat neck stiffness are vibration, massage, and stretching but it is important to manage the central regulation of muscle stiffness and tone by managing mental state (stress) through awareness and attention. (Cacciatore et al., 2024) DDB can be done while sitting, standing, or in a supine posture. It can also be used in conjunction with other exercises. (Bao et al., 2020) Diaphragmatic breathing promise as a low-cost, non-pharmacological intervention to lessen stress-induced neck stiffness because of the strong correlation between stress, dysfunctional breathing, and cervical accessory muscle over activation.

MATERIAL AND METHDOLOGY:

The aim of this study was to evaluate the effectiveness of deep diaphragmatic breathing in reducing neck stiffness caused by stress. 35 participants were selected by purposive sampling technique from physical therapy and orthopedic OPD of Allied hospital, DHQ hospital Faisalabad. All the subjects were informed with written consent before the participation.

Inclusion criteria:

The subjects from both gender in the age group of 18-40 years were included having recent and intermittent neck stiffness (compromised flexion, extension, right and left side bending of neck on Goniometer) and decreased quality of life on QOL questionnaire. All participants should have baseline stress level >20 on Perceived Stress Scale (PSS-10).

Exclusion criteria:

The subjects with any history of cervical radiculopathy, cervical scoliosis, current acute neck injury or neck surgery, chronic neck pain conditions under active treatment (physiotherapy, injections, surgery), diagnosed respiratory disorders (asthma, COPD), or recent respiratory infection within 2 weeks — because these affect breathing mechanics, current use of pain medication, neurological disorders affecting neck/muscle function, malignant tumors, and spinal fractures or trauma were excluded.

Study design: Quasi experimental study

Sampling technique: Purposive sampling technique was used.

Sample size: n= 35 participants.

Hypothesis:

H₁: Diaphragmatic Breathing has a significant effect on modulating stress-induced cervical muscle activation.

H₀: Diaphragmatic Breathing has no significant effect on modulating stress-induced cervical muscle activation.

Online ISSN

3007-3197

Print ISSN

3007-3189

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Data analysis:

All data related to study were tested by using repeated measure ANOVA test. SPSS (Statistical package for social sciences) was used to analyze the data. p value of <0.05 was considered to be statistically significant.

RESULTS:

Effect of deep diaphragmatic breathing exercise on neck stiffness and quality of life in stiff neck patients was determined in this study. By using repeated measure ANOVA test analyze that there is significantly improvement $p < 0.05$ in cervical range of motions, Quality Of Life (QOL), decreased stress score in PSS-10 scale of participants are described in Tables.

TABLE 1: Frequency distribution table of gender

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid MALE	5	14.3	14.3	14.3
FEMALE	30	85.7	85.7	100.0
TOTAL	35	100.0	100.0	

The frequency distribution of participant's gender shows that the sample is mostly female dominated with 85.7% identifying as females and 14.3% identifying as males showing a modest skew towards female respondents.

TABLE 2: Descriptive statistics of gender.

GENDER

N	Valid	35
	Missing	0
Mean		1.86
Median		2.00
Mode		2
Std. Deviation		.355

The mean gender score is 1.86 while the median and mode are both 2.0. Assuming a code where 1 represent male and 2 represent female, the median and mode suggest that most participants are females.

GRAPH 1:



Online ISSN

3007-3197

Print ISSN

3007-3189

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The chart indicates higher number of females participants compared to males. While both genders are well represented, females make up the majority in the sample.

TABLE 3: Frequency distribution table of age.

AGE

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 18-22	9	25.7	25.7	25.7
23-27	11	31.4	31.4	57.1
28-32	9	25.7	25.7	82.9
33-37	2	5.7	5.7	88.6
38-42	4	11.4	11.4	100.0
Total	35	100.0	100.0	

Most participants (31.4%) are aged between 23-27, followed by 25.7% in the both 18-22 and 28-32 age groups indicating predominantly adult sample.

