COMBINED EFFECTIVENESS OF STATIC NECK EXERCISES WITH STRETCHING VERSUS STRETCHING ALONE ON ACUTE NECK PAIN AND CERVICAL RANGE OF MOTION IN SMARTPHONE USERS AMONG COLLEGE STUDENTS

A Randomized Controlled Trial

[1]Kirti Shankar Sahi, [2]Dr. Siddhima Hardikar (PT)

[1]Physiotherapy Intern, [2]Associate Professor (Neurosciences)
[1,2]Department of Physiotherapy,
[1,2]TMV's Jayantrao Tilak College of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune, Maharashtra, India

Abstract : Neck pain is common among college students who spend long hours on smartphones and is often accompanied by restricted cervical movement. Whether adding isometric neck exercises to a stretching programme offers extra benefit in this group is not well established. This study compared static (isometric) neck exercises combined with stretching against stretching alone for acute neck pain and cervical range of motion (ROM). Sixty undergraduate students aged 18–25 years with neck pain were recruited by convenience sampling after ethical clearance and written informed consent, and were randomly allocated to Group A (isometric exercises plus stretching, n = 30) or Group B (stretching alone, n = 30). Both groups trained five sessions per week for four weeks, each lasting 15–20 minutes. Pain was recorded with the Visual Analogue Scale (VAS) and Numeric Pain Rating Scale (NPRS), and cervical ROM with a goniometer, before and after the programme. Both groups improved significantly ($p < .001$). VAS fell by 4.13 points in Group A and 2.83 points in Group B (difference 1.30, 95% CI 1.05–1.55); NPRS fell by 4.10 and 2.60 points (difference 1.50, 95% CI 1.18–1.82). Improvement in all six cervical movements was larger in Group A (between-group differences 1.70–3.07°, Holm-adjusted $p < .001$), and Group × Time interactions were significant for every outcome. Within the limits of a small, single-centre sample with a short intervention period, combining static neck exercises with stretching produced greater short-term reductions in pain and greater gains in cervical ROM than stretching alone.

IndexTerms **- Acute neck pain, isometric neck exercise, stretching, smartphone users, college students, cervical range of motion, physiotherapy.**

I. INTRODUCTION

Neck pain is one of the most common musculoskeletal complaints and a frequent cause of restricted daily activity [1]. Young adults are not spared: prospective data show that risk profiles for neck pain are already visible between adolescence and early adulthood [2], and surveys of undergraduates report a considerable burden of neck pain together with a range of associated factors [3,4].

Smartphones have become central to student life, being used for communication, coursework, social media and entertainment. Using a handheld device usually means looking downward with the head carried forward of the trunk. Lee and colleagues measured head flexion angles during common smartphone tasks and documented sustained neck flexion in users [5]. Cross-sectional work in university populations has linked longer phone use with more severe or longer-lasting neck pain [6,7], and has examined how use duration relates to neck muscle endurance [8]. Because these studies are cross-sectional, they describe associations and cannot establish that smartphone use causes neck pain.

Neck pain interferes with prolonged sitting, turning the head, looking up and bending the neck, and it may coexist with reduced cervical mobility and altered muscle performance. Differences in endurance and fatigue of the neck flexors and extensors have been described in people with postural neck pain [9]. Timely assessment and conservative management are therefore worthwhile in affected students.

Therapeutic exercise is a cornerstone of conservative physiotherapy for neck pain. Stretching is commonly prescribed to ease muscle tightness and restore movement; Alfawaz et al., for example, tested the effect of adding stretching to standardized treatment on cervical ROM, pain and disability in non-specific mechanical neck pain [10]. Static (isometric) cervical exercises are a second option. The muscle contracts against resistance while the head stays still, so the exercise needs no equipment and can be performed in flexion, extension and lateral flexion. Isometric neck programmes have been compared with other exercises in randomized trials [11,12], and a meta-analysis of 18 randomized trials found that isometric training reduced neck pain and improved cervical ROM in the coronal and horizontal planes [13].

