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Comparative Effectiveness of Cervical Stabilization and Scapular Stabilization Exercises in Individuals with Non-Specific Neck Pain: A Randomized Controlled Trial

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KEYWORDS

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Abstract

Background:
Non-specific neck pain is a prevalent musculoskeletal disorder associated with pain, functional limitations, and reduced quality of life. Stabilization exercises targeting the cervical and scapular regions are commonly used; however, comparative evidence regarding their effectiveness remains limited.
Objective:
To compare the effectiveness of cervical stabilization and scapular stabilization exercises on pain intensity and functional disability in individuals with non-specific neck pain.
Methods:
A randomized controlled trial was conducted among 60 participants aged 18–40 years with non-specific neck pain. Participants were randomly allocated into two groups: cervical stabilization (Group A) and scapular stabilization (Group B). Both groups underwent supervised exercise interventions for 3 weeks (5 sessions per week). Outcome measures included pain intensity assessed using the Visual Analog Scale (VAS) and functional disability assessed using the Neck Disability Index (NDI). Statistical analysis was performed using paired and independent t-tests, with significance set at $p < 0.05$.
Results:
Both groups demonstrated significant improvements in VAS and NDI scores following the intervention ($p < 0.001$). No statistically significant difference was observed between groups for pain reduction ($p > 0.05$). However, cervical stabilization exercises resulted in significantly greater improvement in functional disability compared to scapular stabilization exercises ($p < 0.001$).
Conclusion:
Both cervical and scapular stabilization exercises are effective in reducing pain and improving functional disability in individuals with non-specific neck pain. Cervical stabilization exercises demonstrated superior effectiveness in improving functional disability, while both interventions were equally effective in reducing pain intensity.

METHODS

Study Design

A randomized controlled trial with a non-blinded design was conducted to compare the effectiveness of cervical stabilization and scapular stabilization exercises in individuals with non-specific neck pain.

Study Setting

The study was conducted in the Physiotherapy Outpatient Department of Pacific Medical College and Hospital, affiliated with Pacific Medical University, Udaipur, Rajasthan, India.

Participants

A total of 60 participants diagnosed with non-specific neck pain were recruited. Participants were aged between 18 and 40 years and included both males and females. Written informed consent was obtained from all participants prior to enrollment.

Inclusion Criteria

- Individuals aged 18–40 years
- Diagnosed with chronic non-specific neck pain
- Both genders
- Willingness to participate and provide informed consent

Exclusion Criteria

- Presence of structural cervical pathology
- Recent cervical spine surgery or trauma
- Systemic inflammatory or neurological disorders
- Any contraindication to exercise therapy

Sample Size

A total sample size of 60 participants (30 in each group) was determined based on feasibility and previous similar interventional studies.

Randomization and Group Allocation

Participants were randomly allocated into two groups (n = 30 each) using a simple random sampling method (lottery method):

Group A: Cervical stabilization exercises

Group B: Scapular stabilization exercises

Intervention Protocol

The intervention was carried out over a period of 3 weeks with a frequency of 5 sessions per week. Each session lasted approximately 30–40 minutes.

Group A: Cervical Stabilization Exercises

Participants performed exercises focusing on activation and strengthening of deep cervical stabilizing muscles, including:

Chin tuck exercises

Cranio-cervical flexion exercises

Cervical isometric exercises

Functional posture training

Group B: Scapular Stabilization Exercises

Participants performed exercises aimed at improving scapulothoracic muscle control and posture, including:

Scapular retraction and protraction exercises

Serratus anterior activation exercises

Resistance band strengthening exercises

Functional upper limb tasks with scapular control

Outcome Measures

Outcome measures were assessed at baseline and after completion of the 3-week intervention.

Pain Intensity: Measured using the Visual Analog Scale (VAS)

Functional Disability: Measured using the Neck Disability Index (NDI)

Statistical Analysis

Data were analyzed using appropriate statistical methods:

Paired t-test was used to assess within-group differences

Independent t-test was used to compare between-group differences

The level of statistical significance was set at $p < 0.05$

Result

Table 1 Distribution of Age Group

Age	Number of Patients	Percentage
15-20	6	10%
20-25	12	20%
25-30	15	25%
30-35	14	23.3%
35-40	11	18.3%
40 -45	2	3.4%
Total	**60**	**100**

Out of 60 patients studied, 6(10%) had their age between 15-20years,12(20%) had age between 20-25years,15(25%) had age between 25-30years,14(23.3%) had age between30-35 years,11(18.3%) had age between35-40years, 2(3.4%) had age 40-45 years. Mean ± SD of age in the entire study group was 28.6 ± 6.4 years and minimum-maximum age range was 18-40 years.