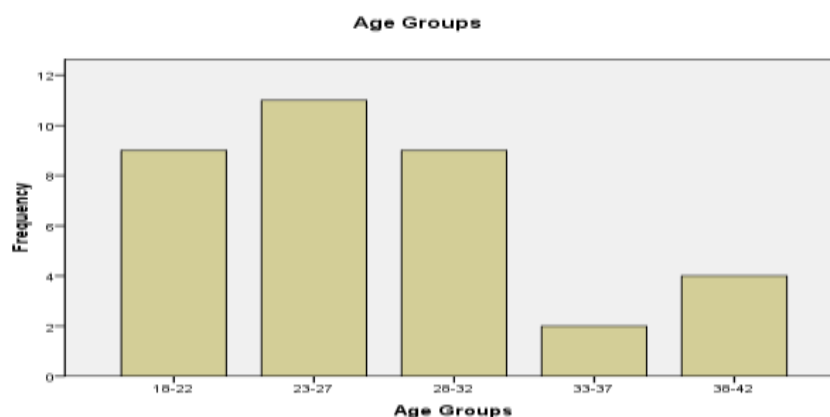
TABLE 4: Descriptive statistics of age.

AGE

N	Valid	35
	Missing	0
Mean		2.46
Median		2.00
Mode		2
Std. Deviation		1.268

The mean age score is 2.46. while the median is 2 and mode is 2, suggesting that most common and central age category among participants is 2.

GRAPH 2:



The bar chart visually confirms that most participants fall in the 23-27 age group, with both 18-22 and 28-32 being the next most common. The 33-37 and 38-42 has significantly fewer participants, highlighting skew toward twenties.

TABLE 5: Descriptive Statistics of variables

Variables	N	Mean	95% Confidence interval		Std. Deviation	Stand Error.
			Lower boundary	Upper boundary		
Pre Stress	35	5.31	5.132	5.496	.530	.090
Post Stress4	35	4.66	4.394	4.920	.765	.129
Post Stress 6	35	3.94	3.680	4.206	.765	.129
Pre Flexion	35	3.23	2.865	3.593	1.060	.179
Post Flexion 4	35	4.00	3.647	4.353	1.029	.174
Post Flexion 6	35	4.20	3.848	4.552	1.023	.173
Pre Extension	35	3.80	3.218	4.382	1.694	.286
Post Extension 4	35	4.63	4.114	5.143	1.497	.253
Post Extension 6	35	5.03	4.486	5.572	1.581	.267
Pre Rt Bending	35	1.71	1.457	1.972	.750	.127
Post Rt Bending 4	35	2.29	2.056	2.515	.667	.113
Post Rt Bending 6	35	2.60	2.376	2.824	.651	.110
Pre Lt Bending	35	1.76	1.521	2.009	.699	.120
Post Lt Bending 4	35	2.38	2.072	2.692	.888	.152
Post Lt Bending 6	35	2.71	2.470	2.942	.676	.116
Pre QOL	35	6.18	5.926	6.426	.716	.123
Post QOL 4	35	6.68	6.438	6.915	.684	.117
Post QOL 6	35	7.15	6.887	7.407	.744	.128

The table show a progressive increase in flexion ROM across the three assessment points. The mean ROM of flexion before intervention was 3.23 ± 1.060 , which increased to 4.00 ± 1.029 after 4 weeks of intervention and further increased to 4.20 ± 1.023 after 6 weeks of intervention. Increase in extension ROM across the three assessment points. The mean ROM of extension before intervention was 3.80 ± 1.694 , which increased to 4.63 ± 1.497 after 4 weeks of intervention and further increased to 5.03 ± 1.581 after 6 weeks of intervention. Increase in right side bending across the three assessment points. The mean ROM of right side bending before intervention was 1.71 ± 0.750 , which increased to 2.29 ± 0.667 after 4 weeks of intervention and further increased to 2.60 ± 0.651 after 6 weeks of intervention. Increase in left side bending across the three assessment points. The mean ROM of left side bending before intervention was 1.76 ± 0.699 , which increased to 2.38 ± 0.888 after 4 weeks of intervention and further increased to 2.71 ± 0.676 after 6 weeks of intervention. Increase in quality of life (QOL) across the three assessment points. The mean QOL score before intervention was 6.18 ± 0.716 , which increased to 6.68 ± 0.684 after 4 weeks of intervention and further decreased to 7.15 ± 0.744 after 6 weeks of intervention. Reduction in stress scores across the three assessment points. The mean stress score before intervention was 5.31 ± 0.530 , which decreased to 4.66

± 0.765 after 4 weeks of intervention and further reduced to 3.94 ± 0.765 after 6 weeks of intervention. This mean difference suggests that diaphragmatic breathing significantly reduced stress, increased cervical ROM and improved QOL over time in patients with acute stress induced neck stiffness.