Stretching and isometric exercise act on different aspects of function. Stretching targets flexibility and joint motion, whereas isometric work loads the cervical musculature without moving the joint. A programme that includes both could therefore be more comprehensive than stretching alone, although the response to exercise depends on the type of exercise, the population and the dosage [14]. Evidence comparing the two approaches in smartphone-using college students is scarce. The present trial was designed to address this gap.

II. Need of the Study

Acute neck pain is often accompanied by reduced cervical ROM, poor posture and muscle pain, and the diagnostic and treatment course can be long, which delays recovery. Systematic reviews show that the usefulness of exercise for neck pain varies with the type of programme and the population, that the certainty of the evidence is frequently low, and that no single exercise approach has been shown to be superior to the others [14,15]. Smartphone-using college students form a large, accessible group in whom a simple, inexpensive and easily taught exercise routine would be valuable. This study was undertaken to find out whether adding static neck exercises to stretching reduces pain more, and improves ROM more, than stretching alone, so that therapists have clearer guidance for managing neck pain in this group.

III. Aim, Objectives and Hypothesis

Aim

To compare the effect of static neck exercises combined with stretching against stretching alone on acute neck pain and cervical range of motion in smartphone-using undergraduate students.

Objectives

(1) To assess neck pain with the Visual Analogue Scale (VAS) and the Numeric Pain Rating Scale (NPRS) before and after the intervention. (2) To measure cervical range of motion with a goniometer before and after the intervention. (3) To compare the change in pain and cervical ROM between students who perform static neck exercises with stretching and those who perform stretching alone.

Hypothesis

Null hypothesis (H0): There is no significant difference in the reduction of neck pain or the improvement of cervical range of motion between the combined programme and stretching alone. **Alternative hypothesis (H1):** College students with acute neck pain related to smartphone use who perform static neck exercises with stretching will show a significantly greater reduction in neck pain and a greater improvement in cervical range of motion than those who perform stretching alone.

IV. Review of Literature

Smartphone use and neck pain in students

Al-Hadidi et al. surveyed 500 students from health care faculties at the University of Jordan and found that the duration of phone use was significantly associated with the severity of neck pain on a 0–10 numeric rating scale and with how long the pain lasted [6]. Maayah et al. examined how demographic characteristics, previous neck pain, and the duration and position of smartphone use relate to the severity and duration of neck and shoulder pain among university students [7]. Elvan et al. studied 62 university students aged 18–35 years and explored the relationship between mobile phone use duration, neck muscle endurance and neck pain [8].

Further surveys have looked at musculoskeletal pain and its risk factors among university smartphone users in India [16], at neck and wrist or hand pain in medical and nursing undergraduates who overuse smartphones [17], and at static balance in student smartphone users with subclinical neck pain [18]. A large cross-sectional study of undergraduates documented the prevalence of neck pain and its associated factors [4].

Exercise approaches for neck pain

Alfawaz et al. conducted a randomized clinical trial of adding stretching to standardized procedures in non-specific mechanical neck pain, with cervical ROM, pain and disability as outcomes [10]. Chung and Jeong compared craniocervical flexion exercise with isometric neck exercise in patients with chronic neck pain [11], and Alpayci and İlter evaluated isometric exercise of the cervical extensors for restoring physiological lordosis and reducing neck pain [12]. Bharti et al. compared scapular functional exercises with cervical isometric exercises in chronic mechanical neck pain [19], and Amjad et al. compared isometric and isotonic global neck strengthening in the same condition [20].

At the review level, the Cochrane review of exercises for mechanical neck disorders found that the evidence differs by condition and type of exercise [14]. A network meta-analysis of 40 randomized trials in chronic non-specific neck pain suggested that motor-control and strengthening exercises may improve pain and disability compared with no treatment, but the certainty of evidence was very low [15]. The meta-analysis of isometric training by Yang et al. pooled 18 trials and reported lower pain scores and better ROM in some planes of movement than in controls [13].

V. Materials and Methods

Study design and participants

The study used a two-group experimental design with assessments before and after the intervention and ran for six months. Sixty undergraduate students were recruited by convenience sampling and randomly allocated to Group A (n = 30) or Group B (n = 30). Students were eligible if they were aged 18–25 years, of either gender, and reported neck pain. Students with a neurological disorder, a history of surgery, or any limitation of upper-extremity range of motion were excluded. Ethical clearance was obtained before the study began. The purpose, duration and procedures were explained to every eligible student, and written informed consent was obtained before enrolment.

