

Deep Neck Flexor Exercise in Coffee Pickers: A Pre-experimental Study

Theo Fontina Kadju¹, I Gede Arya Sena², Ni Luh Made Reny Wahyu Sari³, Daryono⁴

¹⁻⁴Physiotherapy Study Program, Universitas Dhyana Pura, Badung, Bali, Indonesia

Corresponding author:

Name: Theo Fontina Kadju

E-mail: theofontinakadju@gmail.com

Received 29 July 2026; Revised 13 August 2026; Accepted 14 August 2026; Published 29 September 2026.

©2026 The Authors. Published by the Physiotherapy Study Program, Faculty of Medicine, Udayana University, in collaboration with the Indonesian Physiotherapy Association (Ikatan Fisioterapi Indonesia). This is an open-access article distributed under the terms of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

Abstract

Background: Coffee harvesting requires repeated overhead work that may expose the cervical region to sustained nonneutral posture. Evidence regarding neck pain associated with this specific occupational exposure remains limited.

Objective: To evaluate changes in neck pain and neck disability before and after a standardized Deep Neck Flexor exercise program in women coffee pickers.

Methods: This pre-experimental one group pretest posttest study was conducted from April 17 to May 5, 2026, in Tiworiwu 1 Village, Jerebuu District, Ngada Regency. Thirty women aged 40 to 50 years who had worked as coffee pickers for at least 10 years were recruited by purposive sampling. Neck disability was assessed using the Neck Disability Index, and pain intensity was assessed using the Verbal Rating Scale. Participants completed six supervised sessions using the same exercise dose. Paired t tests were used after Shapiro Wilk testing confirmed normality. Cohen's d and 95% confidence intervals were reported.

Results: NDI decreased by 24.10 points (95% CI, 22.233 to 25.967; Cohen's d = 4.82; p < 0.001). VRS decreased by 3.00 points on the right (95% CI, 2.706 to 3.294; Cohen's d = 3.81; p < 0.001) and by 2.967 points on the left (95% CI, 2.649 to 3.284; Cohen's d = 3.49; p < 0.001).

Conclusion: Six supervised sessions were associated with significant reductions in pain and neck disability. Because the study had no control group and no a priori sample size calculation, causal inference and statistical power remain limited.

Keywords

Neck Pain; Exercise Therapy; Neck Muscles; Occupational Health; Disability Evaluation

Introduction

Neck pain is a common musculoskeletal condition that can contribute to disability and reduced quality of life. Global analyses have shown a substantial burden of neck pain across populations, with persistent effects on functioning and participation.¹ Occupational exposure is particularly relevant when work requires repetitive or sustained cervical loading. Coffee harvesting is one such activity. In Tiworiwu 1 Village, Arabica coffee trees can reach approximately 2 m, requiring workers to repeatedly extend the neck while reaching for fruit in the upper parts of the plant. The preliminary ergonomic assessment conducted in this population using the Rapid Upper Limb Assessment produced a score of 7, indicating a high ergonomic risk that warrants corrective action.

Sustained nonneutral cervical posture may increase mechanical demand on cervical structures and can be accompanied by pain and activity limitation.² For workers who repeat the same posture for prolonged periods, the clinical consequences may extend beyond pain to difficulty performing daily activities. Neck related disability can be quantified with the Neck Disability Index (NDI), an established measure of disability associated with neck pain.³ Pain intensity can be assessed using verbal rating methods, which have demonstrated validity and relationships with other commonly used pain measures.⁴ The use of standardized patient reported outcomes is therefore appropriate for evaluating changes in pain and neck disability in occupational populations.

