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Comparing the effects of neck stabilization exercises versus dynamic exercises among patients having nonspecific neck pain with forward head posture: a randomized clinical trial

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Abstract

Background Nonspecific neck pain (NSNP) is a well-established global burden affecting. It is also a common problem in Pakistan. The burden of neck pain is also increasing day by day due to poor work ergonomics, and increased use of computers and mobiles after the pandemic. An individual's poor posture is often associated with forward head posture (FHP). Limited evidence is available about the effects of neck stabilization (NSE) and dynamic exercises (NDE) for nonspecific neck pain particularly in patients with FHP. This aimed to compare the effects of NSE versus NDE among patients having NSNP with FHP in reducing pain, disability, forward head posture and improving neck range of motion.

Methods It is a single-blinded randomized clinical trial with 60 patients aged 18–40 years, with moderate intensity NSNP for > 3 weeks and < 6 months along with FHP with a moderate disability on neck disability index (NDI) randomly assigned to the treatment groups. Group 1 was doing NSE and group 2 was doing NDE. Transcutaneous Electical Nerve Stimulation, cold packs, and stretching exercises were given to both groups. A total of 9 sessions (3 sessions/ week) were given to participants. NDI questionnaire, Visual analogue scale (VAS), goniometry, and plumb line measurement tool were used as baseline and assessment at the end of 3rd week. The data was analyzed on SPSS version 21. Descriptive analysis was performed. Independent t-test was used for between group comparison and paired t-test used for within group comparison. A p-value less than 0.05 was considered statistically significant.

Results After treatment within-group analysis of both NSE and NDE showed significant ($p < 0.001$) improvement in pain on VAS, all ROMs of the neck including flexion, extension, left and right lateral flexion and left rotation, plumb line and NDI score with very large effect size. However, between-group analysis showed non-significant differences ($p > 0.05$) for post-treatment mean VAS, neck ROM, NDI and plumb line measurement.

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Conclusion Between NSE and NDE, no one is more beneficial than another. Both are equally effective in alleviating pain, increasing ROM, decreasing functional disability, and improving forward head posture in patients with NSNP.

Trial Registration Registered trial at ClinicalTrials.gov Identifier: NCT05298631, 28/03/2022, prospectively registered.

Keywords Isometric exercises, Isotonic exercises, Nonspecific neck pain

Background

Nonspecific neck pain (NSNP) is a major health condition in society causing serious debility throughout the world. The NSNP is neck pain without any precise cause [1]. NSNP affects 30–50% of the general population and often causes severe disability [2]. According to the World Health Organization, musculoskeletal (MSK) disorders are problems of muscles, tendons, joints, intervertebral discs, peripheral nerves and the vascular system [3]. Neck pain is defined as a painful sensation in the neck region which is sometimes presented clinically as, tension, or fatigue that may radiate towards head, shoulder, elbow, and even wrist [4]. In terms of global burden, neck pain is the 4th most common MSK condition that causes disability and ranked 21st in a total of 291 conditions [5]. Less than half of the people at any point in their lifetime experience neck pain [6].

In the COVID-19 pandemic due to prolonged sitting, there is an increase in MSK pains with the highest percentage of neck pain at 32% [7]. There is also an increase in neck pain due to laptop and smartphone use in lockdown due to the pandemic [8]. It is commonly observed that neck pain is often associated with the forward head posture (FHP). A FHP commonly known as "hunched upper back" is characterized by rounded shoulders and upper back with an anteriorly inclined neck with hypo flexed lower cervical spine and hyperextended upper cervical spine. In FHP there is also recruitment of accessory muscle [9]. According to the Global Burden of Disease (GBD) Study, in people in their twenties neck pain and low back pain are the second most common causes of disability in a lifetime and prevalence is increasing day by day, with around 21% increase from 2006 to 2016 [10]. Women are more affected than men [11]. Evidence supports the use of neck stabilization exercises (NSE) to reduce the pain in people with insidious neck pain [12]. Stabilization exercises comprise exercises that activate the deep muscles and decrease the over-activity of the superficial muscles [13]. Studies have reported that muscle weakness leads to the activation of accessory muscles that disrupt the normal movement pattern, and neck stabilization exercises decrease the over-activity of these muscles, which restores and facilitates postural control [14]. Strength training and isometric exercises are found to be effective in decreasing neck pain symptoms. Conversely, NSE was introduced as a rehabilitation program for pain management, improved function, and injury prevention [15]. According to the American Physical Therapy Association, clinical practice guidelines exercise therapy like mobilizations and NSE, neck dynamic exercise (NDE) laser therapy, and stabilization with the short-term use of a cervical collar may be provided as treatment options [16]. Among MSK problems, neck pain and FHP stand foremost rising issues with the world moving to work from home and online. Furthermore, according to authors' knowledge the NSE and NDE has been compared in literature but is not evident with limited comparison in neck pain associated with postural deficit. Therefore, identifying which particular exercise is effective in improving pain and posture is going to help patients get the best treatment. These exercises can be followed at home and workplace too so the patient can easily perform self-directed exercises which may reduce their hospital re-visit due to neck pain also, providing the most effective treatment is going to reduce the overall cost of treatment helping organization at a larger scale. This study also helps future researchers to focus on other aspects of treatment that were not explored in this study. So, this study was to compare the effects of NSE versus NDE among patients having NSNP with FHP in reducing pain, disability, FHP, and improving neck range of motion (ROM).

Methodology

Study design and setting

This is a two-arm, parallel-designed, and randomized clinical trial conducted at Sindh Institute of Physical Medicine and Rehabilitation, Karachi, Pakistan with a group allocation ratio of 1:1. The duration of the study was from April 2022 to January 2023.