Materials

A demographic data sheet, the informed consent form, a goniometer, the Visual Analogue Scale and the Numeric Pain Rating Scale were used.

Outcome measures

Pain intensity was measured with two scales [21]. The VAS is a 10 cm horizontal line anchored at 0 (no pain) and 10 (worst imaginable pain), on which the participant marks current pain. The NPRS is an 11-point scale from 0 to 10, with scores of 1–3 taken as mild, 4–6 as moderate and 7–10 as severe pain. For both scales a lower score indicates less pain. **Cervical range of motion** was measured with a goniometer for flexion, extension, right and left rotation, and right and left lateral flexion, and is expressed in degrees. All outcomes were recorded at baseline and again after the four-week programme.

Procedure

Students were first screened against the eligibility criteria, briefed on the study and enrolled once they had signed the consent form. They were then randomly allocated to the two groups. Demographic details and baseline VAS, NPRS and cervical ROM were recorded. Each group then followed its assigned exercise protocol (Table 1) for four weeks, five sessions per week, with each session lasting 15–20 minutes. Participants were monitored during the programme, and post-intervention VAS, NPRS and cervical ROM were recorded using the same procedures as at baseline. The pre- and post-intervention data were then analysed and compared between groups.

Table 1. Exercise protocol for the two groups (4 weeks, 5 sessions/week, 15–20 min/session)

Group	Sr. no.	Exercise	Repetitions	Hold duration
A	1	Neck flexion, isometric	10 reps	5 s
A	2	Neck extension, isometric	10 reps	5 s
A	3	Right lateral flexion, isometric	10 reps	5 s
A	4	Left lateral flexion, isometric	10 reps	5 s
A	5	Upper trapezius stretch	3 reps/side	15–20 s
A	6	Levator scapulae stretch	3 reps/side	15–20 s
B	1	Upper trapezius stretch	3 reps/side	15–20 s
B	2	Levator scapulae stretch	3 reps/side	15–20 s
B	3	Sternocleidomastoid stretch	3 reps/side	15–20 s

Note. Group A: static neck exercises plus stretching. Group B: stretching alone.

VI. Statistical Analysis

Statistical procedures were run in IBM SPSS Statistics for Windows, version 26.0. Pre- and post-intervention data were complete for all 60 participants, so nothing was imputed and no observation was excluded. Continuous variables are summarised as mean and standard deviation (SD) and group allocation as frequency and percentage. Normality, including that of within-participant change scores, was examined with the Shapiro–Wilk test and homogeneity of variance with the median-centred Levene test; these results were interpreted together with the observed distributions and model diagnostics rather than on significance alone.

Within-group change was tested with paired-samples t tests with 95% confidence intervals (CIs). Where every participant had the same change (zero variance), the paired t statistic could not be estimated and the direction of change was tested with an exact sign test. Between-group differences in change scores were tested with Welch's independent-samples t test, with Hedges' g as the standardized effect size. A two-group, two-time-point repeated-measures analysis gave the main effects of group and time and the Group × Time interaction, summarised by partial eta squared (η^2p). Post-intervention scores were also compared with analysis of covariance (ANCOVA) adjusted for the corresponding baseline value, using heteroskedasticity-consistent (HC3) standard errors and 95% CIs. Because a baseline-by-group interaction was detected for cervical flexion, adjusted flexion means were estimated at the overall mean baseline value. ANCOVA diagnostics included residual normality, residual variance, baseline-by-group interaction and Cook's distance. The Holm procedure was applied across the six cervical ROM outcomes within each comparison. All tests were two-tailed and $p < .05$ was considered significant.

VII. Results

Participant characteristics

The analysis covered 60 participants (30 per group, 50% each) with complete data on all eight outcomes. The mean age was 20.83 years (SD 2.34): 22.23 years (SD 2.56) in Group A and 19.43 years (SD 0.73) in Group B. Mean height (163.12 cm, SD 7.45) and body weight (58.15 kg, SD 8.73) were similar in the two groups (Table 2). No baseline significance tests were performed. Pain scores and several change-score distributions departed from normality on the Shapiro–Wilk test, so HC3-robust inference was used for the main comparative analysis, with the Group × Time and Welch analyses as supporting comparisons.