Diagram 1 Showing the bar diagram distribution of age group

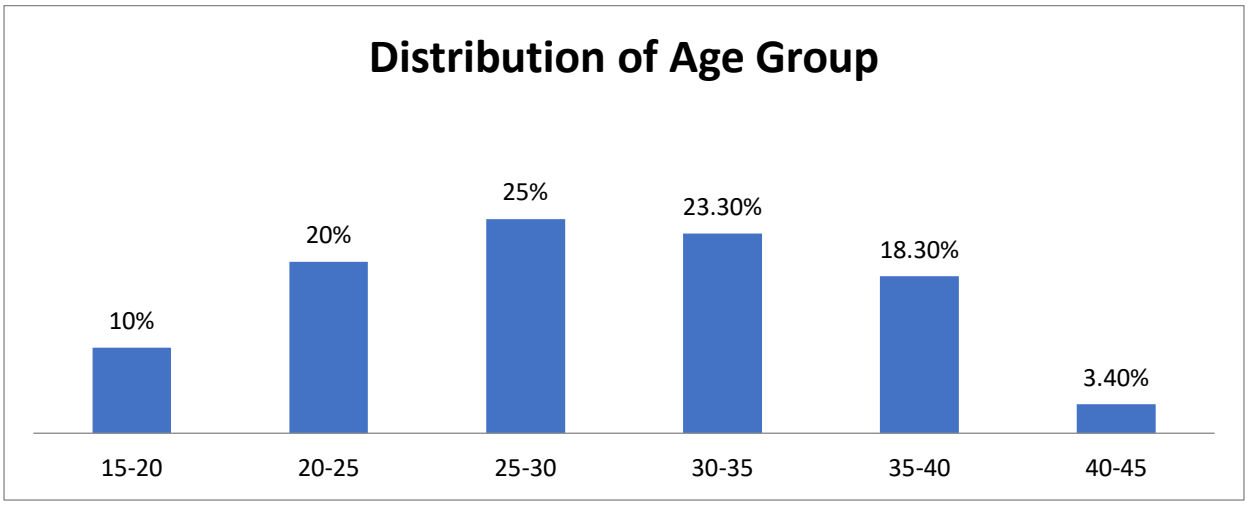

Table 2 Distribution of Gender

Gender	Number of Patients	Percentage
Male	33	55%
Female	27	45%
Total	**60**	**100%**

Out of 60 patients studied, 33(55%) had male, 27(45%) had female.

Diagram 2 Showing the Pie diagram distribution of gender

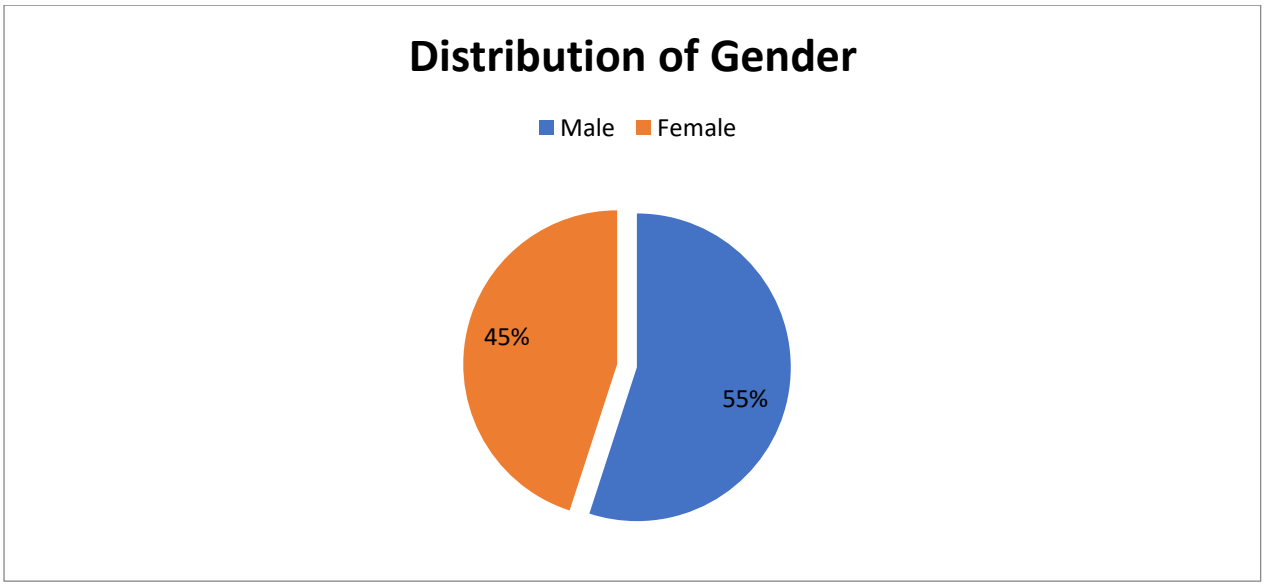

Table 3 Distribution of Pain

Pain	Mean ± SD (n=60)	Range	Maximum	Minimum
VAS Pre	6.4 ± 1.15	3	8	5
VAS POST	4.9 ± 2.3	8	8	0

Mean VAS pain score decreased from 6.4 ± 1.15 (pre) to 4.9 ± 2.3 (post), indicating a reduction in pain after intervention.