Exercise therapy is commonly used in the management of neck pain. Recent evidence indicates that exercise based approaches can improve pain, disability, and quality of life in people with chronic neck pain, although the magnitude of benefit varies according to the population, exercise content, and comparator.^{5,6} Exercise therapy is also described as a person centred intervention that may be adapted to the clinical characteristics and functional demands of the individual.⁷ Deep Neck Flexor exercise specifically targets the deep cervical flexor muscles and is intended to improve cervical motor control and stability while limiting excessive activation of superficial muscles.⁸ Evidence from a systematic review and meta analysis suggests that motor control training of the deep neck flexors can improve pain and disability in people with neck pain.⁹ Clinical research has also reported improvements in pain, disability, and neck muscle endurance after deep cervical flexor training.¹⁰

The occupational context of the present study differs from much of the existing literature. Previous studies have frequently examined office workers, school teachers, or people with mechanical or chronic neck pain, whereas evidence concerning workers who repeatedly perform overhead tasks with sustained cervical extension is less developed.^{5,11,10} This distinction is clinically relevant because the direction and duration of cervical loading may differ between occupations. In addition, the present population consists of women coffee pickers in a rural agricultural setting, a group that may not be adequately represented in studies conducted in clinical or office based populations.

The rationale for the present study is therefore based on two considerations. First, the preliminary ergonomic assessment indicated a high level of occupational risk among the coffee pickers in Tiworiwu 1. Second, deep cervical flexor exercise has been associated with improvements in pain and disability in other neck pain populations, but its use in workers exposed to repeated overhead harvesting activity has not been sufficiently characterized. The present study was designed as an initial pre experimental evaluation of change following a standardized exercise protocol. The objective was to evaluate changes in neck pain and neck disability before and after six supervised sessions of Deep Neck Flexor exercise among women coffee pickers in Tiworiwu 1 Village, Jerebuu District, Ngada Regency. Given the one group pretest posttest design, the study was intended to evaluate within participant change rather than establish a causal treatment effect.

Methods

This study used a pre experimental one group pretest posttest design. Reporting was guided by the Transparent Reporting of Evaluations with Nonrandomized Designs Statement. The study was conducted in Tiworiwu 1 Village, Jerebuu District, Ngada Regency, from April 17 to May 5, 2026. The target population comprised 42 women who worked as coffee pickers in the study area.

Participants were recruited using purposive sampling. The sampling strategy was selected because the study required participants with a relatively homogeneous occupational exposure, specifically women aged 40 to 50 years who had worked as coffee pickers for at least 10 years and routinely performed harvesting activities requiring repeated neck extension. Of the 42 women in the accessible population, 30 met the eligibility criteria and agreed to participate. All eligible participants were included in the final analysis. No a priori sample size calculation or power analysis was performed. The sample size was determined by the accessible population and by inclusion of all individuals who met the eligibility criteria and completed the study. This limitation was considered in the interpretation of the findings.

Inclusion criteria were women who provided written informed consent, were 40 to 50 years old, and had worked as coffee pickers for at least 10 years. Exclusion criteria included a history of significant neck injury and health conditions that could affect cervical flexibility or prevent participation in Deep Neck Flexor exercise. Participants were considered eligible for withdrawal if they could not follow the exercise protocol, missed three consecutive training sessions, experienced an acute injury, or developed a worsening health condition that prevented continuation. In practice, none of the 30 participants met the dropout criteria during the study.

The independent variable was the standardized Deep Neck Flexor exercise program. The outcomes were neck pain intensity and neck disability. Pain intensity was measured separately on the right and left sides using the Verbal Rating Scale (VRS). Neck disability was assessed using the Neck Disability Index (NDI). The NDI was developed by Vernon and Mior and is widely used to quantify disability associated with neck pain. Evidence summarized in a systematic review supports its measurement properties for assessing neck related disability.¹² The VRS is a verbal measure of pain intensity and has demonstrated validity and reliability in comparison with other pain rating instruments.^{13,14,15}

The baseline assessment was performed before the exercise intervention. After completion of the intervention period, the same VRS and NDI procedures were repeated as the posttest assessment. The study therefore used the same outcome instruments before and after the intervention. No additional objective cervical measurements, such as cervical range of motion or neck muscle strength, were collected.