Table 2. Participant characteristics

Characteristic	Group A (n = 30)	Group B (n = 30)	Total (N = 60)
Age (years), M (SD)	22.23 (2.56)	19.43 (0.73)	20.83 (2.34)
Height (cm), M (SD)	162.60 (7.37)	163.63 (7.62)	163.12 (7.45)
Weight (kg), M (SD)	58.10 (8.72)	58.20 (8.88)	58.15 (8.73)
Participants, n (%)	30 (50.00)	30 (50.00)	60 (100.00)

Note. M = mean; SD = standard deviation. No missing observations. No baseline significance tests were performed.

Pain outcomes

Pain fell significantly in both groups (Table 3). On the VAS, Group A improved from 6.67 (SD 0.99) to 2.53 (SD 0.82), a mean reduction of 4.13 points (SD 0.57), $t(29) = 39.62$, $p < .001$. Group B improved from 6.67 (SD 0.99) to 3.83 (SD 0.87), a reduction of 2.83 points (SD 0.38), $t(29) = 40.94$, $p < .001$. On the NPRS, Group A fell from 6.67 (SD 1.21) to 2.57 (SD 0.86), a reduction of

4.10 points (SD 0.71), t(29) = 31.54, p < .001, and Group B fell from 6.67 (SD 1.21) to 4.07 (SD 0.91), a reduction of 2.60 points (SD 0.50), t(29) = 28.58, p < .001.

Table 3. Pain scores before and after the intervention

Outcome	Group	n	Pre, M (SD)	Post, M (SD)	Mean reduction (SD)	t (df)	p
VAS	A	30	6.67 (0.99)	2.53 (0.82)	4.13 (0.57)	39.62 (29)	< .001
VAS	B	30	6.67 (0.99)	3.83 (0.87)	2.83 (0.38)	40.94 (29)	< .001
NPRS	A	30	6.67 (1.21)	2.57 (0.86)	4.10 (0.71)	31.54 (29)	< .001
NPRS	B	30	6.67 (1.21)	4.07 (0.91)	2.60 (0.50)	28.58 (29)	< .001

Note. Paired-samples t tests. VAS = Visual Analogue Scale; NPRS = Numeric Pain Rating Scale; M = mean; SD = standard deviation. A positive reduction denotes improvement.

The reduction was significantly greater in Group A (Table 5): by 1.30 points on the VAS (95% CI 1.049 to 1.551; Welch t(50.385) = 10.38, p < .001; Hedges' g = 2.65) and by 1.50 points on the NPRS (95% CI 1.182 to 1.818; t(51.912) = 9.45, p < .001; g = 2.41). The baseline-adjusted ANCOVA gave the same result (Table 7): adjusted post-intervention VAS was 2.53 in Group A and 3.83 in Group B (difference 1.30, HC3 95% CI 1.078 to 1.522, t(57) = 11.74, p < .001), and adjusted NPRS was 2.57 and 4.07 (difference 1.50, HC3 95% CI 1.272 to 1.728, t(57) = 13.16, p < .001). The Group × Time interaction was significant for VAS, F(1, 58) = 107.85, p < .001, η^2p = .650, and for NPRS, F(1, 58) = 89.38, p < .001, η^2p = .606 (Table 6).

Cervical range of motion

Cervical ROM increased in both groups in all six movements (Table 4, Fig. 1). In Group A, flexion improved by 5.67°, extension by 6.37°, right and left rotation by 8.00° each, and right and left lateral flexion by 5.97° each. In Group B the corresponding gains were 3.97° for flexion and extension, 4.93° for rotation, and 3.97° for lateral flexion. Paired t tests were significant (p < .001) wherever they could be estimated. Every Group A participant gained exactly 8° in each rotation direction, so the change-score variance was zero, the paired t statistic was undefined, and the exact sign test was used instead (p < .001 for both).

