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Original Article

Physiotherapy Section

Impact of Integrated Exercise Protocol on Musculoskeletal Symptoms, Neck Disability and Quality of Life among Computer Professionals: A Quasi-experimental Study

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ABSTRACT

Introduction: Prolonged computer use is a known risk factor for Cervical Spondylosis (CS) and associated musculoskeletal complaints. Occupational neck disorders can negatively impact function, productivity, and overall well-being. Multimodal interventions that integrate exercise and ergonomic strategies offer promising therapeutic benefits.

Aim: To evaluate the effectiveness of a 10-week Integrated Exercise Protocol (IEP) on neck disability, musculoskeletal symptoms, and Quality of Life (QoL) among computer professionals experiencing CS-related symptoms.

Materials and Methods: This quasi-experimental study was carried out at the Outpatient Department of Jyotirao Phule Subharti College of Physiotherapy from August 2024 to March 2025. A total of 120 computer professionals aged 25-50 years presenting with clinical signs of CS or neck and upper back musculoskeletal complaints were included in this study. The Integrated Exercise Group (IEG) underwent a 10-week supervised program including cervical mobility, strengthening exercises, postural correction, and ergonomic training. The Control Group (CG) received only standard ergonomic advice. Primary outcomes were measured using the Neck Disability Index (NDI) and the World Health Organisation Quality of Life Brief version (WHOQOL-BREF). The Nordic Musculoskeletal Questionnaire (NMQ) served as a secondary measure. Pre- and post-intervention scores were analysed using Paired t-tests (within-group comparisons) and an Independent t-test (between-group comparisons). A two-tailed p-value <0.05 was considered statistically significant.

Results: At baseline, no significant differences were noted between groups. After 10 weeks, the IEG showed considerable improvement in NDI scores (p-value <0.001) and WHOQOL-BREF domains (p-value <0.001) compared to the CG. A substantial reduction in reported neck and upper back musculoskeletal symptoms was also observed in the IEG via NMQ (p-value <0.001).

Conclusion: An IEP combined with ergonomic training significantly reduced neck-related disability, alleviated musculoskeletal symptoms, and improved quality of life in computer professionals. Structured physiotherapeutic interventions should be prioritised in occupational health strategies for sedentary workers with CS-related complaints.

Keywords: Health-related quality of life, Neck pain, Occupational diseases, Physical therapy modalities, Posture

INTRODUCTION

Computer Professionals (CPs) are most commonly vulnerable to diseases of the cervical spine and related musculoskeletal complaints due to the increased use of computers [1]. An estimated 1.71 billion people worldwide are thought to suffer from musculoskeletal problems, with 50-70% of these cases including CPs [2]. A common symptom that contributes significantly to morbidity and functional deficits is neck pain. Every year, it has a major influence on the daily activities and lives of about 34.4% of computer workers worldwide [3]. Clinically, CS manifests as chronic neck pain, stiffness, reduced cervical mobility, radiating arm symptoms, and, in advanced stages, myelopathy, all of which interfere with daily functioning, emotional well-being, and social involvement, substantially impairing QoL [4]. Pain, decreased function, and a lower QoL are the results of degenerative spinal abnormalities. Moreover, earlier research suggested the link between inadequate physical activity, extended sitting, and bad posture [5].

A strategy for prevention and rehabilitation is provided by integrated exercise regimens that target posture correction, muscle strength, mobility, and ergonomics. The usefulness of any such protocols among desk job workers has, however, not been studied. By assessing how a validated integrated exercise program affects musculoskeletal complaints, neck impairment, and QoL, the present study fills this gap [6,7]. CPs spend lengthy hours seated in front of screens as a result of the upheaval in workplaces brought about by the advent of information technology.

Poor ergonomic practices combined with this sedentary work environment have developed CS and related musculoskeletal illnesses. Neck pain, stiffness, and in extreme cases, neurological abnormalities are the signs of CS, a degenerative condition of the cervical spine [8]. Long-term computer use, bad posture, and the emergence of neck-related musculoskeletal diseases have all been linked in several studies. Although fitness treatments and ergonomic changes have been promoted, there are still no established, thorough exercise regimens designed especially for computer workers [9].

