

Effect of Age and Gender on Treatment Outcomes Following Stabilization Exercises in Individuals with Non-Specific Neck Pain

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Abstract

Background

Non-specific neck pain (NSNP) is one of the most prevalent musculoskeletal disorders worldwide and is associated with pain, functional limitation, reduced productivity, and diminished quality of life. Stabilization exercises are widely used in conservative physiotherapy to improve cervical stability, neuromuscular control, and functional performance. However, limited evidence exists regarding whether demographic factors such as age and gender influence treatment outcomes following stabilization exercises.

Objective

To determine the effect of age and gender on treatment outcomes following stabilization exercises in individuals with chronic non-specific neck pain.

Methods

This secondary analysis utilized data from a randomized controlled trial involving **60 individuals** with chronic non-specific neck pain. Participants underwent either cervical stabilization or scapular stabilization exercises for **3 weeks**. Pain intensity was assessed using the **Visual Analog Scale (VAS)** and functional disability using the **Neck Disability Index (NDI)**. Treatment outcomes were compared according to age group and gender using paired *t*-tests, independent *t*-tests, and one-way ANOVA, with statistical significance set at $p < 0.05$.

Results

The mean age of the participants was **28.62 ± 6.41 years**, and **55% were male**. Significant improvements were observed following the intervention in both pain intensity (**VAS: 6.48 ± 1.16 to 4.92 ± 2.34; mean improvement 1.57 ± 2.02; $p < 0.001$**) and functional disability (**NDI: 25.87 ± 5.13 to 16.45 ± 6.61; mean improvement 9.42 ± 6.19; $p < 0.001$**). Female participants demonstrated numerically greater improvements than males; however, no statistically significant gender differences were observed for VAS ($p = 0.103$) or NDI ($p = 0.569$). Similarly, treatment outcomes did not differ significantly among age groups for VAS ($p = 0.243$) or NDI ($p = 0.183$).

Conclusion

Stabilization exercises significantly reduced pain and improved functional disability in individuals with chronic non-specific neck pain. Neither age nor gender significantly influenced treatment outcomes, suggesting that stabilization exercises are effective across adult patients aged 18–40 years regardless of demographic characteristics.

INTRODUCTION

Non-specific neck pain (NSNP) is one of the most common musculoskeletal disorders encountered in clinical practice and is recognized as a leading cause of disability worldwide. It affects individuals of different age groups and occupations and contributes substantially to healthcare costs, absenteeism from work, reduced productivity, and impaired quality of life. According to the Global Burden of Disease Study, neck pain remains one of the leading causes of years lived with disability, affecting millions of individuals annually. Unlike neck pain associated with fractures, inflammatory diseases, tumors, or neurological disorders, non-specific neck pain develops without an identifiable structural pathology and accounts for the majority of patients seeking physiotherapy care.

The prevalence of non-specific neck pain has increased considerably during the past two decades owing to rapid urbanization, technological advancement, prolonged computer use, excessive smartphone usage, sedentary lifestyles, and poor ergonomic habits. Individuals employed in desk-based occupations, healthcare professionals, students, drivers, and office workers are particularly vulnerable because of prolonged static postures and repetitive upper-limb activities. Persistent forward head posture, rounded shoulders, inadequate workstation ergonomics, and reduced physical activity contribute to abnormal loading of the cervical spine, muscular imbalance, impaired neuromuscular control, and progressive functional disability.

The cervical spine functions as an integral component of the cervicothoracic kinetic chain and relies on coordinated activity of the deep cervical stabilizing muscles and scapular musculature to maintain optimal

posture and movement. Dysfunction of the deep cervical flexors, reduced muscular endurance, altered scapular positioning, and impaired motor control have been consistently reported in individuals with chronic non-specific neck pain. These impairments increase mechanical stress on cervical joints, ligaments, and surrounding soft tissues, resulting in persistent pain and limitations in daily activities. Consequently, rehabilitation strategies increasingly focus on restoring neuromuscular control rather than merely reducing symptoms.