Table 4. Cervical range of motion before and after the intervention (degrees)

Movement	Group	Pre, M (SD)	Post, M (SD)	Mean increase (SD)	t (df)	p
Flexion	A	39.10 (2.52)	44.77 (2.33)	5.67 (0.48)	64.73 (29)	< .001
Flexion	B	39.07 (2.33)	43.03 (2.33)	3.97 (0.18)	119.00 (29)	< .001
Extension	A	43.80 (2.88)	50.17 (2.72)	6.37 (0.62)	56.71 (29)	< .001
Extension	B	43.23 (2.65)	47.20 (2.64)	3.97 (0.18)	119.00 (29)	< .001
Right rotation	A	59.63 (3.55)	67.63 (3.55)	8.00 (0.00)	NE	NE
Right rotation	B	59.67 (3.20)	64.60 (3.19)	4.93 (0.25)	106.50 (29)	< .001
Left rotation	A	60.77 (3.44)	68.77 (3.44)	8.00 (0.00)	NE	NE
Left rotation	B	60.27 (3.06)	65.20 (3.09)	4.93 (0.25)	106.50 (29)	< .001
Right lateral flexion	A	29.50 (2.21)	35.47 (2.21)	5.97 (0.18)	179.00 (29)	< .001
Right lateral flexion	B	29.67 (1.99)	33.63 (1.97)	3.97 (0.18)	119.00 (29)	< .001
Left lateral flexion	A	30.53 (2.19)	36.50 (2.18)	5.97 (0.18)	179.00 (29)	< .001
Left lateral flexion	B	30.67 (1.99)	34.63 (1.97)	3.97 (0.18)	119.00 (29)	< .001

Note. Paired-samples t tests; n = 30 per group. NE = not estimable: every Group A participant improved by exactly 8° in rotation (zero variance); the exact sign test gave p < .001 for both rotation movements.

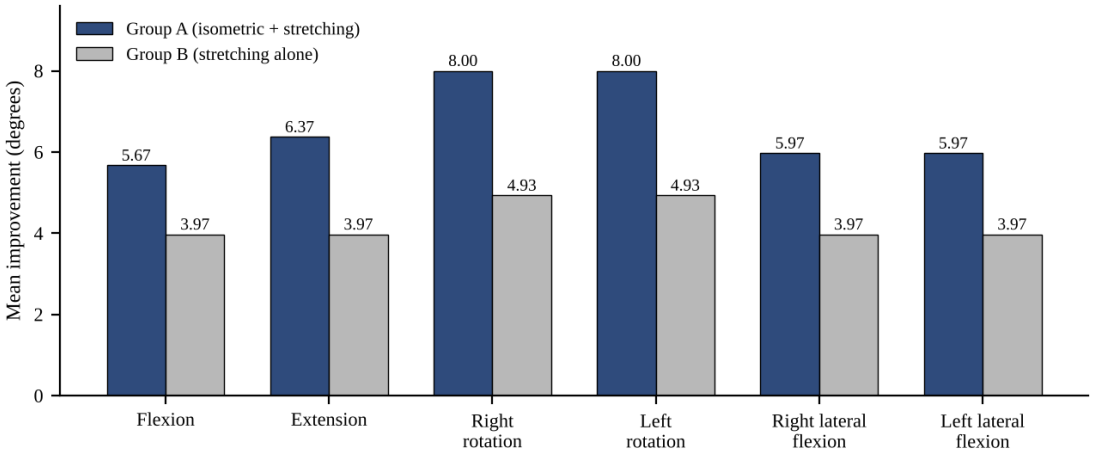

Fig. 1. Mean improvement in cervical range of motion by group and movement.

Group A improved significantly more than Group B in every movement (Table 5), by 1.70° in flexion, 2.40° in extension, 3.07° in right and left rotation and 2.00° in right and left lateral flexion (all Holm-adjusted p < .001). Group × Time interactions were significant for all six movements after Holm adjustment (Table 6), and baseline-adjusted ANCOVA with HC3 standard errors confirmed higher adjusted post-intervention ROM in Group A in all six movements (Table 7).