Diagram 3 Showing the bar diagram distribution of pain

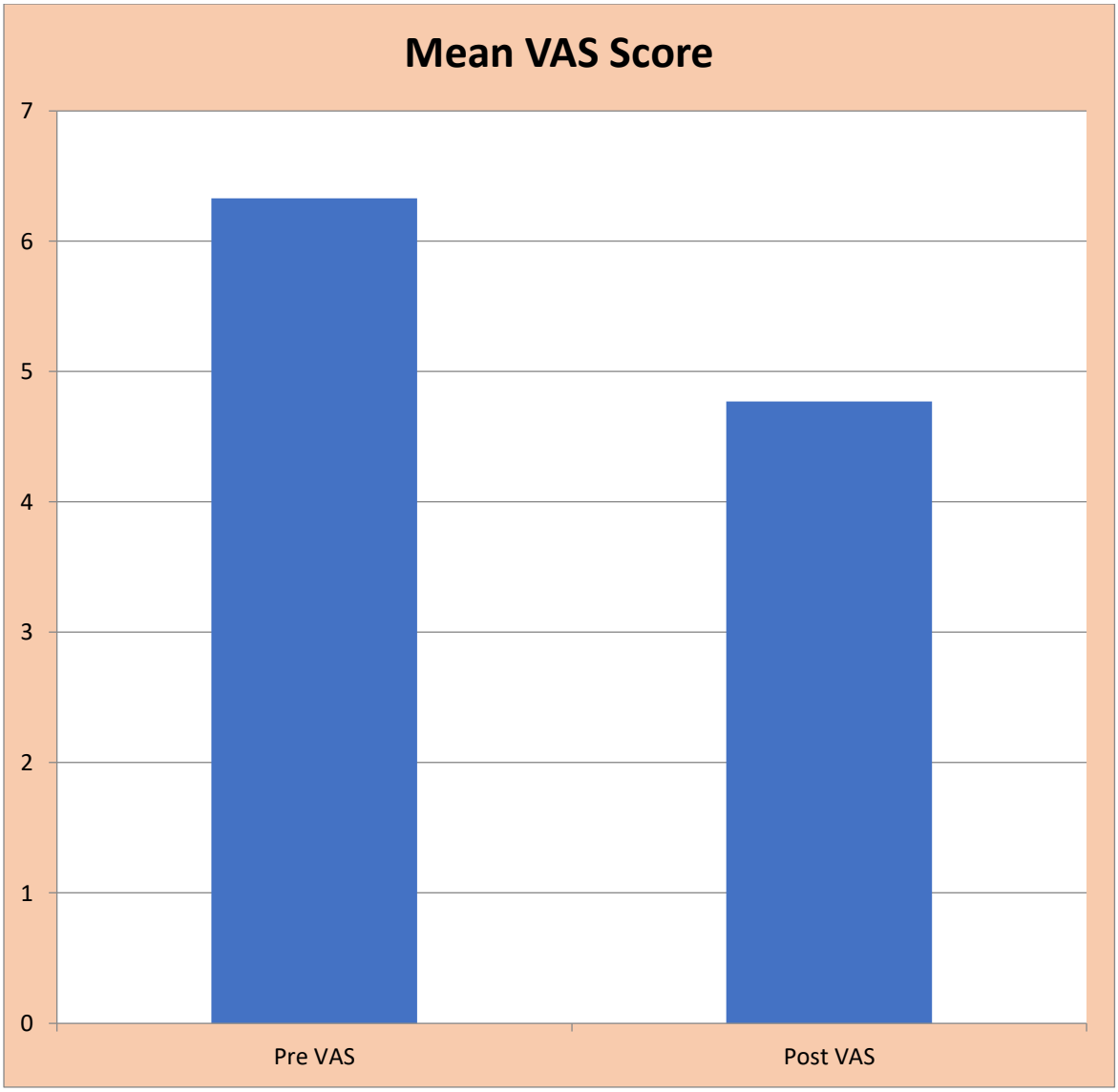

Table 4 Distribution of Disability

Disability	Mean ± SD (n=60)	Range	Maximum	Minimum
NDI Pre	25.8 ± 5.1	23	35	12
NDI POST	16.4 ± 6.6	27	33	6

Mean NDI disability score decreased from **25.8 ± 5.1 (pre)** to **16.4 ± 6.6 (post)**, indicating reduced disability after intervention.