Inclusion and exclusion criteria

Individuals included in the study were patients of age range from 18 to 40 years [16] having NSNP for more than 3 weeks to <6 months [17] along with FHP on plumb line measurement tool and with moderate intensity pain on Visual analogue scale (VAS) 3.5–7.4 cm [18] and moderate disability on neck disability index (NDI) questionnaire score (50–64%) [19].

However, the participants with a history of any accident (whiplash), vertebral fracture, tumor, previous surgery, psychological disorders etc. and participants unwilling to participate are excluded.

Sampling technique and sample size estimation

A sample size of 60 patients (30 in each group) was considered on the basis of non-probability, purposive sampling. The sample size was calculated using PASS software version 11. Group sample sizes of 10 and 10 achieve 83% power to detect a difference of 1.8 and with a significance level (alpha) of 0.05 using a two-sided two-sample t-test. The mean ± SD of visual analogue scale scores of the relevant article used for sample size calculation were 4.48 ± 1.38 in the neck stabilization plus dynamic exercises group and 2.66 ± 1.27 in the NSE group [4].

Randomization and envelope concealment

A physician with more than 13 years of experience screened the patients for study criteria to enroll in the study. Randomization was done by a computer-generated online randomizer (https://www.sealedenvelope.com) for a sample size of 60 for NSE group and NDE group. An independent statistician performed this. The outcome assessor (physician) assessed study outcomes before and after the intervention and was blinded to the treatment allocation. The participants and intervention providers could not be blinded due to the nature of the treatment.

Data collection procedure

All the participants were randomized into two groups after screening for NSNP which was conducted by a consultant physician through detailed history taking, aided by a screening proforma. This process aimed to rule out potential causes of neck pain, through x-ray as diagnostic imaging, prior to enrolling patients. All participants filled informed consent before randomization. Group one received stabilization exercises and group two received dynamic exercises. Neck stretching exercises and pain modalities were given to both groups. Participants were assessed before and after treatment. VAS, NDI questionnaire, goniometry, and plumb line assessment were used for the assessment of pain intensity, functional disability, ROM and FHP respectively. The treatment was provided by a qualified physiotherapist with more than two years of clinical experience. The data was analyzed statistically for its significance. The CONSORT flow diagram is also given (Fig. 1).

Consent form and questionnaire

A very concise consent form was provided to all participants before enrollment. It contains the possible harms and benefits of the study. The participants are informed