The Deep Neck Flexor protocol was standardized across all participants. Participants performed the exercise in a supine position on a mat with both knees flexed and the feet flat on the floor. They were instructed to perform a chin tuck by gently drawing the chin toward the neck without lifting the head from the mat. The contraction was maintained for 10 seconds followed by 15 seconds of relaxation. Each session consisted of 10 repetitions performed for 3 sets. The intervention comprised six supervised sessions. The protocol remained unchanged throughout the six sessions. There was no progression in contraction duration, number of repetitions, number of sets, or training frequency. No modification of the intervention protocol was made during the study. The absence of progression was intentional because the study evaluated response to a single standardized Deep Neck Flexor protocol rather than a progressively loaded exercise program.

The exercise dose was not individualized according to the participant's baseline condition. All participants received the same exercise position, technique, contraction duration, relaxation duration, repetitions, sets, and session schedule. This approach was used to maintain intervention consistency and to ensure that each participant received the same planned exposure. The source manuscript does not report individualized dose adjustment, and no individualized modification was performed. Adherence was monitored through direct supervision by the researcher and a physiotherapist during each session. The exercise sessions were conducted face to face, and the supervising personnel checked the technique and completion of each exercise component. All 30 participants completed all six sessions. No adverse events, acute injuries, or other complaints requiring interruption of exercise were reported.

The study used basic assessment equipment consisting of an NDI questionnaire, VRS assessment form, sphygmomanometer, stethoscope, thermometer, weighing scale, height measurement device, stopwatch, exercise mat, and writing materials. The same measurement instruments and standardized procedures were used for the pretest and posttest assessments. The study procedures were kept consistent throughout data collection to reduce procedural variation.

Ethical approval was obtained from the Research Ethics Committee of Universitas Dhyana Pura under Ethical Approval No. 001716 of 2026, approved on April 2, 2026. Participants received an explanation of the study objectives, procedures, potential benefits, and risks and signed informed consent on March 26, 2026, before participation. The study was conducted in accordance with the principles of the Declaration of Helsinki.

For statistical analysis, descriptive statistics were used to summarize participant characteristics and outcome categories. The Shapiro Wilk test was used to assess the distribution of the pretest and posttest outcome variables. All assessed variables had p values greater than 0.05 and were therefore analyzed using paired t tests. The analysis compared pretest and posttest measurements within the same participants. Mean differences, 95% confidence intervals, t statistics, degrees of freedom, and Cohen's d effect sizes were reported. Statistical significance was interpreted at $p < 0.05$. The source manuscript does not specify the statistical software used for the analysis. No imputation for missing outcome data was required because all 30 participants completed the intervention and posttest assessment.

The participant recruitment, eligibility assessment, intervention completion, and final analysis are summarized in Figure 1.

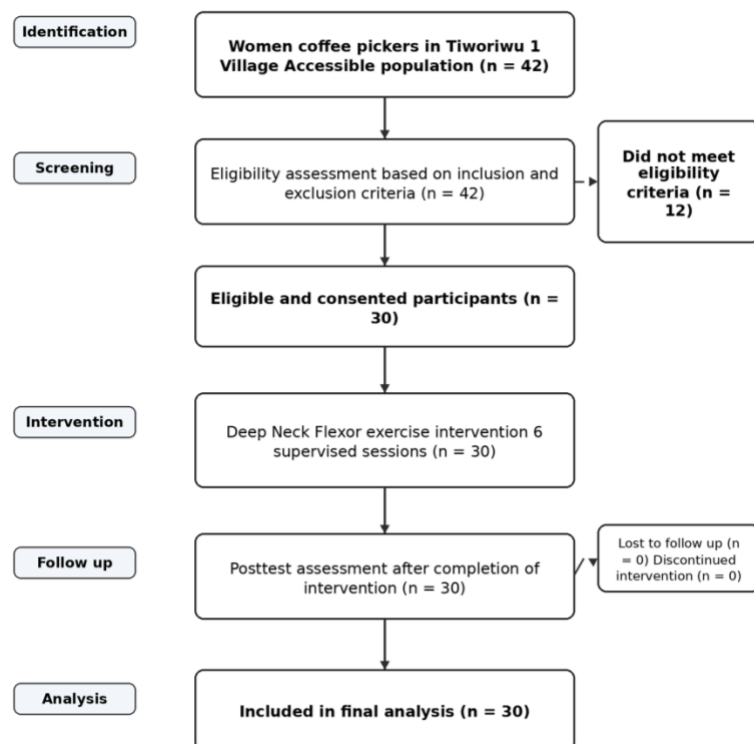


Figure 1. Participant flow from the accessible population to final analysis.