Diagram 4 Showing the bar diagram distribution of disability

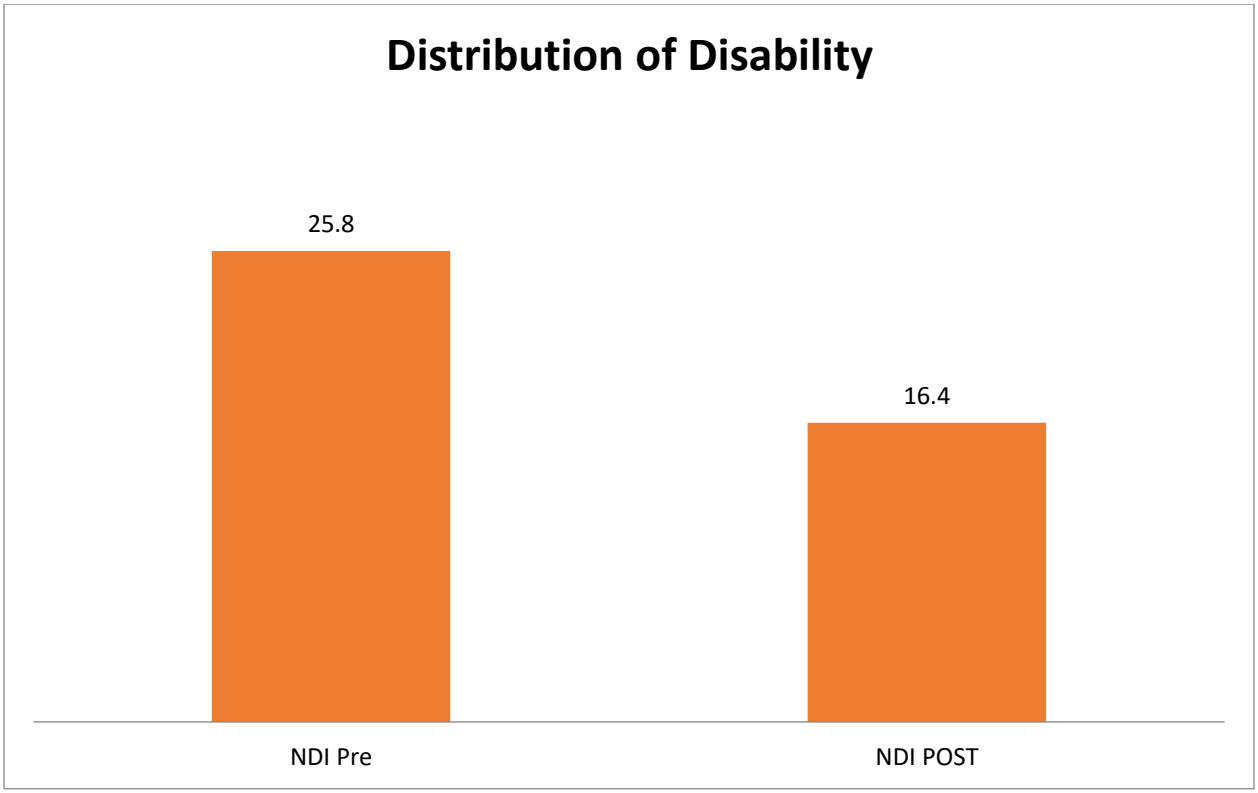

Table 5 Age-wise Distribution of Patients in Group A and Group B

Age	Group A (n=30)		Group B (n=30)	
	Number of Patients	Percentage	Number of Patients	Percentage
15-20	2	6.6%	4	13.3%
20-25	6	20%	6	20%
25-30	8	26.6%	7	23.3%
30-35	7	23.3%	7	23.3%
35-40	6	20%	5	16.6%
40-45	1	3.33%	1	3.33%
Total	30	100%	30	100%

The age distribution in both Group A and Group B is fairly comparable across all categories.The majority of participants in both groups fall within the 25–35 years age range.

Diagram 5 Showing the bar diagram age-wise distribution of patients in Group A and Group B