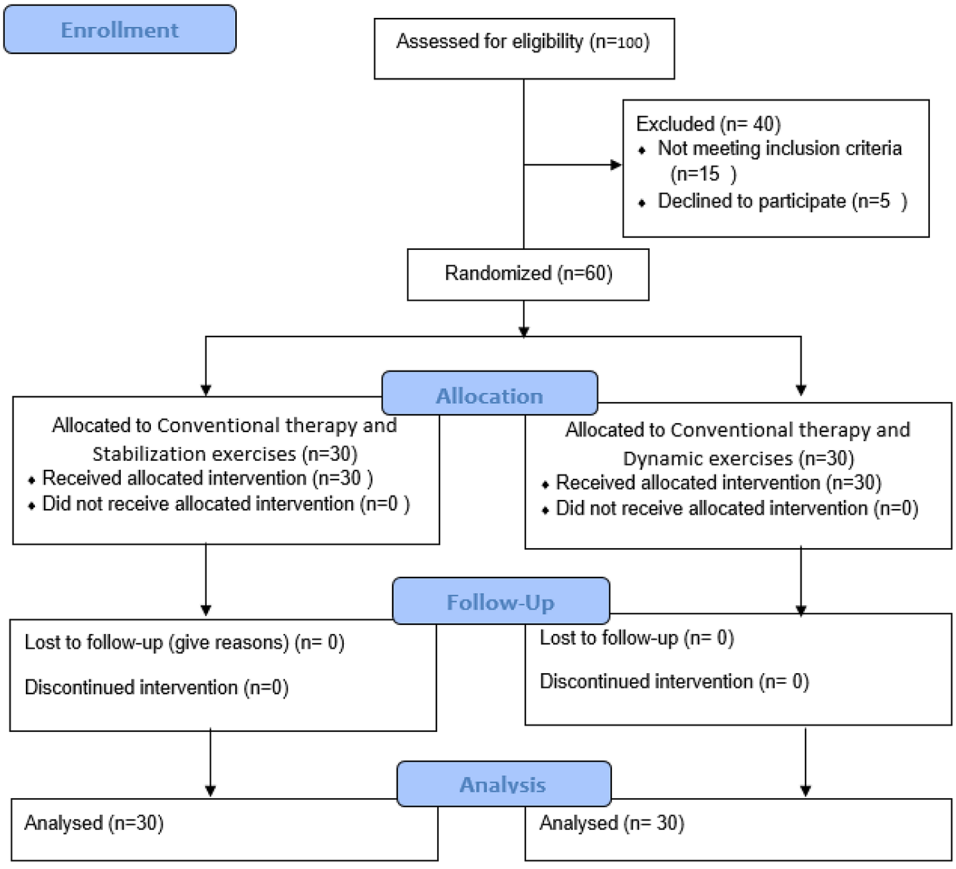

Fig. 1 The Consort flow diagram

Fig. 2 Chin tuck

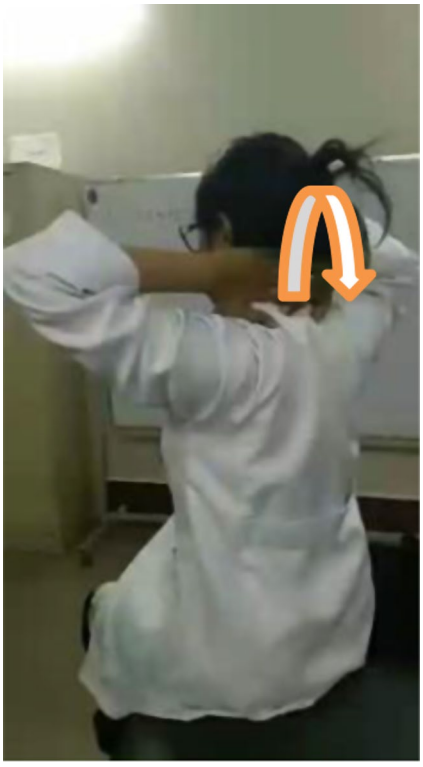

Fig. 3 Cervical extension

about confidentiality and their voluntary participation and the treatment was free of cost. The participant was informed about the objective of the research and the treatment provided. English and Urdu versions of the NDI questionnaire were used for the assessment of participants. The licensed version is used by the investigator and permission was granted by the MAPI research trust.

Ethical considerations

The research was approved by the Institutional Review Board (IRB) of Dow University of Health Sciences (DUHS) ref: IRB-2391/DUHS/Approval/2022/731.

Intervention

Treatment group 1 was provided with NSE and treatment group 2 was provided with NDE along with Conventional treatment; transcutaneous electrical nerve stimulation (TENS) [20], Comfy Stim: Model EV-806 (10 min of electrical stimulation was given with a pulse rate of 80 to 120 Hz and pulse width of 200uS in normal mode). Electrode 1 A: right side of posterior neck. Electrode 1B: left side above scapula. Electrode 2 A: left side of posterior neck Electrode 2B: right side above scapula, MEDICARE reusable hot/cold pack (20 minutes of cryotherapy will be given after therapy) [20] on the posterior aspect of neck and shoulders, cervical muscle stretching was provided to both treatment groups. The patient sitting at the edge of the couch comfortably facing forward for all self-stretch. For trapezius participant performed contralateral lateral bending with the help of the opposite hand to touch the shoulder with the earlobe [21]. For the right side Pectoralis minor the participant's right forearm was stabilized from the front by vertical plane the trunk is then rotated in the left direction. Movement was external rotation and abduction to 90°. For the right side sternocleidomastoid participant touched the left shoulder with the left ear by rotating the neck upward toward the ceiling and the stretch felt on the right side, applying pressure from the other hand. The movement was lateral flexion and rotation. For the right side levator scapulae, participant touched the left shoulder with the left ear by rotating the neck downward towards the ground and the stretch felt at the right side and applied pressure from the other hand. The movement was lateral flexion and rotation [22]. Participant kept each stretch for 10 s and 5 reps for each side of the muscle.

NSE included Chin tuck (patient pulled back the chin towards the body while maintaining gaze; Fig. 2), Cervical extension (patient extended the neck as far as possible while supporting the neck from the back with both hands; Fig. 3), Shoulder shrugs (patient shrugged the shoulders; bringing them up towards the ears; Fig. 4), Shoulder rolls (patient rolled the shoulders in the circle, clockwise and anticlockwise; Fig. 5), Scapular retraction (participant brings both scapulae towards the midline; Fig. 6) All exercises were performed in sitting a position

Fig. 4 Shoulder shrugs

Fig. 5 Shoulder rolls

Fig. 6 Scapular retractions

with a frequency of 15 repetitions 1 set with relaxation [4].

NDE included the usage of a Thera band with increasing resistance. It included cervical extension-dynamic. The participant's position was upright sitting. The participant extended their neck, then held it for 5 s and slowly returned to the neutral position, using a Thera band to maintain an erect posture throughout the exercise (Fig. 7). Cervical Flexion-Dynamic isometric in upright sitting the participant flexes their neck, then held it for 5 s and slowly returns to the neutral position (Fig. 8), using Thera band to maintain erect posture throughout the exercise and Chest flies exercises in standing position the participant grip the Thera-band at the level of his or her shoulders with the elbows in extension and pulled the bands with both hands toward each other hands and then returned slowly (Fig. 9). The frequency of exercise was 15 per 1 set [4].

Fig. 7 Cervical extension-dynamic isometric

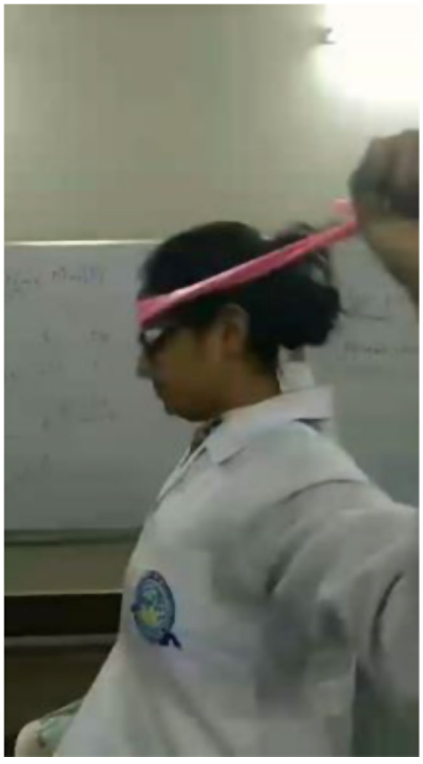

Fig. 8 Cervical flexion-dynamic isometric

Fig. 9 Chest fly's exercises

Treatment group 1	Treatment group 2
• TENS, stretching exercises of the neck, cold packs. • Stabilization exercises 1) Chin tuck 2) Cervical extension 3) Shoulder shrugs 4) Shoulder rolls 5) Scapular retraction	• TENS, stretching exercises of the neck, cold packs. • Dynamic exercises. 1) Cervical extension-dynamic isometric. 2) Cervical Flexion-Dynamic isometric. 3) Chest flies exercises.
Treatment time per session: 45 min [4]	
Duration of treatment: 3 weeks	
3 visits per week total of 9 sessions [19].	
Follow up	
Results were evaluated before and after treatment for both treatment groups first initially at baseline and then after 3 weeks of treatment.	