The findings support further evaluation of Deep Neck Flexor exercise as a potential component of occupational musculoskeletal health programs for agricultural workers exposed to repeated overhead activity. Future studies should use controlled designs, prospective sample size determination, longer follow up, and additional objective measures of cervical function to determine the reproducibility, durability, and comparative effectiveness of the observed changes.

Results

The participant flow is summarized in Figure 1. Of the 42 women coffee pickers in the accessible population, 30 met the eligibility criteria and were included in the intervention. Twelve women did not meet the study criteria. All 30 eligible participants completed six supervised Deep Neck Flexor sessions, no participant was lost to follow up, and all 30 were included in the final analysis. The participant flow therefore remained complete from recruitment to analysis.

Participant age and body mass index distributions are presented in Tables 1 and 2. Participants were 40 to 50 years old. The largest age group was 50 years, comprising 7 participants (23.3%), whereas the smallest group was 40 years, comprising 1 participant (3.3%). The remaining participants were distributed across ages 43, 44, 45, 46, 47, 48, and 49 years. Regarding body mass index, 13 participants (43.3%) were classified as normal weight, 8 (26.7%) as obese, 8 (26.7%) as overweight, and 1 (3.3%) as underweight. These findings indicate that the study sample included variation in body mass index despite the relatively homogeneous occupational exposure.

Table 1. Age distribution of participants

Age (years)	n	%
40	1	3.3
43	1	3.3
44	4	13.3
45	3	10.0
46	5	16.7
47	3	10.0
48	2	6.7
49	4	13.3
50	7	23.3
Total	30	100.0

Table 2. Body mass index distribution of participants

BMI category	n	%
Normal weight	13	43.3
Obesity	8	26.7
Overweight	8	26.7
Underweight	1	3.3
Total	30	100.0

The distribution of NDI categories before and after the intervention is shown in Tables 3 and 4. At baseline, 26 participants (86.7%) were categorized as having moderate disability and 4 participants (13.3%) as having severe disability. After the six session intervention, 28 participants (93.3%) were categorized as having mild disability and 2 participants (6.7%) were within the normal category. No participant remained in the moderate or severe disability categories at posttest.

Table 3. NDI categories at pretest

NDI category	n	%
Moderate disability	26	86.7
Severe disability	4	13.3
Total	30	100.0

NDI = Neck Disability Index.

Table 4. NDI categories at posttest

NDI category	n	%
Mild disability	28	93.3
Normal	2	6.7
Total	30	100.0

NDI = Neck Disability Index.

The distribution of VRS categories is presented in Tables 5 through 8. On the right side, 15 participants (50.0%) reported mild pain and 15 (50.0%) reported moderate pain at baseline. After the intervention, all 30 participants (100%) were classified as having mild pain. On the left side, 14 participants (46.7%) reported mild pain and 16 (53.3%) reported moderate pain at baseline. At posttest, all 30 participants (100%) were classified as having mild pain. Thus, the categorical distribution shifted toward lower pain intensity on both sides.

Table 5. Right sided VRS categories at pretest

Right VRS category	n	%
Mild pain	15	50.0
Moderate pain	15	50.0
Total	30	100.0

VRS = Verbal Rating Scale.

Table 6. Left sided VRS categories at pretest

Left VRS category	n	%
Mild pain	14	46.7
Moderate pain	16	53.3
Total	30	100.0

VRS = Verbal Rating Scale.

Table 7. Right sided VRS categories at posttest

Right VRS category	n	%
Mild pain	30	100.0
Total	30	100.0

VRS = Verbal Rating Scale.

Table 8. Left sided VRS categories at posttest

Left VRS category	n	%
Mild pain	30	100.0
Total	30	100.0

VRS = Verbal Rating Scale.