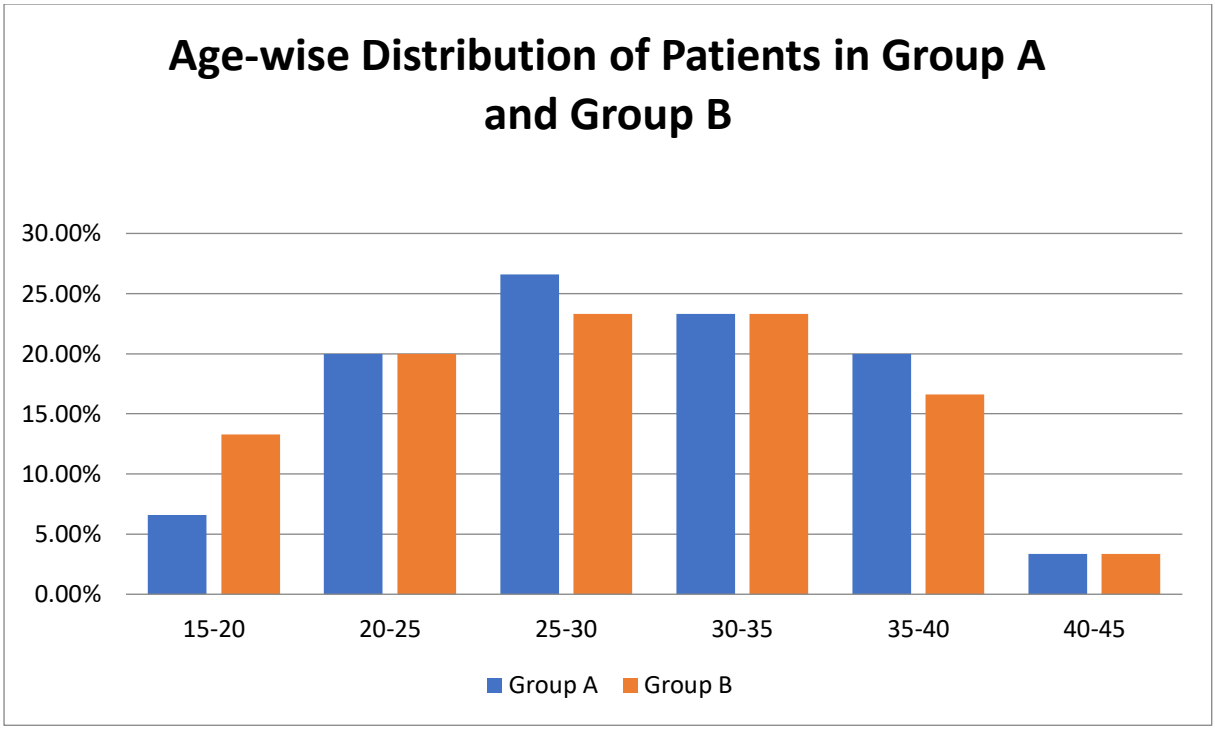

Table 6 Comparison of Age-wise Distribution between Group A and Group B

Age	Group A (n=30)		Group B (n=30)		Statistics test value
	Number of Patients	Percentage	Number of Patients	Percentage	
15-20	2	6.6%	4	13.3%	$X^2 = 0.8, P = 0.9, P<0.01$(NS)
20-25	6	20%	6	20%	
25-30	8	26.6%	7	23.3%	
30-35	7	23.3%	7	23.3%	
35-40	6	20%	5	16.6%	
40-45	1	3.33%	1	3.33%	
Total	**30**	**100%**	**30**	**100%**	

The age distribution between Group A and Group B is comparable, with no significant difference observed ($\chi^2 = 0.8$, $p = 0.9$).

Table 7 Gender-wise Distribution of Patients in Group A and Group B

Gender	Group A		Group B	
	Number of Patients	Percentage	Number of Patients	Percentage
Male	18	60%	15	50%
Female	12	40%	15	50%
Total	**30**	**100%**	**30**	**100%**

The gender distribution in Group A and Group B is fairly similar, with males slightly higher in Group A and equal distribution in Group B.

Diagram 6 Showing the bar diagram gender wise distribution of patients in Group A and Group B