Exercise therapy is considered the cornerstone of conservative management for non-specific neck pain. Among the various exercise approaches, stabilization exercises have demonstrated consistent effectiveness in improving cervical muscle endurance, enhancing postural control, reducing pain intensity, and improving functional performance. Cervical stabilization exercises specifically target the deep cervical flexor and extensor muscles to improve segmental spinal stability, whereas scapular stabilization exercises emphasize strengthening of the serratus anterior, lower trapezius, middle trapezius, and other scapulothoracic muscles to restore normal scapular biomechanics. Both approaches aim to reduce excessive mechanical stress on cervical structures while improving movement efficiency.

Although stabilization exercises are widely accepted as an effective treatment modality, patients often demonstrate variable responses to rehabilitation. Such variability may be influenced by demographic and biological characteristics, particularly age and gender. Age-related physiological changes, including reduced muscle mass, diminished connective tissue elasticity, decreased proprioception, and slower tissue

healing, may influence the effectiveness of exercise interventions. Similarly, gender-related differences in muscle strength, hormonal profile, pain perception, psychosocial factors, and physical activity levels may affect rehabilitation outcomes. Understanding these differences is important because they may assist physiotherapists in developing individualized treatment programmes and realistic prognostic expectations.

Several randomized controlled trials have compared different exercise interventions for non-specific neck pain; however, relatively few studies have specifically investigated whether demographic variables modify treatment response. Most published research has focused primarily on comparing cervical stabilization exercises, scapular stabilization exercises, manual therapy, or multimodal rehabilitation approaches. Consequently, evidence regarding the influence of age and gender on treatment outcomes remains limited and inconclusive. Exploring these relationships is clinically relevant because identifying patient characteristics associated with better or poorer outcomes may help optimize treatment planning, improve patient education, and facilitate evidence-based clinical decision-making.

Personalized rehabilitation has become an important principle in modern physiotherapy practice. Rather than applying identical treatment protocols to all individuals, clinicians are encouraged to consider patient-specific factors that may influence prognosis and response to intervention. Determining whether age and gender affect improvements in pain intensity and functional disability may provide valuable information for tailoring rehabilitation programmes, selecting exercise progression, and improving long-term clinical outcomes.

Therefore, the present study aimed to investigate the effect of age and gender on treatment outcomes following stabilization exercises in individuals with non-specific neck pain. Treatment outcomes were evaluated using the Visual Analog Scale (VAS) and the Neck Disability Index (NDI). By examining the relationship between demographic characteristics and rehabilitation outcomes, this study seeks to contribute to the growing body of evidence supporting individualized physiotherapy management for patients with non-specific neck pain.

MATERIALS AND METHODS

Study Design

This study is a **secondary analysis of a randomized controlled trial (RCT)** conducted to investigate the influence of age and gender on treatment outcomes following stabilization exercises in individuals with non-specific neck pain. The primary trial compared the effectiveness of cervical stabilization exercises and scapular stabilization exercises. The present analysis utilized the same dataset to evaluate whether demographic characteristics affected improvements in pain intensity and functional disability.

Study Setting

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

Participants

Sixty individuals diagnosed with chronic non-specific neck pain participated in the study. Participants were recruited from the outpatient physiotherapy department after meeting the eligibility criteria and

providing written informed consent. Both male and female participants aged between 18 and 40 years were included.

Eligibility Criteria

Inclusion Criteria

- Individuals aged 18–40 years.
- Diagnosis of chronic non-specific neck pain.
- Both male and female participants.
- Willingness to participate in the study.

Exclusion Criteria

- History of cervical spine fracture or surgery.
- Specific cervical pathology, including cervical radiculopathy or myelopathy.
- Neurological disorders affecting neck function.
- Systemic inflammatory musculoskeletal disorders.
- Any contraindication to therapeutic exercise.

Intervention

Participants were randomly allocated into two intervention groups.

Group A received a cervical stabilization exercise programme consisting of deep cervical flexor activation exercises, cranio-cervical flexion training, cervical isometric strengthening exercises, and postural correction exercises.

Group B received a scapular stabilization exercise programme focusing on strengthening and neuromuscular control of the serratus anterior, middle trapezius, lower trapezius, and rhomboid muscles

through progressive scapular stabilization exercises.

Both groups received supervised treatment five sessions per week for three consecutive weeks. Each treatment session lasted approximately 30–40 minutes.