The Shapiro Wilk results are shown in Table 9. All pretest and posttest variables had p values greater than 0.05. The W statistic and p value were 0.638 and 0.281 for right VRS pretest, 0.638 and 0.281 for right VRS posttest, 0.638 and 0.281 for left VRS pretest, 0.637 and 0.280 for left VRS posttest, 0.846 and 0.412 for NDI pretest, and 0.897 and 0.409 for NDI posttest. The observed distributions therefore met the normality assumption used for the subsequent paired t test analysis.

Table 9. Shapiro Wilk normality test for study outcomes

Variable	W	df	p value	Interpretation
Right VRS pretest	0.638	30	0.281	Normal
Right VRS posttest	0.638	30	0.281	Normal
Left VRS pretest	0.638	30	0.281	Normal
Left VRS posttest	0.637	30	0.280	Normal
NDI pretest	0.846	30	0.412	Normal
NDI posttest	0.897	30	0.409	Normal

VRS = Verbal Rating Scale; NDI = Neck Disability Index.

The primary paired analysis is presented in Table 10. For right VRS, the mean difference was 3.000 points, with a 95% CI from 2.706 to 3.294, $t = 20.857$, $df = 29$, Cohen's $d = 3.81$, and $p < 0.001$. For left VRS, the mean difference was 2.967 points, with a 95% CI from 2.649 to 3.284, $t = 19.110$, $df = 29$, Cohen's $d = 3.49$, and $p < 0.001$. For NDI, the mean difference was 24.100 points, with a 95% CI from 22.233 to 25.967, $t = 26.406$, $df = 29$, Cohen's $d = 4.82$, and $p < 0.001$.

Table 10. Paired t test results for pain and neck disability

Outcome	Pretest mean ± SD	Posttest mean ± SD	Mean difference	95% CI	t	df	Cohen's d	p value
Right VRS	Not reported	Not reported	3.000	2.706 to 3.294	20.857	29	3.81	<0.001
Left VRS	Not reported	Not reported	2.967	2.649 to 3.284	19.110	29	3.49	<0.001
NDI	38.43 ± 7.82	14.33 ± 5.59	24.100	22.233 to 25.967	26.406	29	4.82	<0.001

CI = confidence interval; VRS = Verbal Rating Scale; NDI = Neck Disability Index; SD = standard deviation. Pretest and posttest VRS mean ± SD values were not reported in the source manuscript and were not reconstructed.

The source manuscript reported NDI mean scores of 38.43 ± 7.82 at pretest and 14.33 ± 5.59 at posttest. These values are included in Table 10 to provide the requested pretest and posttest descriptive statistics. However, the source manuscript did not report the mean $\pm$ SD values for right and left VRS at pretest and posttest. Because those values cannot be reconstructed reliably from the reported mean differences, confidence intervals, t statistics, and categorical distributions, they are explicitly identified as not reported rather than estimated. This preserves the integrity of the original dataset while addressing the reviewer request as far as the available data permit.

No missing outcome data were reported. All participants completed the intervention and the posttest assessment. No adverse events or injuries requiring discontinuation were reported during the six supervised sessions.

The age distribution was not concentrated exclusively in one narrow age band. One participant was 40 years old (3.3%), one was 43 (3.3%), four were 44 (13.3%), three were 45 (10.0%), five were 46 (16.7%), three were 47 (10.0%), two were 48 (6.7%), four were 49 (13.3%), and seven were 50 years old (23.3%). The total sample was therefore 30 participants, representing 100% of the analyzed cohort.

The body mass index distribution also showed that normal weight was the most frequent category. Thirteen participants were classified as normal weight, while obesity and overweight each accounted for eight participants. Only one participant was classified as underweight. These descriptive data are relevant to interpretation because the sample was not completely uniform in anthropometric characteristics, although all participants shared the specified occupational and age criteria.

The change in NDI categories was accompanied by a marked shift in the distribution of disability severity. Before exercise, most participants had moderate disability, with a smaller group categorized as having severe disability. After exercise, nearly all participants were categorized as having mild disability and two participants were categorized as normal. The categorical data therefore showed a consistent direction of change in neck disability across the cohort, while the paired analysis quantified the magnitude and statistical significance of the pretest to posttest difference.