Outcome measures

The VAS was used for pain intensity, NDI for disability, goniometry for ROM, and plumb line assessment for FHP. All the outcome measures were primary.

Neck disability index questionnaire (NDI)

It is a validated tool that has been widely used in assessing disability in individuals with neck pain. It is available

in multiple languages. The NDI-Urdu version has also high reliability and validity [23]. It is also found to be effective with VAS and other pain scales. It is a ten-item questionnaire. Each item scores from 0 no disability to 5 complete disability (6 responses) total score of 0–50. 4 or less indicates no, 4–15 mild, 15–25 moderate, 25–35 severe and more than 35 is complete disability [18].

Visual analogue scale (VAS) for pain

VAS is a validated tool used for assessing pain. It is a subjective measure used for both acute and chronic pain. It is a 10 cm straight line. One side of the straight line is minimum/no pain and the other side is worst pain from left to right. The patient marks his/her pain on the line. The score is assessed by the therapist. 0–3.4 cm is mild, 3.5–7.4 cm is moderate and 7.5–10 cm on a 10 cm line is considered severe pain [24].

Goniometry

Goniometry has excellent intra-rater reliability for the measurements of ROM [18]. Measurements of all the ranges were assessed in a sitting position (for flexion and extension, the center of the goniometer was placed over the external auditory meatus stationary arm was placed straight point the toward ceiling and the moving arm moved in the direction of flexion and extension following the nose. For lateral flexion, the center of the goniometer was placed over the C7 spinous process stationary arm placed straight point toward the ceiling and the moving arm moved in the direction of side-flexion from the midline and for rotation, the center of the goniometer was placed over the center of the head from above and the moving arm moves in the direction of rotation following nose.) [25].

Plumb line measurement

The plumb line is an inexpensive and easy to use measurement tool. It has a high inter-rater reliability for measuring postural deviations. Head and shoulder landmarks are used for reference (mastoid process and auditory meatus). Head and shoulder alignment was assessed using a plumb line as a reference line for ideal head posture. Any forward Deviation of the tragus of the ear from the ideal plumb line is considered as FHP [26]. It was measured through the measuring scale in inches. This deviation can be subjectively assessed as a slight deviation, moderate deviation, or marked deviation in inches on the scale [27]. It is performed in both standing and sitting.

Harms and adverse events

No harm or any adverse event was reported during the period of trial.

Data analysis procedure

Data was entered and analyzed by IBM-SPSS 21, and mean and SD was calculated for quantitative variables like age (years), height (cm), weight (Kg), Body Mass Index (BMI) (Kg/m2), marital status (single, married, divorced), irritability (present/absent), severity (mild, moderate, severe). Counts with percentages given for gender (male, female), and occupations, means and SD were also given for studied parameter VAS (pain intensity), NDI questionnaire (functional disability), Goniometry (ROM) and plumb line assessment tool (FHP) scores in both groups NSE and NDE. Paired sample t-test is used to compare these parameters within groups and independent sample t-test is used to compare between-group outcomes post treatments. A P-value less than 0.05 is considered statistically significant. The normality of all outcome measures was measured with the Shapiro-Wilk test p-value >0.05 is considered as significant. Graphical representation of the data set is by bar diagrams and pie charts.

Results

Among all study participants ($n=60$), there were mostly females [47(78.33%)] and only 13(21.67%) were males with total mean age of 30.08±6.35 years, mean height of 161.23±9.09 cm, mean weight of 61.2±13.19 kg and mean BMI of 23.63±4.39 kg/m^2. All the participants had moderate pain intensity. Most of the participants [57(95%)] had no irritability and only 3(5%) had irritability. About half of the participants [30(50%)] were married, 28(46.67%) were unmarried and only 2(3.33%) participants were divorced (Table 1).

The baseline data analysis for comparison of gender, irritability, marital status (Table 1), occupation, age, height, weight, body mass index, VAS, neck range of motions, plumb line and NDI between groups showed no statistically significant differences ($p>0.05$) between both groups (Table 2).

The within group analysis of both groups for mean VAS (0–10 cm) showed significant ($p<0.001$) pain improvement after treatment with a very large effect size and no zero value in a 95% confidence interval there is almost approximately 2/3rd decrease in pain within both groups (Table 3).

Table 4 shows significant ($p<0.001$) improvement in all range of motions of the neck including flexion, extension, left and right lateral flexion and left and right rotation with a large effect size and no zero value in 95% confidence interval of difference.

The within group analysis of both groups for the mean plumb line showed significant ($p<0.001$) improvement after treatment with a very large effect size and no zero value in 95% confidence interval of difference, approximately 1/3rd decrease within both groups (Table 5).

Table 1 Frequency and percentages of the baseline characteristics ($N=60$)

variables	Group 1: ($n=30$)	Group 2: ($n=30$)	*P* value	total ($n=60$)
Age (Years) [a]	30.33 ± 6.68	29.83 ± 6.1	0.763	30.08 ± 6.35
height (cm)	162.93 ± 10.78	159.53 ± 6.77	0.150	161.23 ± 9.09
Weight (Kg) [a]	62.03 ± 14.62	60.38 ± 11.79	0.632	61.2 ± 13.19
body mass index (kg/m^2)	23.32 ± 4.63	23.95 ± 4.19	0.583	23.63 ± 4.39
VAS (0–10) [a]	5.9 ± 0.92	6 ± 1.11	0.706	5.95 ± 1.01
Neck flexion (degree)	62.7 ± 9.12	62.23 ± 16.19	0.891	62.46 ± 13.03
Neck extension	52.43 ± 14.9	56.9 ± 14.65	0.246	54.66 ± 14.82
Neck left lateral flexion	50.46 ± 11.33	46.8 ± 10.26	0.194	48.63 ± 10.87
Neck right lateral flexion	48.8 ± 10.21	46.16 ± 10.01	0.317	47.48 ± 10.11
Neck left rotation	66.7 ± 12.05	70.5 ± 8.7	0.166	68.6 ± 10.59
Neck right rotation	65.93 ± 10.75	70.9 ± 9.98	0.068	68.41 ± 10.58
Plumb line (inches)	1.52 ± 0.38	1.41 ± 0.4	0.284	1.47 ± 0.39
NDI (%)	54.2 ± 3	55.65 ± 5.01	0.179	54.92 ± 4.16