TABLE 6: ANOVA Test Statistics

Variable	Mauchly p	Correction	F	p	df	Partial Eta Squared
Flexion	.003	Huynh-Feldt	51.13	<0.001	1.60	.602
Extension	.000	Greenhouse-Geisser	50.475	<0.001	1.45	.600
Rt bending	.535	Sphericity assumed	52.054	<0.001	2	.605
Lt bending	.631	Sphericity assumed	35.507	<0.001	2	.518
QOL	.654	Sphericity assumed	41.800	<0.001	2	.559
PSS	.003	Huynh-Feldt	68.276	<0.001	1.60	.668

Mauchly's test indicated that the assumption of sphericity was violated for cervical flexion, $p = .003$, extension, $p < .001$, and stress, $p = .003$. Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimates for these variables. For right bending, left bending, and QOL, Mauchly's test was non-significant, $p > .05$, indicating that sphericity was assumed and no correction was required. The analysis revealed statistically significant main effects of time for all five outcome variables, $p < .001$, demonstrating that the intervention produced consistent improvements across the study period. For cervical flexion, results showed $F(1.60, 54.40) = 51.13$, $p < .001$, partial $\eta^2 = .60$. This reflects a large effect size, with 60.2% of the variance in flexion ROM explained by the intervention. Similarly, cervical extension demonstrated $F(1.45, 49.25) = 50.48$, $p < .001$, partial $\eta^2 = .60$, also indicating a large effect with 60% of variance accounted for. Right side bending showed the strongest effect among ROM measures, $F(2, 68) = 52.05$, $p < .001$, partial $\eta^2 = .61$, suggesting that 60.5% of the improvement in right lateral flexion was attributable to the treatment. Left side bending also improved significantly, $F(2, 68) = 35.51$, $p < .001$, partial $\eta^2 = .52$, representing a large effect. Quality of life scores showed significant enhancement over time, $F(2, 68) = 41.80$, $p < .001$, partial $\eta^2 = .56$. This large effect indicates that 55.9% of the variance in QOL was explained by the intervention.

TABLE 7: Repeated measure ANOVA statistical analysis pairwise comparison of flexion ROM.

Pairwise comparison:						
Group 1 Flexion	Group 2 Flexion	Mean Difference (group 1 - group 2)	Std. Error	95% Confidence Interval for Difference ^a		Sig. ^a
				Lower Boundary	Upper Boundary	

1	2	-.771*	.117	-1.065	-.478	.000
	3	-.971*	.112	-1.254	-.689	.000
2	1	.771*	.117	.478	1.065	.000
	3	-.200*	.069	-.373	-.027	.019
3	1	.971*	.112	.689	1.254	.000
	2	.200*	.069	.027	.373	.019

There is a statistically significant difference in flexion ROM across all time points. Pairwise comparisons revealed that ROM significantly increased from baseline to 4 weeks ($p < 0.05$) with mean difference from .971* to .200, baseline to 6 weeks ($p < 0.05$) with mean difference from .771 to -.200, and also from 4 weeks to 6 weeks ($p < 0.05$) with mean difference from -.771 to -.971. The largest increase in flexion ROM is observed between baseline and 6 weeks.

TABLE 8: Repeated measure ANOVA statistical analysis pairwise comparison of extension ROM.

Pairwise comparison:						
Group 1 extension	Group 2 extension	Mean Difference (group 1 - group 2)	Std. Error	95% Confidence Interval for Difference ^a		Sig. ^a
				Lower Boundary	Upper Boundary	
1	2	-.829*	.126	-1.147	-.511	.000
	3	-1.229*	.154	-1.616	-.841	.000
2	1	.829*	.126	.511	1.147	.000
	3	-.400*	.084	-.612	-.188	.000
3	1	1.229*	.154	.841	1.616	.000
	2	.400*	.084	.188	.612	.000

There is a statistically significant difference in extension ROM across all time points. Pairwise comparisons revealed that ROM significantly increased from baseline to 4 weeks ($p < 0.05$) with mean difference from .1.229* to .400, baseline to 6 weeks ($p < 0.05$) with mean difference from .829 to -.400, and also from 4 weeks to 6 weeks ($p < 0.05$) with mean difference from -.829 to -1.229. The largest increase in extension ROM is observed between baseline and 6 weeks. These findings indicate that the intervention is effective in progressively increasing extension over time.