A comprehensive treatment strategy for prevention and rehabilitation is provided by an IEP that combines cervical mobility exercises, upper back and neck muscle strengthening, posture correction techniques and ergonomic education. There is, however, no empirical data available to support the efficacy of such methods in the work environment. The present study aimed to evaluate the effectiveness of a validated IEP comprising cervical mobility exercises, upper back and neck muscle strengthening, posture correction techniques, and ergonomic education on musculoskeletal symptoms, neck disability, and QoL in CPs. The primary hypothesis is that a 10-week supervised IEP will significantly reduce musculoskeletal symptoms and neck disability while improving the QoL among CPs, compared to standard ergonomic advice alone.

MATERIALS AND METHODS

This quasi-experimental study was conducted at the Outpatient Department (OPD), Jyotirao Phule Subharti College of Physiotherapy, Meerut, Uttar Pradesh, India, from August 2024 to March 2025. Ethical clearance was obtained from the University Ethics Committee (Approval No. SMC/UECM/2024/894/365), and written informed consent was taken from all participants before inclusion.

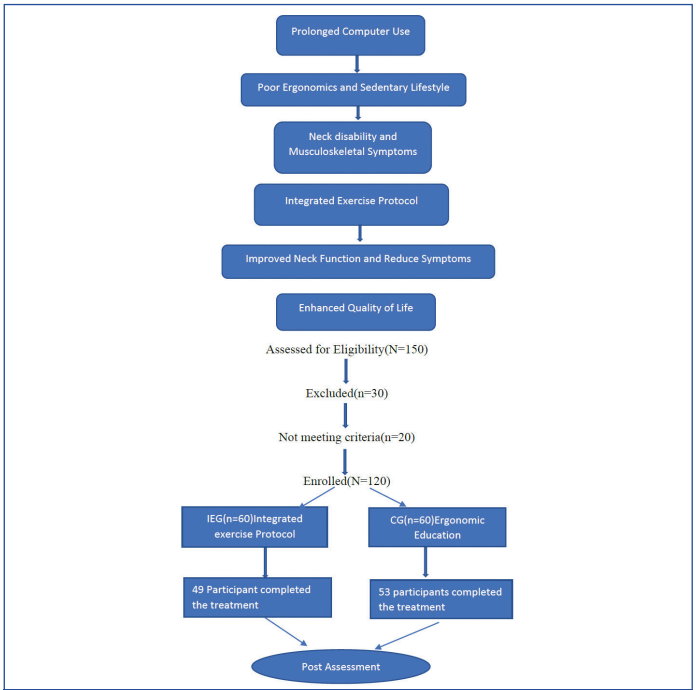
Inclusion criteria: It comprised individuals aged 25-50 years, employed in Information Technology-based or computer-related professions requiring prolonged computer use of six or more hours per day, having a clinical diagnosis of CS with associated neck pain or stiffness confirmed by a physiotherapist or orthopaedic specialist, and presenting with a Neck Disability Index (NDI) score of 10 or above, indicating at least mild disability [10]. Participants were also required to be willing to participate in the 10-week intervention program and provide informed consent.

Exclusion criteria: It included a history of traumatic neck injury, cervical spine surgery or fracture; presence of neurological deficits such as radiculopathy, myelopathy, or upper limb weakness; diagnosis of systemic, inflammatory, or rheumatologic conditions such as rheumatoid arthritis or ankylosing spondylitis; concurrent participation in other physiotherapy or rehabilitation programs during the study period; and medical conditions or pregnancy that contraindicated active exercise participation.