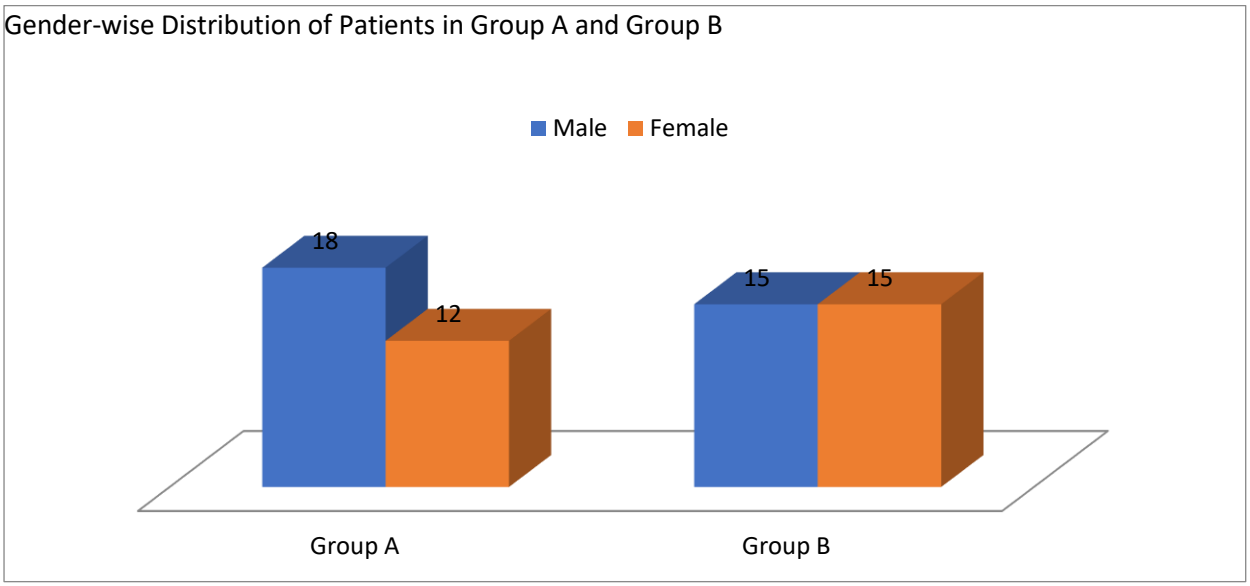

Table 8 Comparison of Age-wise Distribution between Group A and Group B

Gender	Group A		Group B		Statistics test value
	Number of Patients	Percentage	Number of Patients	Percentage	
Male	18	60%	15	50%	$X^2 = 0.6, P = 0.4, P<0.01$(NS)
Female	12	40%	15	50%	
Total	30	100%	30	100%	

The gender distribution between Group A and Group B shows no significant difference ($\chi^2 = 0.6$, $p = 0.4$, NS).

Table 9 Distribution of VAS Pain Scores in Group A and Group B pre and post Intervention

Pain	Group A	Group B
	Mean ± SD(n=30)	Mean ± SD(n=30)
VAS Pre	6.3 ± 1.09	6.6 ± 1.2
VAS POST	4.7 ± 2.02	5.06 ± 2.6

Both Group A and Group B showed a reduction in VAS pain scores from pre- to post-intervention, indicating improvement in pain.

Diagram 7 Showing the multiple bar diagram Distribution of VAS Pain Scores in Group A and Group B pre and post Intervention

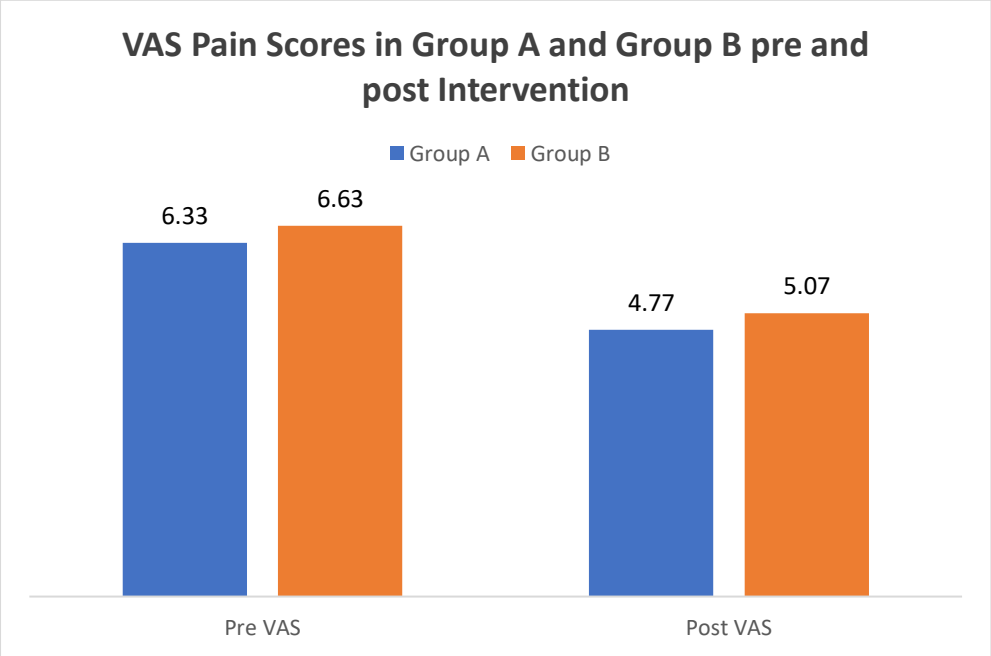

Table 10 Comparison of VAS Pain Scores Between and Within Group A and Group B

Pain	Group A	Group B	Statistics test value
	Mean ± SD(n=30)	Mean ± SD(n=30)	
VAS Pre	6.3 ± 1.09	6.6 ± 1.2	t = 1.0,P = 0.31,P<0.01(NS)
VAS POST	4.7 ± 2.02	5.06 ± 2.6	t = 0.5,P = 0.55,P<0.01(NS)
Statistics test value	t = 4.2, P = 0.0002,P<0.001(S)	t = 4.1,P = 0.0003,P<0.001(S)	

Both Group A and Group B showed a highly statistical significant in VAS pain scores from pre- to post-intervention ($P < 0.001$). Pre-intervention VAS scores between Group A and Group B showed no significant difference. post intervention VAS scores between Group A and Group B showed no significant.