TABLE 9: Repeated measure ANOVA statistical analysis pairwise comparison of ROM of right side bending.

Pairwise comparison:						
Group 1 right side bending	Group 2 right side bending	Mean Difference (group 1 - group 2)	Std. Error	95% Confidence Interval for Difference ^a		Sig. ^a
				Lower Boundary	Upper Boundary	

Online ISSN

3007-3197

Print ISSN

3007-3189

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1	2	-.571*	.094	-.809	-.334	.000
	3	-.886*	.090	-1.111	-.660	.000
2	1	.571*	.094	.334	.809	.000
	3	-.314*	.080	-.515	-.114	.001
3	1	.886*	.090	.660	1.111	.000
	2	.314*	.080	.114	.515	.001

There is a statistically significant difference in right side bending ROM across all time points. Pairwise comparisons revealed that ROM significantly increased from baseline to 4 weeks ($p < 0.05$) with mean difference from .886* to .314, baseline to 6 weeks ($p < 0.05$) with mean difference from .571 to -.314, and also from 4 weeks to 6 weeks ($p < 0.05$) with mean difference from -.571 to -.886. The largest increase in right side bending ROM is observed between baseline and 6 weeks. These findings indicate that the intervention is effective in progressively increasing right side bending over time.

TABLE 10: Repeated measure ANOVA statistical analysis pairwise comparison of ROM of left side bending.

Pairwise comparison:						
Group 1 left side bending	Group 2 left side bending	Mean Difference (group 1 - group 2)	Std. Error	95% Confidence Interval for Difference ^a		Sig. ^a
				Lower Boundary	Upper Boundary	
1	2	-.618*	.104	-.879	-.356	.000
	3	-.941*	.119	-1.241	-.641	.000
2	1	.618*	.104	.356	.879	.000
	3	-.324*	.117	-.619	-.028	.028
3	1	.941*	.119	.641	1.241	.000
	2	.324*	.117	.028	.619	.028

There is a statistically significant difference in left side bending ROM across all time points. Pairwise comparisons revealed that ROM significantly increased from baseline to 4 weeks ($p < 0.05$) with mean difference from .941* to .324, baseline to 6 weeks ($p < 0.05$) with mean difference from .618 to -.324, and also from 4 weeks to 6 weeks ($p < 0.05$) with mean difference from -.618 to -.941. The largest increase in left side bending ROM is observed between baseline and 6 weeks. These findings indicate that the intervention is effective in progressively increasing left side bending over time.

TABLE 11: Repeated measure ANOVA statistical analysis pairwise comparison stress

Pairwise comparison:						
Group 1 PSS	Group 2 PSS	Mean Difference (group 1 - group 2)	Std. Error	95% Confidence Interval for Difference ^a		Sig. ^a
				Lower Boundary	Upper Boundary	
1	2	.657*	.081	.452	.862	.000
	3	1.371*	.124	1.060	1.683	.000
2	1	-.657*	.081	-.862	-.452	.000
	3	.714*	.139	.363	1.065	.000
3	1	-1.371*	.124	-1.683	-1.060	.000
	2	-.714*	.139	-1.065	-.363	.000

There is a statistically significant difference in stress scores across all time points. Pairwise comparisons revealed that stress significantly decreased from baseline to 4 weeks ($p < 0.05$) with mean difference from -1.371 to -.714, baseline to 6 weeks ($p < 0.05$) with mean difference from -.657 to .714, and also from 4 weeks to 6 weeks ($p < 0.05$) with mean difference from .657 to .1371. The largest reduction in stress is observed between baseline and 6 weeks. These findings indicate that the intervention is effective in progressively reducing stress over time.