For the present secondary analysis, treatment groups were combined, and participants were categorized according to age and gender to determine whether these demographic variables influenced rehabilitation outcomes.

Outcome Measures

Visual Analog Scale (VAS)

Pain intensity was measured using the 10-cm Visual Analog Scale (VAS), where 0 represented "no pain" and 10 represented "worst imaginable pain." The VAS is a reliable and valid instrument widely used for assessing pain intensity in individuals with musculoskeletal disorders.

Neck Disability Index (NDI)

Functional disability was assessed using the Neck Disability Index (NDI), a validated self-administered questionnaire consisting of ten items evaluating the impact of neck pain on activities of daily living. Higher scores indicate greater functional disability.

Outcome measures were recorded before initiation of the intervention and immediately after completion of the three-week rehabilitation programme.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics (Version XX; IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages.

Normality of the data was assessed using the Shapiro–Wilk test. Pre- and post-intervention changes in VAS and NDI scores were evaluated using paired t-tests. Differences in treatment outcomes between male and female participants were analyzed using independent-samples t-tests. Comparisons among different age groups were performed using one-way analysis of variance (ANOVA), followed by post hoc analysis where appropriate. Statistical significance was established at $p < 0.05$.

RESULTS

Participant Characteristics

A total of 60 participants with chronic non-specific neck pain completed the study and were included in the final analysis. The mean age of the participants was $28.62 \pm$

6.41 years (range: 18–40 years). Of the 60 participants, 33 (55.0%) were males and 27 (45.0%) were females.

Table 1. Demographic Characteristics of Participants

Variable	Value
Sample size	60
Age (years), Mean $\pm$ SD	28.62 ± 6.41
Age range	18–40
Male	33 (55.0%)
Female	27 (45.0%)

Figure 1. Mean Visual Analog Scale (VAS) scores before and after the 3-week stabilization exercise programme.

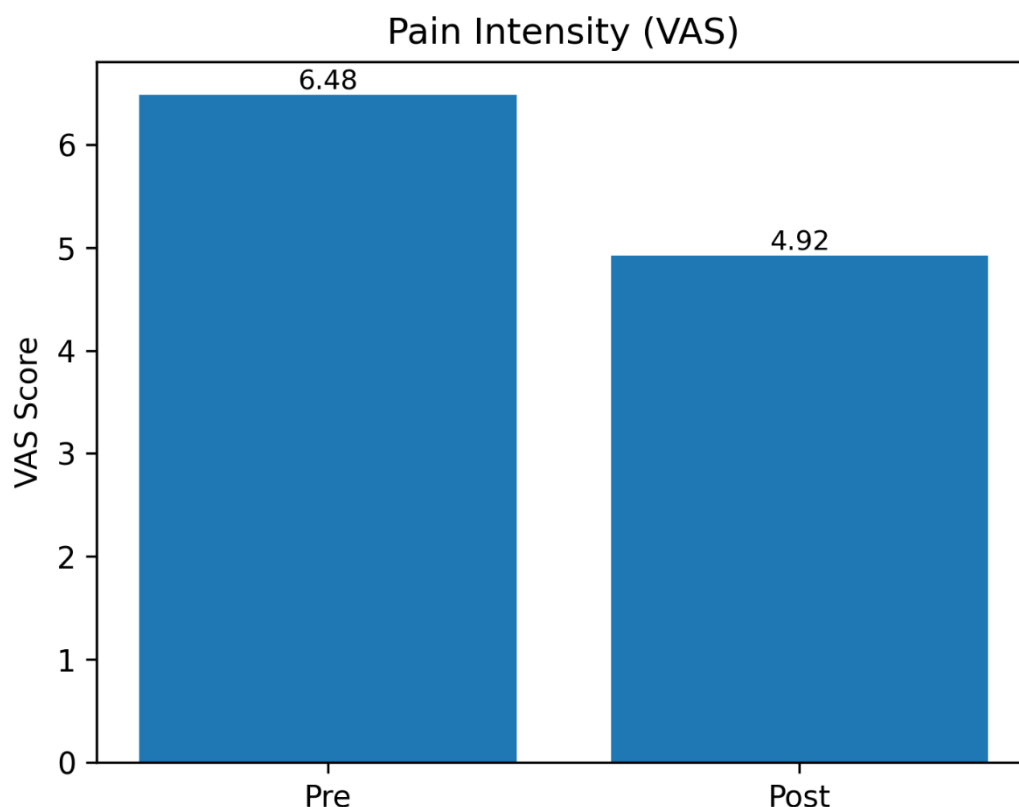


Figure 2. Mean Neck Disability Index (NDI) scores before and after the intervention.