Table 11 Distribution of disability NDI in Group A and Group B pre and post Intervention

Disability	Group A	Group B
	Mean ± SD(n=30)	Mean ± SD(n=30)
NDI Pre	23.7 ± 5.7	27.8 ± 3.4
NDI POST	13.2 ± 4.4	19.2 ± 6.8

Both Group A and Group B showed a reduction in NDI scores from pre- to post-intervention, indicating improvement in functional disability.Group A revealed a greater decrease in disability compared to Group B.

Diagram 8 Showing the multiple bar diagram distribution of disability NDI in Group A and Group B pre and post Intervention

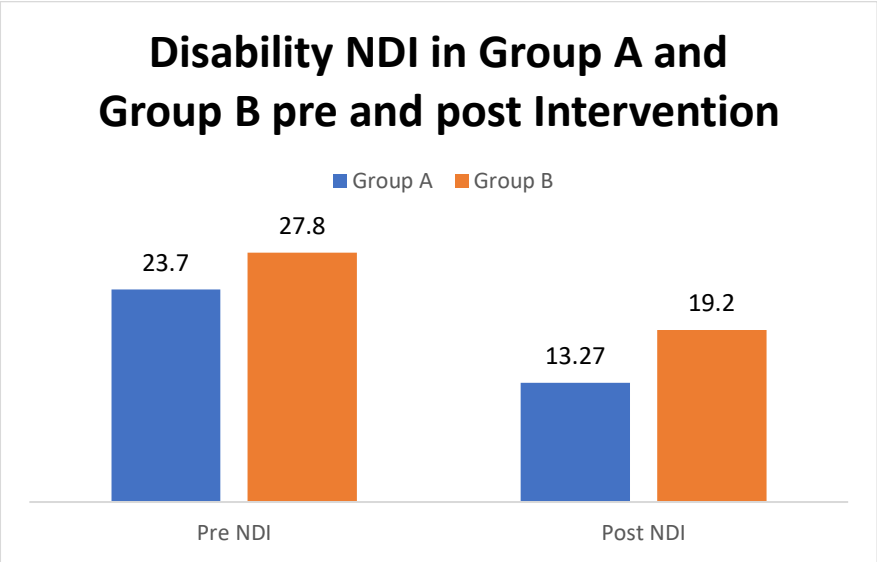

Table12 Comparison of NDI Disability Scores Between Group A and Group B

Disability	Group A	Group B	Statistics test value
	Mean ± SD(n=30)	Mean ± SD(n=30)	
NDI Pre	23.7 ± 5.7	27.8 ± 3.4	t = 3.3,P = 0.0013,P<0.001(S)
NDI POST	13.2 ± 4.4	19.2 ± 6.8	t = 4.0,P = 0.0002,P<0.001(S)
Statistics test value	t = 9.5, P= 0.0001,P<0.001(S)	t = 6.1, P = 0.0001,P<0.001(S)	

Both Group A and Group B showed a **highly significant reduction in NDI scores** from pre- to post-intervention (Group A: t = 9.5, P = 0.0001; Group B: t = 6.1, P = 0.

RESULTS

Participant Characteristics

A total of 60 participants completed the study. The mean age was **28.6 ± 6.4 years**, with the majority (48.3%) within the 25–35-year age group.

The sample comprised **33 males (55%) and 27 females (45%)**.

Baseline comparisons showed **no significant differences** between Group A (cervical stabilization) and Group B (scapular stabilization) in age ($\chi^2 = 0.8$, p =

0.9) or gender distribution ($\chi^2 = 0.6$, p = 0.4), indicating that the groups were comparable at baseline.

Pain Outcomes (VAS)

Both groups demonstrated a significant reduction in pain intensity following the intervention.

Group A: 6.3 ± 1.09 to 4.7 ± 2.02

Group B: 6.6 ± 1.2 to 5.06 ± 2.6

Within-group analysis showed statistically significant improvement in both groups:

Group A: $t = 4.2$, $p < 0.001$

Group B: $t = 4.1$, $p < 0.001$

Between-group comparisons revealed:

No significant difference at baseline (p = 0.31)

No significant difference post-intervention (p = 0.55)

These findings indicate that **both interventions were equally effective in reducing pain intensity**.

Functional Disability Outcomes (NDI)

Both groups demonstrated significant improvement in functional disability following the intervention.