TABLE 12: Repeated measure ANOVA statistical analysis pairwise comparison of QOL score

Pairwise comparison:						
Group 1 QOL	Group 2 QOL	Mean Difference (group 1 - group 2)	Std. Error	95% Confidence Interval for Difference ^a		Sig. ^a
				Lower Boundary	Upper Boundary	
1	2	-.500*	.114	-.787	-.213	.000
	3	-.971*	.099	-1.220	-.721	.000
2	1	.500*	.114	.213	.787	.000
	3	-.471*	.105	-.736	-.205	.000
3	1	.971*	.099	.721	1.220	.000
	2	.471*	.105	.205	.736	.000

There is a statistically significant difference in quality of life across all time points. Pairwise comparisons revealed that quality of life significantly increased from baseline to 4 weeks ($p < 0.05$) with mean difference from .971* to .471, baseline to 6 weeks ($p < 0.05$) with mean difference from .500 to -.471 and also from 4 weeks to 6 weeks ($p < 0.05$) with mean difference from -.500 to -.971. These findings indicate that the intervention is effective in progressively increasing QOL over time.

DISCUSSION:

It is clear from data interpretation that deep diaphragmatic breathing has significant effect in improvement of cervical range of motion of flexion, extension, right and left side bending which indicates decreased neck stiffness. As p value is <0.05 . Stress score is also decreased with time $p<0.05$. Females are more prone to acute neck pain due to stress as compared to males. Out of 35 members 30 were female patients and only 5 were male patients. This implies that acute neck pain is more prevalent in female patients than male patients. 85.7% are females and just 14.3% are males. The evaluation of neck stiffness is performed on goniometer by measuring ROM. Pre treatment, mid treatment, and post treatment values of ROM are taken and comparison is made by statistical test, repeated measure ANOVA. The results implied significant difference in ROM of selected patients of acute neck stiffness before, post 4 weeks and post 6 weeks treatment that the stiffness decreases after the treatment session with p-value < 0.05 . The results of this study demonstrated difference in the mean of perceived stress scale (PSS-10) before, post 4 weeks and post 6 weeks of treatment. There is a significant difference in means of pre and post 4 weeks and post 6 weeks treatment of PSS-10 with p-value of < 0.05 in stress induced neck stiffness patients. It is also demonstrated by results that quality of life (QOL) is improved significantly $p<0.05$ after the treatment. The metabolic consequences of continuous stress activation include accumulation of metabolic byproducts including lactate, protons, and adenosine diphosphate within the muscle fiber. (Ahmed et al., 2024) Slow diaphragmatic breathing at frequencies of approximately 0.1 Hz (six breaths per minute) produces maximal resonance between the rhythmic fluctuations in vagal outflow driven by the respiratory cycle (respiratory sinus arrhythmia, RSA) and the Mayer wave oscillations of blood pressure at the same frequency, resulting in a pronounced increase in HRV amplitude referred to as resonance frequency breathing. (Little, 2025) This progressive improvement in cervical ROM and quality of life suggests that shifting upper thoracic shallow breathing to deep diaphragmatic breathing can reduce cervical discomfort, muscle tension in stress induced neck pain patients. Diaphragmatic breathing stimulates the parasympathetic nervous system, and as a result, decreased stress and muscle tension. Due to its relaxing effects, it promotes overall functions. (Suryavanshi et al., 2025) Electromyographic (EMG) evidence also supports the role of deep diaphragmatic breathing in cervical muscle activity regulation. The shifting of shallow breathing to deep diaphragmatic breathing minimize over activity of superficial neck muscles, this minimize the compensatory cervical muscle activity and decrease stiffness caused by overactivity. (Hwang et al., 2021). Many clinicians use diaphragmatic breathing combination with other techniques. In this study alone diaphragmatic breathing is performed to evaluate its effects on neck stiffness and functional quality. It produce significant results $p<0.05$ and proving this treatment effective for acute stress induced neck stiffness patients.

CONCLUSION:

The conclusion is made from the results of this study that deep diaphragmatic breathing in acute neck stiffness due to psychological stress patients showed beneficial effects in improving cervical ROM and functional quality in the short term of 1-4 week treatment and it remained a positive role at 6th-week follow-up.

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