[a]Values are mean ± standard deviation, *level of significance using independent t-test

Table 2 Mean and standard deviation of the baseline characteristics ($N=60$)

Variables		Group 1[a] ($n=30$)	Group 2[a] ($n=30$)	*P* value	total ($n=60$)
Gender	Male	9(69.2)	4(30.8)	0.209	13 (21.7)
	Female	21(44.7)	26(55.7)		47 (78.3)
Irritability	Absent	30(52.6)	27(47.4)	0.237	57(95)
	Present	0(0)	3(100)		3(5)
marital status	married	16(53.3)	14(46.7)	0.135	30(50)
	unmarried	12(42.9)	16(57.1)		26(46.7)
	divorced	2(100)	0(0)		2(3.3)

[a]Values are frequency (percentage), *level of significance using chi square t-test

Table 3 Comparison of pain intensity (VAS) within groups

Variables	At baseline [b]	Post treatment [b]	Mean difference (95% CI)	d	*P* value*
VAS (0–10 cm)					
Group 1	5.90 ± 0.92	1.66 ± 1.68	4.23 (3.69,4.76)	2.95	< 0.001
Group 2	6 ± 1.11	1.43 ± 1.73	4.56 (3.91, 5.22)	2.6	< 0.001

CI: Confidence Interval, *d*: effect size, VAS: visual analogue scale

[b]Values are mean ± standard deviation, *level of significance using paired sample t-test

Table 6 shows significant ($p<0.001$) improvement in the neck disability index score with a very large effect size and no zero value in the 95% confidence interval of the mean difference. There is more than 1/3rd mean neck disability index score improvement.

However, the between group analysis showed a non-significant difference ($p>0.05$) for post-treatment mean VAS and all neck range of motions including flexion, extension, left and right lateral flexion and left rotation. The null hypothesis fell within the 95% confidence interval of the mean difference of all variables (Table 7).

The between group analysis for mean plumb line measurement and NDI also showed a non-significant difference ($p>0.05$) after treatment. The null hypothesis fell within the 95% confidence interval of the mean difference of all variables (Table 8).

Discussion

The study was conducted to evaluate the effectiveness of the neck NSE and neck dynamic exercises in improving pain, neck ROM and functional ability in patients with neck pain it also evaluates the effect of exercises in normalizing forward head posture using VAS as a tool to assess pain improvement whereas NDI questionnaire, goniometry and plumb line measurement tool are used to assess the functional ability, ROM and forward head posture respectively.

The results of the study showed that in both groups NSE and NDE, There was a marked improvement in pain on VAS from baseline to after the 9th session and the functional status of the patient also improved after 3 weeks of treatment. ROM of the neck is increased in all ranges in both groups NSE and NDE as well as the head posture is normalized.

Numerous research has shown that females are more prone to head and neck pain and injury as compared to males due to their anthropometric differences like the anatomy of the neck (smaller head and shorter neck length), muscle strength (less than males), arthokinemetics (differences in vertebral dimensions) [28]. Due to the high prevalence of neck pain in females this study also has more females (78.33%) than males (21.67%).

Most of the participants in the study are housewives (30%) the second highest number of individuals consists of students (20%) due to the increased use of computers for online education during the COVID-19 pandemic. Their prolonged computer use and forward bending of the neck lead to the tightness of the anterior neck muscle causing neck pain, fatigue, and discomfort [29]. There was also a large number of physiotherapists (15%) participants. According to the literature, healthcare professionals especially physical therapists are at increased risk of work-related MSK disorder because of their work routine and among all kinds of WRMDs neck pain is very frequently reported (44.1%) [30]. The rest of the participants belong to multiple professions including teaching, government jobs, private jobs, etc.

VAS scoring is a subjective measurement of pain on a scale of 0–10 cm. In this study, a 2/3rd decrease in pain

Table 4 Comparison of neck range of motion within groups

Variables	At baseline [b]	Post treatment [b]	Mean difference (95% CI)	d	*P* value*
Flexion ROM (degree)					
Group 1	62.70 ± 9.12	73.46 ± 9.30	-10.76 (-13.85,-7.68)	-1.3	< 0.001
Group 2	62.23 ± 16.19	73.3 ± 14.02	-11.06 (-14.84, -7.28)	-1.09	< 0.001
Extension ROM (degree)					
Group 1	52.43 ± 14.90	64.83 ± 13.65	-12.4 (-15.65,-9.14)	-1.42	< 0.001
Group 2	56.9 ± 14.65	69.83 ± 13.4	-12.93 (-17.14, -8.71)	-1.14	< 0.001
Neck Left lateral flexion ROM (degree)					
Group 1	50.46 ± 11.33	62.96 ± 10.14	-12.5 (-15.19,-9.8)	-1.73	< 0.001
Group 2	46.80 ± 10.26	60.53 ± 9.25	-13.73 (-16.6, -10.85)	-1.78	< 0.001
Right lateral flexion ROM (degree)					
Group 1	48.80 ± 10.21	61.70 ± 10.44	-12.9 (-15.81,-9.98)	-1.65	< 0.001
Group 2	46.16 ± 10.01	59.63 ± 9.89	-13.46 (-17.44, -9.48)	-1.26	
Left rotation ROM (degree)					
Group 1	66.70 ± 12.04	75.56 ± 10.95	-8.86 (-11.61,-6.12)	-1.2	< 0.001
Group 2	70.5 ± 8.7	81.03 ± 9.09	-10.53 (-12.96, -8.1)	-1.62	< 0.001
Right rotation ROM (degree)					
Group 1	65.93 ± 10.75	76.60 ± 9.55	-10.66 (-13.37, -7.96)	-1.47	< 0.001
Group 2	70.9 ± 9.98	83.16 ± 8.72	-12.26 (-14.74, -9.78)	-1.84	< 0.001