The same pattern was observed for pain intensity. At baseline, right sided pain was evenly divided between mild and moderate categories, whereas left sided pain was slightly more frequent in the moderate category. At posttest, all participants were classified as having mild pain on both sides. The categorical findings were consistent with the direction of the mean differences obtained from the paired analyses. The statistical analysis was performed on the paired measurements rather than on the categorical frequencies.

Discussion

This study found statistically significant within participant changes in neck pain and neck disability after six supervised sessions of standardized Deep Neck Flexor exercise. NDI scores decreased by 24.10 points, while VRS scores decreased by 3.00 points on the right and 2.967 points on the left. The corresponding effect sizes were large, with Cohen's d values of 4.82, 3.81, and 3.49, respectively. These findings indicate substantial pretest to posttest differences in the measured outcomes. However, because the study used a one group pretest posttest design without a control group, the observed changes should be interpreted as associations with the intervention period rather than as definitive evidence of a causal treatment effect.

The reduction in NDI scores is clinically relevant because the NDI is designed to capture the functional consequences of neck pain in daily activities.¹² The baseline mean NDI score was 38.43 ± 7.82 , compared with 14.33 ± 5.59 after the intervention. The categorical distribution also changed from predominantly moderate or severe disability at baseline to predominantly mild disability or normal status at posttest. The consistency between the continuous and categorical findings strengthens the description of the observed change within this sample. The measurement properties of the NDI have been examined extensively, supporting its use for evaluating neck related disability.¹⁶

The findings are broadly consistent with previous evidence concerning exercise based management of neck pain. Systematic review evidence indicates that exercise interventions can reduce pain and disability in people with neck pain, although outcomes vary across intervention types and populations.^{5,6} A systematic review and meta analysis focusing on motor control training of the deep neck flexors also reported improvements in pain and disability.⁸ The present findings extend this general evidence to a rural occupational population exposed to repeated overhead harvesting activity. The occupational context is important because the participants were not recruited from a conventional clinical population or from office based work. Their repeated cervical extension during coffee harvesting represents a different exposure pattern from the sustained forward head posture commonly described in sedentary occupational settings.

A plausible physiological explanation is that Deep Neck Flexor exercise provides low load training for the deep cervical flexor muscles, including the longus colli and longus capitis, which contribute to cervical segmental control.¹⁷ Improved activation and coordination of these muscles may influence cervical motor control and the distribution of muscular demand during neck movement.¹² Evidence from previous clinical research suggests that deep cervical flexor training can improve neck muscle endurance and reduce pain and disability.¹⁰ The present study did not directly measure muscle activation, cervical range of motion, or muscle strength, so the proposed mechanism cannot be confirmed from the study data. The mechanism should therefore be regarded as an interpretation supported by previous literature rather than a finding directly demonstrated by this study.

The observed reduction in VRS was also consistent with previous literature supporting exercise based approaches for neck pain. Pain measurement literature indicates that verbal rating methods can provide valid assessments of pain intensity and can correlate with other commonly used pain scales.^{14, 15} The present study found reductions on both the right and left sides, and all participants were classified in the mild pain category at posttest. The magnitude of the paired differences was statistically significant, with narrow confidence intervals and large effect size estimates. Nevertheless, the absence of a control group means that the findings cannot distinguish the contribution of the exercise from other factors occurring during the study period.

Several alternative explanations are therefore possible. Natural variation in symptoms, changes in occupational activity during the observation period, participant expectations, repeated exposure to the outcome measures, and other daily activities could have contributed to the observed changes. The study attempted to maintain procedural consistency by providing the same exercise protocol and supervising all sessions, but these measures do not eliminate confounding in a one group design. The participants' work and daily activities were not controlled, and the study did not include a comparison group receiving no exercise or another intervention.

The standardized intervention itself has strengths and limitations. A major strength is that all participants received the same position, technique, contraction duration, relaxation period, number of repetitions, number of sets, and number of sessions. There were no modifications during the intervention, and no individualized dose adjustment was performed. This consistency reduces variation in intervention exposure and addresses an important component of intervention reporting identified by the reviewers. The absence of progression was also explicitly documented. However, a fixed dose may not reflect the optimal training stimulus for

participants with different baseline abilities. Because the study did not individualize exercise dosage, the results should not be interpreted as evidence that this exact dose is optimal for all coffee pickers.