Group A: 23.7 ± 5.7 to 13.2 ± 4.4

Group B: 27.8 ± 3.4 to 19.2 ± 6.8

Within-group improvements were statistically significant:

Group A: $t = 9.5$, $p < 0.001$

Group B: $t = 6.1$, $p < 0.001$

Between-group comparisons revealed:

A significant difference at baseline (p = 0.0013)

A significant difference post-intervention (p = 0.0002)

These results indicate that **Group A demonstrated significantly greater improvement in functional disability compared to Group B**.

Summary of Findings

Both cervical stabilization and scapular stabilization exercises resulted in significant improvements in pain intensity and functional disability. There was no significant difference between the groups in pain reduction; however, cervical stabilization exercises demonstrated superior effectiveness in improving functional disability.

DISCUSSION

The present study aimed to compare the effectiveness of cervical stabilization exercises and scapular stabilization exercises in individuals with non-specific neck pain. The findings indicate that both interventions were effective in reducing pain intensity and improving functional disability following a 3-week exercise program.

Both groups demonstrated a significant reduction in pain intensity, as measured by the Visual Analog Scale (VAS), with no statistically significant difference between groups. This suggests that cervical and scapular stabilization exercises are equally effective in alleviating pain in individuals with non-specific neck pain. The observed reduction in pain may be attributed to improved neuromuscular control, reduced mechanical stress on cervical structures, and enhanced muscle coordination.

Cervical stabilization exercises likely contributed to pain reduction by improving the activation and endurance of deep cervical flexor muscles, including the longus colli and longus capitis. These muscles are essential for maintaining cervical spine stability and minimizing excessive load on superficial musculature. Improved motor control may reduce abnormal muscle activation patterns and associated pain.

Similarly, scapular stabilization exercises may reduce pain by improving scapulothoracic alignment, correcting postural deviations, and decreasing mechanical strain on the cervical spine. Restoration of normal scapular movement and muscle balance enhances load distribution and reduces stress on cervical structures.

With respect to functional disability, both groups showed significant improvement; however, cervical stabilization exercises demonstrated significantly greater improvement compared to scapular stabilization exercises. This finding suggests that interventions targeting deep cervical stabilizers may have a more direct influence on functional performance and activities of daily living.

The superior improvement in functional disability observed in the cervical stabilization group may be explained by the central role of deep cervical muscles in maintaining postural control, segmental stability, and coordinated cervical movement. Enhanced activation of these muscles likely improves movement efficiency, reduces fatigue, and facilitates better functional outcomes.

These findings are consistent with previous studies reporting that both cervical and scapular stabilization exercises are effective in managing non-specific neck pain. The greater improvement in functional disability associated with cervical stabilization aligns with evidence emphasizing the importance of deep cervical muscle training in restoring functional capacity.

However, a significant difference in baseline Neck Disability Index (NDI) scores was observed between the two groups. This baseline imbalance may have influenced the magnitude of post-intervention improvement and should be considered when interpreting the results. Therefore, the superior functional outcomes observed in the cervical stabilization group should be interpreted with caution.

Although scapular stabilization exercises did not demonstrate superior improvement in functional disability, they remain clinically relevant due to their role in optimizing scapular mechanics and reducing cervical strain. Given the biomechanical interdependence between the cervical spine and scapula, a combined rehabilitation approach incorporating both cervical and scapular stabilization exercises may yield more comprehensive outcomes.

Overall, the findings of this study support the use of stabilization-based exercise programs in the management of non-specific neck pain. Both interventions are effective, with cervical stabilization exercises demonstrating greater effectiveness in improving functional disability.

CONCLUSION

Both cervical stabilization and scapular stabilization exercises are effective in reducing pain intensity and improving functional disability in individuals with non-specific neck pain.

Cervical stabilization exercises demonstrated greater effectiveness in improving functional disability, likely due to enhanced activation of deep cervical stabilizing muscles and improved neuromuscular control. However, both interventions were equally effective in reducing pain intensity.

These findings support the inclusion of stabilization exercises as a core component of physiotherapy rehabilitation programs. A combined approach incorporating both cervical and scapular stabilization exercises may provide optimal clinical outcomes.

LIMITATIONS

- The sample size was relatively small, which may limit the generalizability of the findings.
- The intervention duration was short (3 weeks), which may not reflect long-term treatment effects.
- No follow-up assessment was conducted to evaluate the sustainability of outcomes.
- A significant baseline difference in functional disability (NDI) between groups may have influenced the comparative results.
- External factors such as posture, occupational activities, and ergonomic conditions were not controlled, which may have affected the outcomes.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the Institutional Ethical Committee of Pacific Medical University, Udaipur, India. The study was conducted in accordance with accepted ethical standards for human research.

INFORMED CONSENT

Written informed consent was obtained from all participants prior to inclusion in the study.

FUNDING

No external funding was received for this study.

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