CI: Confidence Interval, *d*: effect size, ROM: Range of motion

[b]Values are mean ± standard deviation, *level of significance using paired sample t-test

Table 5 Comparison of forward head posture within groups

Variables	At baseline [b]	Post treatment [b]	Mean difference (95% CI)	d	*P* value*
Plumb Line (Inches)					
Group 1	1.52 ± 0.38	1.06 ± 0.32	0.46 (0.37, 0.54)	2	< 0.001
Group 2	1.41 ± 0.4	0.94 ± 0.39	0.47 (0.38, 0.56)	1.95	< 0.001

CI: Confidence interval, *d*: effect size,

[b]Values are mean ± standard deviation, *level of significance using paired sample t-test

Table 6 Comparison of neck disability within groups

Variables	At baseline [b]	Post treatment [b]	Mean difference (95% CI)	d	*P* value*
NDI (%)					
Group 1	54.20 ± 3.00	9.94 ± 8.86	44.25 (41.48, 47.03)	5.97	< 0.001
Group 2	55.65 ± 5.01	8.21 ± 8.59	47.44 (43.87, 51)	4.96	< 0.001

CI: Confidence Interval, *d*: effect size, NDI: Neck disability index

[b]Values are mean and standard deviation, *level of significance using paired sample t-test

is found in the within-group analysis of both groups NSE and NDE. The mean difference of group 1 NSE is 4.23 and the mean difference of group 2 NDE is 4.56. MCID value of VAS for neck pain is 4.6 [31] the VAS is found to be clinically significant. This may be due to the mechanism through which exercises reduce pain i.e., it is believed that intense exercises enhance activity in the motor pathways causing an inhibitory effect on the pain center present in central nervous system (CNS). Also, the contraction of muscles strains different connective tissues stimulating mechanoreceptors thereby increasing the activity of sensory nerves which inhibits the pain mediating pathways [4]. Cervical NSE has also shown significant improvement in pain by enhancing the control of deep cervical muscles [32]. These results are the same as the previous studies but there is no statistical significance was found in between group analysis of VAS. The mean difference between groups is -0.1 which is contradictory to the previous evidence in which NSE are found to be more effective than dynamic exercises [4].

Table 7 Comparison of post-treatment pain intensity and neck range of motions between groups

Variables	Group 1 [b]	Group 2 [b]	Mean difference (95% CI)	*P* value*
VAS score (0–10 cm)	1.66 ± 1.68	1.43 ± 1.73	-0.1(-0.62, 0.42)	0.706
Neck flexion ROM (degree)	73.47 ± 9.3	73.3 ± 14.04	0.46(-6.36, 7.30)	0.891
Neck extension ROM (degree)	64.83 ± 13.65	69.83 ± 13.4	-4.46(-12.1, 3.17)	0.246
Neck Left lateral flexion ROM (degree)	62.96 ± 10.14	60.53 ± 9.25	3.66(2.79, -1.92)	0.194
Neck right lateral flexion ROM (degree)	61.7 ± 10.44	59.63 ± 9.89	2.63(-2.59, 7.86)	0.317
neck Left rotation ROM (degree)	75.56 ± 10.96	81.03 ± 9.09	-3.80(-9.22, 1.63)	0.166
neck right rotation ROM (degree)	76.6 ± 9.55	83.16 ± 8.72	-4.96(-10.32, 0.39)	0.068

CI: Confidence Interval, VAS: visual analogue scale, ROM: Range of motion

[b]Values are mean and standard deviation, * level of significance using independent t-test

Table 8 Comparison of post-treatment plumb line and NDI between groups

Variables	Group 1 [b] (*n* = 30)	Group 2 [b] (*n* = 30)	Mean difference (95% CI)	*P* value*
Plumb Line (Inches)	1.06 ± 0.32	0.94 ± 0.39	0.12(-0.06, 0.3)	0.191
NDI (%)	9.94 ± 8.86	8.21 ± 8.59	1.73(-2.77, 6.24)	0.445

CI: Confidence Interval, NDI: Neck disability index

[b]Values are mean and standard deviation, * level of significance using independent t-test

In this study, more than 1/3rd improvement in NDI is seen in within group analysis of both groups NSE and NDE. The mean difference of group 1 NSE is 44.25 and the mean difference of group 2 NDE is 47.44. This may be due to the effect of exercises on the MSK system, CVS, immune system, CNS, and other brain functions like mood, sleep, etc. Exercise is also beneficial in improving mobility and flexibility of different structures as well as increasing strength and endurance of muscles and also prevents injury by improving tensile strength of capsule and ligaments hence, providing both physical and mental benefits. Previous studies suggest that these benefits are more with stabilization exercises [4] but in this study, there is no statistical significance was found in between group analysis of NDI. The mean difference between groups is 1.73. That may be because dynamic exercises were also found to be much more effective in treating neck pain and disability as compared to other exercises i.e., isometric exercises [13].