Table 5. Between-group comparison of change scores (Group A − Group B)

Outcome	Change A, M (SD)	Change B, M (SD)	Mean diff.	Welch t (df)	95% CI	Hedges' g	p (Holm)
VAS	4.13 (0.57)	2.83 (0.38)	1.30	10.38 (50.39)	1.049 to 1.551	2.65	< .001
NPRS	4.10 (0.71)	2.60 (0.50)	1.50	9.45 (51.91)	1.182 to 1.818	2.41	< .001
Flexion	5.67 (0.48)	3.97 (0.18)	1.70	18.15 (37.24)	1.510 to 1.890	4.63	< .001
Extension	6.37 (0.62)	3.97 (0.18)	2.40	20.49 (34.07)	2.162 to 2.638	5.22	< .001
Right rotation	8.00 (0.00)	4.93 (0.25)	3.07	66.21 (29)	2.972 to 3.161	16.87	< .001
Left rotation	8.00 (0.00)	4.93 (0.25)	3.07	66.21 (29)	2.972 to 3.161	16.87	< .001
Right lateral flexion	5.97 (0.18)	3.97 (0.18)	2.00	42.43 (58)	1.906 to 2.094	10.81	< .001
Left lateral flexion	5.97 (0.18)	3.97 (0.18)	2.00	42.43 (58)	1.906 to 2.094	10.81	< .001

Note. Welch independent-samples t tests; n = 30 per group. Pain change = reduction in points; ROM change = increase in degrees. Holm-adjusted p-values are given for the six ROM movements (pain outcomes unadjusted). Hedges' g values are large because the spread of change scores was very small.

Table 6. Group × Time interaction from repeated-measures analysis

Outcome	F (1, 58)	p	Partial η²	Holm-adjusted p
VAS	107.846	< .001	.650	–
NPRS	89.384	< .001	.606	–
Flexion	329.384	< .001	.850	< .001
Extension	419.933	< .001	.879	< .001
Right rotation	4383.143	< .001	.987	< .001
Left rotation	4383.143	< .001	.987	< .001
Right lateral flexion	1800.000	< .001	.969	< .001
Left lateral flexion	1800.000	< .001	.969	< .001

Note. Two-group, two-time-point repeated-measures analysis; N = 60. Sphericity correction was not required with two time points. Holm adjustment was applied across the six ROM interaction tests.

Table 7. Baseline-adjusted comparison of post-intervention outcomes (ANCOVA with HC3 standard errors)

Outcome	Adj. mean A	Adj. mean B	Diff. (B − A)	HC3 SE	HC3 95% CI	t (df)	p (Holm)
VAS	2.533	3.833	1.300	0.111	1.078 to 1.522	11.741 (57)	< .001
NPRS	2.567	4.067	1.500	0.114	1.272 to 1.728	13.163 (57)	< .001
Flexion	44.752	43.050	−1.702	0.087	−1.876 to −1.528	−19.592 (56)	< .001
Extension	49.896	47.471	−2.425	0.116	−2.657 to −2.193	−20.965 (57)	< .001
Right rotation	67.650	64.583	−3.067	0.047	−3.161 to −2.972	−65.076 (57)	< .001
Left rotation	68.516	65.451	−3.065	0.046	−3.158 to −2.973	−66.177 (57)	< .001
Right lateral flexion	35.549	33.551	−1.999	0.048	−2.094 to −1.903	−41.937 (57)	< .001
Left lateral flexion	36.566	34.567	−1.999	0.048	−2.095 to −1.902	−41.583 (57)	< .001

Note. N = 60. Adjusted means are evaluated at the overall baseline mean (VAS, NPRS: points; ROM: degrees). A positive B − A difference in pain, and a negative B − A difference in ROM, indicate a better result in Group A. Cervical flexion used a baseline-by-group interaction model; other outcomes used common-slope ANCOVA. Holm correction applies to the six ROM outcomes.

VIII. Discussion

We tested whether adding static cervical isometric exercises to stretching works better than stretching on its own for acute neck pain and cervical ROM in college students who use smartphones. Pain and every measured cervical movement improved under both programmes, yet the gains were bigger on every outcome when isometric exercises were included. The results suggest that adding isometric exercises to a stretching programme may give additional benefit, with the caveats set out under limitations.