The study also has important limitations concerning sample size and generalizability. No a priori sample size calculation or power analysis was performed. Although all eligible members of the accessible population were included, the sample of 30 participants does not establish that the study had adequate statistical power for a prespecified effect. The very large effect sizes should therefore be interpreted with caution, particularly because uncontrolled pretest to posttest designs may produce exaggerated estimates of intervention associated change. Future studies should determine sample size prospectively and use a design capable of controlling for secular trends and other sources of bias.

Generalizability is also limited. The sample consisted exclusively of women aged 40 to 50 years who had worked as coffee pickers for at least 10 years in one rural location. The findings may therefore not apply directly to male workers, younger or older agricultural workers, coffee pickers with different occupational exposures, or workers in other regions. The study also measured outcomes immediately after the intervention period and did not include medium or long term follow up. Consequently, the persistence of the observed changes remains uncertain.

From a practical perspective, the findings suggest that a standardized Deep Neck Flexor exercise protocol may be considered for further evaluation within occupational health programs for workers who perform repeated overhead tasks. Such use should be accompanied by appropriate ergonomic measures rather than viewed as a substitute for modification of occupational exposure. Education concerning posture, work organization, and opportunities for rest may be relevant components of a broader musculoskeletal health strategy.¹⁸ However, the current study does not provide comparative evidence that exercise is superior to ergonomic modification or other physiotherapy interventions.

Future research should use a controlled design, preferably a randomized controlled trial when feasible, with prospective sample size determination and longer follow up. Additional objective outcomes such as cervical range of motion, neck muscle strength, or the Cranio Cervical Flexion Test could complement patient reported measures. Comparative intervention designs could also examine whether Deep Neck Flexor exercise alone, exercise combined with ergonomic education, or alternative exercise approaches provide different outcomes. Such studies would help determine whether the large within participant changes observed in this preliminary study can be reproduced under stronger methodological conditions.

Conclusion

In this pre-experimental one group pretest posttest study, six supervised sessions of standardized Deep Neck Flexor exercise were followed by statistically significant reductions in neck pain and neck disability among women coffee pickers in Tiworiwu 1 Village. NDI scores decreased by 24.10 points, while VRS scores decreased by 3.00 points on the right and 2.967 points on the left. The observed changes were accompanied by large Cohen's d estimates and statistically significant paired t test results. The categorical findings also showed a shift toward lower disability and milder pain after the intervention period.

These findings indicate that the standardized exercise protocol was associated with favorable within participant changes in the measured outcomes. They do not, however, establish that Deep Neck Flexor exercise alone caused the observed improvements. The absence of a control group, lack of a priori sample size calculation or power analysis, restriction of the sample to women coffee pickers in one location, absence of objective cervical measurements, and lack of longer term follow up limit causal interpretation and generalizability.

Author Contribution

Theo Fontina Kadju: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing, Original Draft, Visualization.

I Gede Arya Sena: Methodology, Supervision, Writing, Review and Editing.

Ni Luh Made Reny Wahyu Sari: Methodology, Supervision, Writing, Review and Editing.

Daryono: Supervision, Writing, Review and Editing.

Acknowledgments

The authors thank the Physiotherapy Study Program, Universitas Dhyana Pura, for providing the opportunity and support for the research. The authors also thank the Government of Tiworiwu 1 Village, Jerebuu District, Ngada Regency, and all women coffee pickers who participated in the study. The authors further acknowledge the academic supervisors, research assistants, and other individuals who supported the research and manuscript preparation.

Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

This study received no external funding.

Ethics Statement

This study was approved by the Research Ethics Committee of Universitas Dhyana Pura under Ethical Approval No. 001716 of 2026. The manuscript reports that informed consent was obtained from all participants.