Literature has suggested that ROM has a strong relation with neck disorders. Poor posture results in muscle imbalance and reduces the strength of cervical muscles. However, performing NSE leads to improved posture and restoring balance resulting in increased ROM [33]. In this study ROM improvement (in all ranges flexion, extension, left and right rotation, left and right lateral flexion) is seen in within group analysis of both groups NSE and NDE (p-value: <0.001) for all ranges which is consistent with previous literature that shows there is increased ROM in all ranges due to stabilization exercises [32, 33] This was thought to be due to normalization of straight neck and normalization of muscle asymmetry [33]. Dynamic exercises are also found to be effective in maintaining the flexibility of joints, muscles, ligaments, and capsules resulting in increased joint movement [13]. There is no statistical significance was found in between group analysis of ROM. there are limited studies that show the comparison between NSE and NDE exercises in improving ROM.

The FHP is associated with neck pain, stiffness, and fatigue because of overloading of the cervical spine these patients present with tightening of cervical extensors and weakness of scapular retractors [9]. There is a 1/3rd improvement seen in within group analysis of both groups NSE and NDE plumb line measurement. The mean difference of group 1 NSE is 0.46 and the mean difference of group 2 NDE is 0.47. This is consistent with the studies that show that the NSE affects deep cervical muscles of the neck restoring strength of the cervical muscles and improving postural alignment. The NSE is beneficial in improving the strength and endurance of spinal stabilizers which helps in reducing pain and improves cervical function [9] Also dynamic exercises affect pain and neck alignment by increasing the strength of deep neck flexor muscle [34]. There is no statistical significance found in the between-group analysis of plumb line measurement. The mean difference between groups is 0.12. However, there is a lack of composite research showing a comparison between NSE and NDE in treating FHD along with nonspecific neck pain.

Limitations:

This study is limited to only physical disability, and psycho-social aspects of disability were not considered. There was no control group in the study because the objective of the study is to compare the two different interventions however, all the confounding factors are controlled as per consort guidelines. The assessment is done manually by goniometry and plumb line assessment so there are chances of manual error however to overcome the chances of error average values were taken.

Conclusion

It is concluded no one of the two treatments is more beneficial than the other. Both NSE and neck dynamic exercises are equally efficient in alleviating pain, decreasing functional disability, and improving ROM and FHP. Therefore, both NSE and NDE are equally beneficial to use with conventional treatment for providing better results in patients with NSNP with FHP.

Abbreviations

CNS	Central nervous system
ROM	Range of motion
FHP	Forward head posture
MSK	Musculoskeletal
NSNP	Nonspecific neck pain
NSE	Neck stabilizing exercises
NDE	Neck dynamic exercises
NDI	Neck disability index
TENS	Transcutaneous electrical nerve stimulation
VAS	Visual analog scale

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Author contributions

AB, RRS, AAMB: Substantial contribution to conception and design. AB, AAMB: Acquisition of data. AB, RRS, AAMB: Analysis and interpretation of data. AB, AAMB: Drafting of the manuscript. AB, RRS, AAMB: Critical revision of the manuscript for important intellectual content. All authors have read and approved the final manuscript.

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Data availability

The data is available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study followed the Declaration of Helsinki. Ethical Approval was obtained from the Institutional Review Board (IRB), Dow University of Health and Sciences (DUHS) with ref: IRB-2391/DUHS/Approval/2022/731. The study protocol was prospectively registered on ClinicalTrials.gov Identifier: NCT05298631, 28/03/2022. An informed consent form was signed by patients before they participated in the study.

Consent for publication

Written informed consent was obtained from patient and/or their legal guardians for publication of identifying information/images in an online open-access publication.

Competing interests

The authors declare no competing interests.