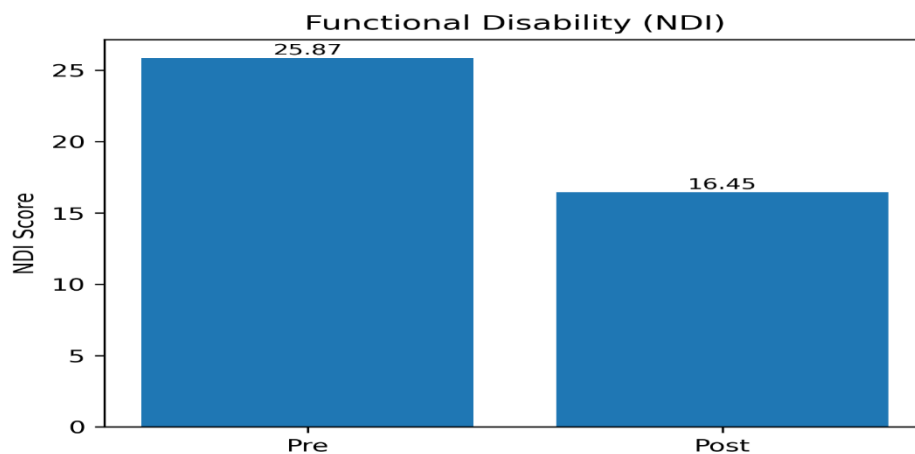


Figure 3. Mean improvement in VAS scores according to gender.

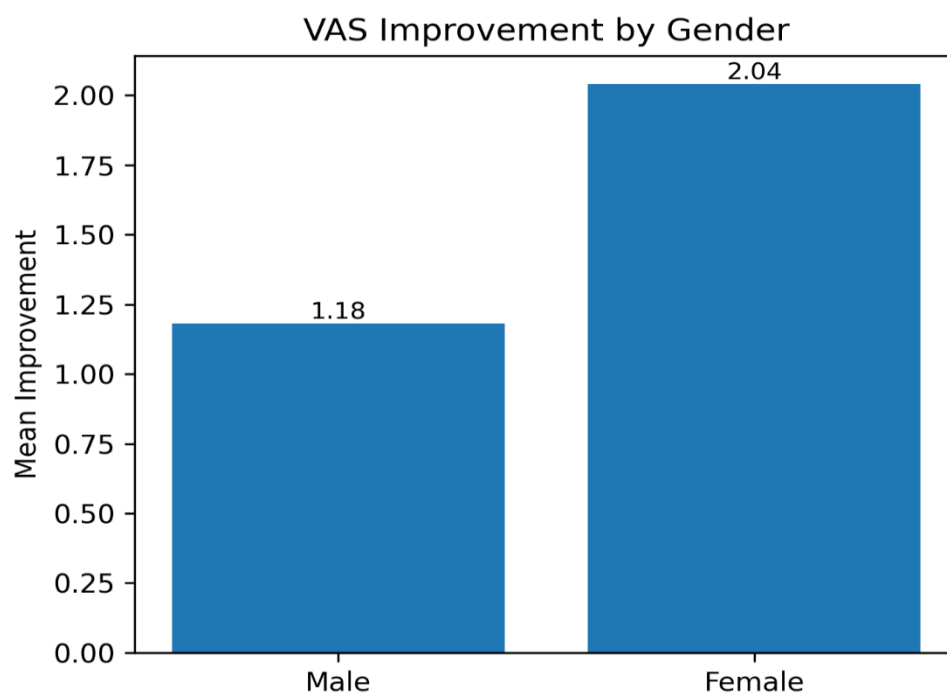
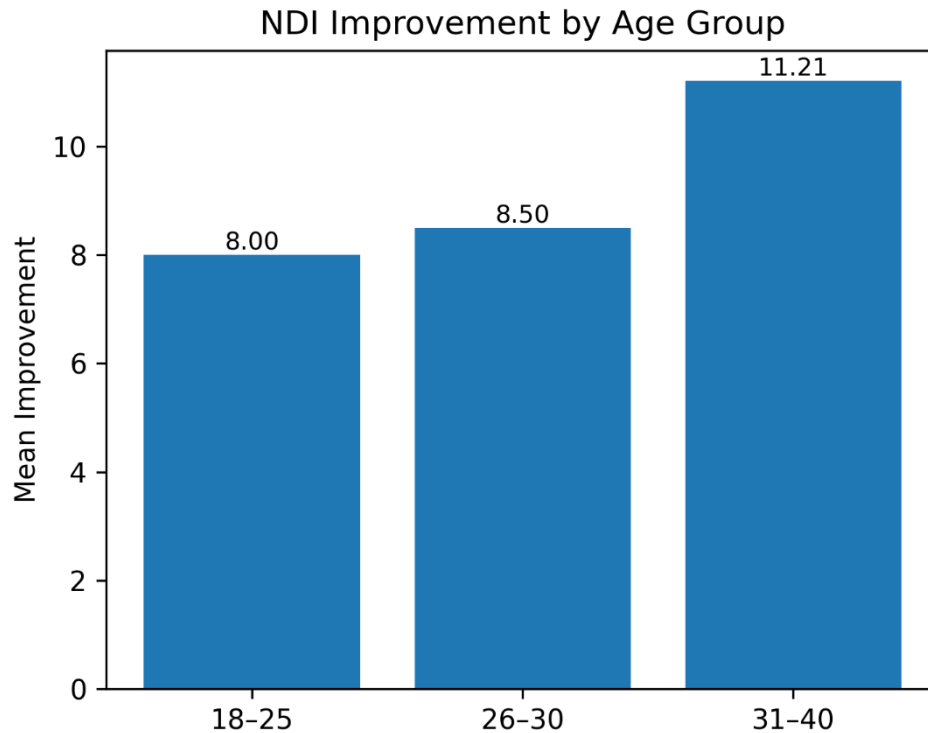