Pain

Mean VAS dropped 4.13 points with the combined programme and 2.83 with stretching alone, while NPRS dropped 4.10 and 2.60 points; the advantage of the combined programme was therefore 1.30 (VAS) and 1.50 (NPRS) points. Each approach helped, but adding isometric work helped more. The two scales gave the same direction and similar size of effect, but because both measure pain intensity they should not be read as two independent confirmations.

A plausible explanation is that isometric contractions give a controlled loading stimulus to the cervical muscles while stretching deals with tightness and restricted movement. The meta-analysis by Yang et al. supports the use of isometric training for neck pain, reporting lower pain scores and gains in some cervical movement planes [13]. Studies of smartphone users also place the present work in context: longer phone use has been associated with more severe and longer-lasting neck pain in students [6,7], although such studies cannot show cause. The present trial adds information on how symptoms respond to exercise. Muscle strength, endurance and activation were not measured, so any mechanism remains a possibility rather than a finding.

Cervical range of motion

Group A gained more motion than Group B in flexion (5.67° vs 3.97°), extension (6.37° vs 3.97°), rotation (8.00° vs 4.93°) and lateral flexion (5.97° vs 3.97°). Stretching was part of both programmes, which is consistent with improvement in both groups, and stretching is widely used to increase ROM [10]. The additional gain in Group A may be linked to the isometric component, but flexibility, strength and muscle activity were not assessed, so this explanation cannot be tested with the present data.

Rotation gains in Group A were uniform at 8°, so paired t tests could not be computed and the sign test was used instead; the large standardized effects reflect the narrow spread of change scores.

Comparison with previous exercise research

Previous trials and reviews have studied strengthening, motor-control, stretching and combined exercise programmes for neck pain. The Cochrane review found that the strength of evidence depends on the type of neck disorder and exercise [14], and a network

meta-analysis of 40 trials concluded that motor-control and strengthening exercises may help chronic non-specific neck pain but that the certainty of evidence was very low and no exercise type was clearly superior [15]. Most of those trials enrolled people with chronic pain, whereas the present participants were young students with acute pain, so direct comparison should be made carefully. Differences in symptom duration, exercise dosage and follow-up make the findings of different studies difficult to equate. The present findings are best regarded as preliminary evidence for a combined isometric and stretching programme in this population.

IX. Conclusion

Both static cervical isometric exercises combined with stretching and stretching alone were associated with less neck pain and better cervical ROM in smartphone-using college students over four weeks. The combined programme produced larger reductions in VAS and NPRS scores and larger gains in all six cervical movements. The combined programme may therefore be considered a useful physiotherapy option for students with neck pain. These findings should be interpreted cautiously in view of the study limitations, and larger trials with standardized protocols and longer follow-up are needed to confirm them.

X. Clinical Implications

(1) Pain: a programme of isometric neck exercises with stretching may help reduce acute neck pain linked to prolonged smartphone use. (2) Mobility: the programme may improve flexion, extension, rotation and lateral flexion of the neck and so ease daily activities. (3) Practicality: the exercises are brief, need no equipment and can be taught easily, which suits students. (4) Prevention: physiotherapists can add advice on avoiding prolonged forward-head posture and on keeping the screen at a suitable height.

XI. Limitations and Future Scope

The study has several limitations. Participants were college students recruited by convenience sampling, so the findings may not apply to other age groups or occupations. Mean age differed between the groups (22.23 vs 19.43 years). The stretching component was not identical in the two groups, because Group B also performed a sternocleidomastoid stretch. The intervention was short and there was no follow-up, so lasting effects are unknown. Smartphone screen time, posture and habits were not quantified and may influence pain and ROM. Only pain and cervical ROM were measured; muscle endurance, posture and functional disability were not. Finally, rotation change in Group A showed no variation between participants, which limited the choice of statistical test.

Future studies should use larger and more varied samples, standardized and matched protocols, and longer follow-up to test whether improvements persist and whether the programme prevents recurrence. They could also measure muscle strength, endurance, posture, functional disability and quality of life, compare different exercise protocols, and combine exercise with postural correction, ergonomic education and changes in smartphone habits.

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