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References

1. Gautam R, Dhamija JK, Puri A, Trivedi P, Sathiyavani D, Nambi G. Comparison of Maitland and Mulligan mobilization in improving neck pain, ROM and disability. Int J Physiother Res. 2014;2(3):561–6.
2. Sbardella S, La Russa C, Bernetti A, Mangone M, Guarnera A, Pezzi L et al. Muscle energy technique in the rehabilitative treatment for acute and chronic non-specific neck pain: a systematic review. In Healthcare 2021 Jun 17 (Vol. 9, No. 6, p. 746). MDPI.
3. Ijaz A, Khan I, Ahmed A, Sadiq S. Frequency of neck pain among dentists. Pakistan Orthodontic J. 2016;8(2):89–93.
4. Kaka B, Ogwumike OO. Effect of neck stabilization and dynamic exercises on pain, disability and fear avoidance beliefs in patients with non-specific neck pain. Physiotherapy. 2015;101:e704.
5. Hoy D, March L, Woolf A, Blyth F, Brooks P, Smith E, et al. The global burden of neck pain: estimates from the global burden of disease 2010 study. Ann Rheum Dis. 2014;73(7):1309–15.
6. Khalid FA, Amjad FA, Ashfaq Ahmad SA, Hanif MK. Frequency of neck pain due to school bag usage among students of public high schools in Lahore, Pakistan. Pakistan Pediatr J. 2018;42(3):207–11.
7. Akulwar-Tajane I, Darvesh M, Ghule M, Deokule S, Deora B, Mhatre V. Effects of COVID-19 pandemic lock down on posture in physiotherapy students: a cross-sectional study. Med Clin Res. 2021;6(1):91–102.
8. Taneja A. Effects of work-from-home use laptop or mobile phone causing text neck syndrome during the quarantine period COVID-19. Int J Sci Dev Res. 2021;2(6):54–7.
9. Pawaria S, Sudhan D, Kalra S. Effectiveness of cervical stabilisation exercises on respiratory strength in chronic Neck Pain patients with Forward Head Posture-A pilot study. J Clin Diagn Res. 2019;13:6–9.
10. Jahre H, Grotle M, Smedbråten K, Dunn KM, Øiestad BE. Risk factors for non-specific neck pain in young adults. A systematic review. BMC Musculoskelet Disord. 2020;21(1):1–2.
11. Palacios-Ceña D, Albaladejo-Vicente R, Hernández-Barrera V, Lima-Florencio L, Fernández-de-Las-Peñas C, Jimenez-Garcia R, López-de-Andrés A, de Miguel-Diez J, Perez-Farinos N. Female gender is associated with a higher prevalence of chronic neck pain, chronic low back pain, and migraine: results of the Spanish National Health Survey, 2017. Pain Med. 2021;22(2):382–95.
12. Sowmya MV. Isometric neck exercises versus dynamic neck exercises in chronic neck pain. IOSR J Nurs Health Sci. 2014;3:32–43.
13. Celenay ST, Akbayrak T, Kaya DO. A comparison of the effects of stabilization exercises plus manual therapy to those of stabilization exercises alone in patients with nonspecific mechanical neck pain: a randomized clinical trial. J Orthop Sports Phys Ther. 2016;46(2):44–55.
14. Im B, Kim Y, Chung Y, Hwang S. Effects of scapular stabilization exercise on neck posture and muscle activation in individuals with neck pain and forward head posture. J Phys Therapy Sci. 2015;28(3):951–5.
15. Nichol E. Neck stabilization exercises compared to physical therapy modalities to decrease insidious neck pain in adults treated in an outpatient setting.
16. Blanpied PR, Gross AR, Elliott JM, Devaney LL, Clewley D, Walton DM, Sparks C, Robertson EK, Altman RD, Beattie P, Boeglin Eshi. Neck pain: revision 2017: clinical practice guidelines linked to the international classification of functioning, disability and health from the orthopaedic section of the American Physical Therapy Association. J Orthop Sports Phys Therapy. 2017;47(7):A1–83.
17. Silva AG, Punt TD, Sharples P, Vilas-Boas JP, Johnson MI. Head posture assessment for patients with neck pain: is it useful? Int J Therapy Rehabilitation. 2009;16(1):43–53.
18. Siddiqui M, Akhter S, Baig AA. Effects of autogenic and reciprocal inhibition techniques with conventional therapy in mechanical neck pain–a randomized control trial. BMC Musculoskelet Disord. 2022;23(1):704.
19. Bernal-Utrera C, González-Gerez JJ, Saavedra-Hernandez M, Lérida-Ortega MÁ, Rodríguez-Blanco C. Manual therapy versus therapeutic exercise in non-specific chronic neck pain: study protocol for a randomized controlled trial. Trials. 2019;20(1):487.
20. Demir Y. Non-pharmacological therapies in pain management. In Pain management-current issues and opinions. 2012 Jan 18. Intech Open.
21. Park KN, Ha SM, Kim SH, Kwon OY. Immediate effects of upper trapezius stretching in more and less tensed positions on the range of neck rotation in patients with unilateral neck pain. Phys Therapy Korea. 2013;20(1):47–54.
22. Ruivo RM, Pezarat-Correia P, Carita AI. Effects of a resistance and stretching training program on forward head and protracted shoulder posture in adolescents. J Manipulative Physiol Ther. 2017;40(1):1–0.

23. Farooq MN, Mohseni-Bandpei MA, Gilani SA, Hafeez A. Urdu version of the neck disability index: a reliability and validity study. BMC Musculoskelet Disord. 2017;18:1–1.
24. Nafees K, Baig AA, Ali SS, Ishaque F. Dynamic soft tissue mobilization versus proprioceptive neuromuscular facilitation in reducing hamstring muscle tightness in patients with knee osteoarthritis: a randomized control trial. BMC Musculoskelet Disord. 2023;24(1):447.
25. Cervical Spine Goniometry. Uwa.edu. [cited 2021 Apr 2]. http://at.uwa.edu/gon/cspine.htm
26. Kandasamy G, Bettany-Saltikov J, Van Schaik P. Posture and back shape measurement tools: a narrative literature review. Spinal deformities in adolescents, adults and older adults. 2020 Apr 8.
27. Haas AL, Bracht K, Stöggl T, Brunner R. Which reference line describes head position best. Physiother Rehabil. 2016;1(2).
28. Keidan L, Barash A, Lenzner Z, Pick CG, Been E. Sexual dimorphism of the posterior cervical spine muscle attachments. J Anat. 2021;239(3):589–601.
29. Sabeen F, Bashir MS, Hussain SI, Ehsan S. Prevalance of neck pain in computer users. Ann King Edw Med Univ. 2013;19(2):137.
30. Le TT, Jalayondeja W, Mekhora K, Bhuuanantanondh P, Jalayondeja C. Prevalence and risk factors of work-related musculoskeletal disorders among physical therapists in Ho Chi Minh City, Vietnam. BMC Public Health. 2024;24(1):6.
31. MacDowall A, Skeppholm M, Robinson Y, Olerud C. Validation of the visual analog scale in the cervical spine. J Neurosurg Spine. 2017;28(3):227–35.
32. Kuo YL, Lee TH, Tsai YJ. Evaluation of a cervical stabilization Exercise Program for Pain, disability, and physical impairments in University Violinists with nonspecific Neck Pain. Int J Environ Res Public Health. 2020;17(15):5430.
33. Oh SH, Yoo KT. The effects of stabilization exercises using a sling and stretching on the range of motion and cervical alignment of straight neck patients. J Phys Ther Sci. 2016;28(2):372–7.
34. Shin H, Kim K, Jung N. Effects of dynamic exercise program using thera-band on craniovertebral angle in adults with forward head posture. J Int Acad Phys Ther Res. 2020;11(1):1960–8.

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