Figure 4. Mean improvement in NDI scores across the three age groups.



Overall Treatment Outcomes

Following the stabilization exercise programme, statistically significant improvements were observed in both pain intensity and functional disability.

The mean VAS score decreased from 6.48 ± 1.16 before treatment to 4.92 ± 2.34 after treatment. The mean reduction was 1.57 ± 2.02 points (95% CI: 1.04–2.09), which was statistically significant ($t = 6.01$, $p < 0.001$).

The within-subject effect size was Cohen's $d = 0.78$, indicating a moderate-to-large treatment effect.

Similarly, the mean NDI score decreased from 25.87 ± 5.13 before treatment to 16.45 ± 6.61 after treatment. The mean improvement was 9.42 ± 6.19 points (95% CI: 7.82–11.02), which was highly statistically significant ($t = 11.78$, $p < 0.001$). The effect size was Cohen's $d = 1.52$, indicating a large treatment effect.

Table 2. Overall Treatment Outcomes

Outcome	Pre-treatment (Mean $\pm$ SD)	Post-treatment (Mean $\pm$ SD)	Mean Change (95% CI)	t	p-value	Cohen's d
VAS	6.48 ± 1.16	4.92 ± 2.34	1.57 (1.04–2.09)	6.01	<0.001	0.78
NDI	25.87 ± 5.13	16.45 ± 6.61	9.42 (7.82–11.02)	11.78	<0.001	1.52

Effect of Gender on Treatment Outcomes

Male participants demonstrated a mean VAS improvement of 1.18 ± 1.59 , whereas female participants showed a mean improvement of 2.04 ± 2.39 . The between-group difference was not statistically significant ($t = -1.66$, $p = 0.103$). The effect

size was Cohen's $d = -0.43$, indicating a small-to-moderate effect.

For functional disability, males improved by 9.00 ± 5.87 points on the NDI, whereas females improved by 9.93 ± 6.64 points. This difference was also not statistically significant ($t = -0.57$, $p = 0.569$), with a negligible effect size (Cohen's $d = -0.15$).