References

1. Kmietowicz Z. Pension crisis: 11 medical organisations call on chancellor to find long term solution. *BMJ*. 2020;368:m719.
2. Rani B, Paul A, Chauhan A, Pradhan P, Dhillon MS. Is neck pain related to sagittal head and neck posture? A systematic review and meta-analysis. *Indian J Orthop*. 2023;57(3):371-403.
3. Divya M, Chaitanya MS, Kumar RP, Kamesh S. To compare the effectiveness of deep neck flexor exercise and cervical stabilization exercise for neck pain among bike riders. *Int J Drug Deliv Technol*. 2026;16(48s):486-490.
4. Kim HJ, Jung SO. Comparative evaluations of single-item pain-intensity measures in cancer patients: numeric rating scale vs. verbal rating scale. *J Clin Nurs*. 2020;29(15-16):2945-2952.

5. Alshehre YM, Pakkir Mohamed SH, Nambi G, Almutairi SM, Alharazi AA. Effectiveness of physical exercise on pain, disability, job stress, and quality of life in office workers with chronic non-specific neck pain: a randomized controlled trial. *Healthcare (Basel)*. 2023;11(16):2286.
6. Thomas AS, Nikhilesh A. Effects of exercise therapy on chronic neck pain: a systematic review. *Int J Sports Health Phys Educ*. 2026;8(5):134-141.
7. de Zoete RMJ. Exercise therapy for chronic neck pain: tailoring person-centred approaches within contemporary management. *J Clin Med*. 2023;12(22):7108.
8. Tsiringakis G, Dimitriadis Z, Triantafylloy E, McLean S. Motor control training of deep neck flexors with pressure biofeedback improves pain and disability in patients with neck pain: a systematic review and meta-analysis. *Musculoskelet Sci Pract*. 2020;50:102220.
9. Dar AJ, John A, Ashraf S, Faridi TA, Zahid S, Nazir AB. MRI diagnosis and grading of anterior cruciate ligament injuries. *Pak Biomed J*. 2022;5(1):341-345.
10. Alghadir AH, Iqbal ZA. Effect of deep cervical flexor muscle training using pressure biofeedback on pain and forward head posture in school teachers with neck pain: an observational study. *Biomed Res Int*. 2021;2021:5588580.
11. Osborne D, Jadhakhan F, Falla D. The effects of neck exercise in comparison to passive or no intervention on quantitative sensory testing measurements in adults with chronic neck pain: a systematic review. *PLoS One*. 2024;19(5):e0303166.
12. Saltychev M, Pylkäs K, Karklins A, Juhola J. Psychometric properties of neck disability index: a systematic review and meta-analysis. *Disabil Rehabil*. 2024;46(23):5415-5431.
13. John B, Røe C, Brox JI, Sveinall H, Ignatius J, Wilhelmsen M, et al. Responsiveness and minimal important change of neck disability index and numeric pain rating scale for neck patients in the Norwegian neck and back register. *Eur Spine J*. 2025;34(6):2219-2226.
14. Thong ISK, Jensen MP, Miró J, Tan G. The validity of pain intensity measures: what do the NRS, VAS, VRS, and FPS-R measure? *Scand J Pain*. 2018;18(1):99-107.
15. Al-Khazali HM, Al-Sayegh Z, Younis S, Christensen RH, Ashina M, Schytz HW, et al. Systematic review and meta-analysis of Neck Disability Index and Numeric Pain Rating Scale in patients with migraine and tension-type headache. *Cephalalgia*. 2024;44(8):3331024241274266.
16. Pontes-Silva A, Avila MA, Fidelis-de-Paula-Gomes CA, Dibai-Filho AV. The short-form Neck Disability Index has adequate measurement properties in chronic neck pain patients. *Eur Spine J*. 2021;30(12):3593-3599.
17. Blomgren J, Strandell E, Jull G, Vikman I, Røijezon U. Effects of deep cervical flexor training on impaired physiological functions associated with chronic neck pain: a systematic review. *BMC Musculoskelet Disord*. 2018;19(1):415.
18. Swedish Agency for Health Technology Assessment and Assessment of Social Services. Occupational exposures and complaints of neck, shoulder, arm, or hand: a systematic review. Stockholm: Swedish Agency for Health Technology Assessment and Assessment of Social Services; 2022.