Table 3. Comparison of Treatment Outcomes According to Gender

Outcome	Male (n = 33)	Female (n = 27)	Mean Difference (95% CI)	t	p-value	Cohen's d
VAS Improvement	1.18 ± 1.59	2.04 ± 2.39	-0.86 (-1.89 to 0.18)	-1.66	0.103	-0.43
NDI Improvement	9.00 ± 5.87	9.93 ± 6.64	-0.93 (-4.16 to 2.31)	-0.57	0.569	-0.15

Effect of Age on Treatment Outcomes

Participants were categorized into three age groups: 18–25 years ($n = 20$), 26–30 years ($n = 16$), and 31–40 years ($n = 24$).

The mean improvements in VAS were 2.00 ± 2.25 , 0.88 ± 1.59 , and 1.67 ± 2.04 , respectively. One-way ANOVA

demonstrated no statistically significant difference among the age groups ($F = 1.45$, $p = 0.243$).

Similarly, the mean improvements in NDI were 8.00 ± 6.03 , 8.50 ± 7.01 , and 11.21 ± 5.52 , respectively. No statistically significant difference was observed between age groups ($F = 1.75$, $p = 0.183$).

Table 4. Treatment Outcomes According to Age Group

Age Group	n	VAS Improvement (Mean $\pm$ SD)	NDI Improvement (Mean $\pm$ SD)
18–25 years	20	2.00 ± 2.25	8.00 ± 6.03
26–30 years	16	0.88 ± 1.59	8.50 ± 7.01
31–40 years	24	1.67 ± 2.04	11.21 ± 5.52

ANOVA Results

- VAS Improvement: $F = 1.45$, $p = 0.243$
- NDI Improvement: $F = 1.75$, $p = 0.183$

Summary of Findings

The stabilization exercise programme resulted in significant improvements in both pain intensity and functional disability. Pain intensity improved by 1.57 points (Cohen's $d = 0.78$), while functional disability improved by 9.42 points (Cohen's

$d = 1.52$), demonstrating a large clinical effect. However, neither gender nor age group significantly influenced treatment outcomes (all $p > 0.05$), suggesting that stabilization exercises were similarly effective across the demographic subgroups included in this study.

DISCUSSION

The present study investigated whether age and gender influenced treatment outcomes following stabilization exercises in individuals with chronic non-specific neck pain. The findings demonstrated that participants experienced clinically meaningful improvements in pain intensity and functional disability after the intervention. However, comparisons across age groups and between male and female participants revealed no statistically significant differences in treatment outcomes. These findings suggest that stabilization exercises are effective regardless of age or gender within the study population.

Overall improvements in pain and disability observed in the present study are consistent with previous research supporting stabilization exercises as an effective intervention for non-specific neck pain. Stabilization exercises improve activation of the deep cervical flexor muscles, enhance neuromuscular control, restore cervical stability, and reduce abnormal mechanical stress on the cervical spine. Similarly, scapular stabilization exercises improve scapulothoracic alignment and muscle coordination, thereby reducing the biomechanical load on cervical structures. Together, these mechanisms contribute to reductions in pain and improvements in functional ability.

Although female participants demonstrated slightly greater improvements in pain and disability than male participants, these

differences were not statistically significant. Previous studies have reported that females generally experience higher pain intensity and greater disability related to neck pain, possibly due to hormonal influences, muscle characteristics, psychosocial factors, and differences in pain perception. Despite these baseline differences, the present findings indicate that both sexes respond similarly to stabilization-based rehabilitation. This suggests that the physiological benefits of exercise, including improved muscular endurance, motor control, and postural stability, are achieved irrespective of gender.

Similarly, analysis according to age demonstrated no significant influence on treatment outcomes. While younger participants showed slightly greater reductions in pain and older participants exhibited greater improvements in disability, these variations were not statistically significant. Age-related changes in muscle strength, tissue elasticity, and neuromuscular function are known to influence physical performance. However, the participants included in the present study were between 18 and 40 years of age, representing a relatively young adult population in whom age-related degenerative changes are generally limited. Consequently, stabilization exercises appear to provide comparable clinical benefits across this age range.

The findings of the present study support the concept that demographic variables alone should not determine rehabilitation strategies for individuals with non-specific neck pain. Instead, clinicians should prioritize clinical presentation, symptom severity, functional limitations, movement impairments, and individual rehabilitation goals when designing exercise programmes. Stabilization exercises can

therefore be considered an effective treatment option for a broad range of adult patients with non-specific neck pain.

The results are in agreement with previous randomized controlled trials reporting significant improvements in pain and disability following cervical stabilization and scapular stabilization exercises. While earlier studies primarily compared different exercise approaches, the present study extends existing knowledge by evaluating whether patient demographics modify treatment response. The absence of significant demographic differences suggests that stabilization exercises may have broad applicability across adult populations with non-specific neck pain.

Several limitations should be acknowledged. This study was a secondary analysis of data obtained from a single randomized controlled trial with a relatively modest sample size, which may have limited the ability to detect small differences between demographic groups. The age range was restricted to 18–40 years, limiting the generalizability of the findings to older adults. Additionally, only short-term outcomes following a three-week intervention were evaluated, and long-term follow-up was not available. Future studies with larger, more diverse populations and extended follow-up periods are recommended to determine whether age and gender influence long-term rehabilitation outcomes.

Overall, the present findings indicate that stabilization exercises effectively reduce pain and improve functional disability in individuals with non-specific neck pain. Although minor variations were observed across age groups and between genders, these differences were not statistically significant. The study supports the use of stabilization exercises as a beneficial intervention across adult patients with non-

specific neck pain while emphasizing that rehabilitation should remain individualized according to each patient's clinical characteristics rather than demographic factors alone.

CONCLUSION

The present study evaluated whether age and gender influence treatment outcomes following stabilization exercises in individuals with chronic non-specific neck pain. The findings demonstrated that participants experienced clinically meaningful improvements in pain intensity and functional disability after completion of the rehabilitation programme. Although minor variations in treatment response were observed across different age groups and between male and female participants, these differences were not statistically significant.

These findings suggest that stabilization exercises are effective in reducing pain and improving neck-related disability irrespective of age or gender among adults aged 18–40 years. Therefore, demographic characteristics alone should not be considered predictors of rehabilitation outcomes when prescribing stabilization exercises for individuals with non-specific neck pain.

The results support the use of cervical and scapular stabilization exercises as effective components of conservative physiotherapy management. Future studies involving larger sample sizes, broader age groups, and long-term follow-up are recommended to further investigate the influence of demographic and clinical factors on rehabilitation outcomes.

CLINICAL IMPLICATIONS

- Stabilization exercises can be prescribed effectively for adults with non-specific neck pain regardless of age or gender.
- Clinicians should focus on individual clinical presentation and functional impairments rather than demographic characteristics when planning rehabilitation.
- Both cervical and scapular stabilization exercises remain valuable components of evidence-based physiotherapy management for chronic non-specific neck pain.
- The findings support the implementation of individualized exercise programmes to improve pain and functional outcomes in routine clinical practice.

LIMITATIONS

- The study included a relatively small sample size, which may have limited the ability to detect subtle demographic differences.
- Participants were restricted to an age range of 18–40 years; therefore, the findings may not be generalizable to older adults or adolescents.
- The study evaluated only short-term outcomes following a three-week intervention, and long-term effects were not assessed.
- As a secondary analysis of an existing randomized controlled trial, the study was limited to the variables available in the original dataset.

FUTURE RECOMMENDATIONS

- Conduct multicentre studies with larger and more diverse populations.
- Include participants from wider age ranges, particularly older adults.
- Evaluate long-term follow-up to determine the sustainability of treatment outcomes.
- Investigate additional predictors of rehabilitation outcomes, such as symptom duration, occupational factors, psychological status, physical activity levels, and ergonomic exposure.
- Develop predictive models to support personalized rehabilitation strategies for individuals with non-specific neck pain.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

ETHICAL APPROVAL

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Pacific Medical University before commencement of the original randomized controlled trial. Written informed consent was obtained from all participants prior to their enrolment in the study.

AUTHOR CONTRIBUTIONS

Nandini Paliwal: Conceptualization, data collection, data analysis, manuscript drafting, and final approval.

Vaishnavi Jaikant Kania: Study supervision, methodology, manuscript review, editing, and final approval.

Krati Jain: Data interpretation, literature review, manuscript revision, and final approval.

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