Sample size calculation: A two-tailed significance level (α) of 0.05, statistical power ($1 - \beta$) of 0.80, and a Minimum Clinically Important Difference (MCID) of 5 points on the NDI were used [10]. This represents a moderate effect size, suitable for evaluating the impact of the integrated exercise protocol. Based on these parameters, the minimum required sample size was calculated to be 41 participants per group. To accommodate an anticipated 20% attrition or dropout, the sample size was 60 participants per group, resulting in a total of 120 participants.

Study Procedure

Due to practical constraints, randomisation was not used in the study. Participants were sequentially allocated to groups based on enrollment order, with efforts to match them by age, gender, and computer use duration to reduce selection bias. An independent administrator managed the allocation sequence, ensuring basic concealment. A blinded physiotherapist conducted outcome assessments to minimise detection bias [Table/Fig-1].



[Table/Fig-1]: Enrollment of the subjects.

Integrated Exercise Group (IEG): IEG took part in a 10-week supervised IEP that comprised strengthening exercises for the neck, shoulders, and upper back muscles, as well as mobility exercises for the cervical and upper back, along with the postural correction techniques and ergonomic training.

The Integrated Exercise Protocol (IEP) was systematically developed in alignment with the Frequency, Intensity, Time, and Type (FITT) principle to ensure safety, effectiveness, and reproducibility. The intervention was delivered three times per week over a duration of 10 weeks, ensuring consistent engagement without overloading participants. Exercises were performed at a moderate intensity, tailored to individual capability and progressively increased based on participant performance and tolerance. Each session (out of a total of 30 sessions) lasted approximately 45 to 60 minutes, including warm-up, main components (strengthening, mobility, and postural correction exercises), and cool-down periods.

The protocol incorporated a combination of isometric and isotonic strengthening exercises for the cervical, scapular, and upper thoracic musculature; mobility exercises targeting cervical and thoracic segments; ergonomic training; and postural correction techniques [Table/Fig-2].

Control Group (CG): Participants in the CG received ergonomic education and posture correction training. The program was delivered through weekly supervised sessions (30-40 minutes) over ten weeks and included instruction on optimal workstation set-up, neutral cervical alignment, micro-breaks, and stretching exercises for neck and shoulder relaxation. Participants were also provided printed materials and digital reminders to reinforce compliance, which was monitored through weekly follow-ups [Table/Fig-3].

The NDI demonstrated high internal consistency with Cronbach's $\alpha = 0.86$ among cervical-spondylosis patients [10-11]; the WHOQOL-BREF showed strong construct validity, with inter-domain convergent correlations ranging from 0.56 to 0.74 [12-13] and the Nordic Musculoskeletal Questionnaire (NMQ) exhibited good test-retest reliability (0.57-0.90) with excellent construct validity [14].

STATISTICAL ANALYSIS

All statistical analyses were performed using IBM Statistical Pacakge for Social Sciences (SPSS) Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Data were checked for normality using the Shapiro-Wilk test. Based on the distribution, parametric tests (paired t-test, independent t-test) were applied for normally distributed continuous variables. A p-value <0.05 was considered significant.

RESULTS

Adherence to the intervention was high in both groups. In the IEG, 49 out of 60 participants completed at least 9 of the 10 sessions, while in the control group, 53 participants met the same criterion. The demographic data were non significant in both groups [Table/Fig-4].

At baseline, both groups had similar NDI scores. After the 10-week intervention, the IEG showed a significant reduction in NDI scores to 18.4 and an improvement in WHOQOL-BREF to 75.5, whereas the CG showed minimal changes (NDI: 27.9; WHOQOL-BREF: 63.2). Musculoskeletal Symptom (MS) prevalence decreased markedly in the IEG (81% → 35%) but changed only slightly in the CG (83% → 79%) [Table/Fig-5].

Between group differences post-intervention were statistically significant (p-value <0.001), indicating the IEP effectively reduced neck disability, improved quality of life, and alleviated musculoskeletal symptoms compared to ergonomic advice alone (p-value <0.001) [Table/Fig-6].

Week	Strengthening exercises	Mobility exercises	Postural correction	Ergonomic training and workplace adjustments
1–2	• Isometric Neck Flexion and Extension (3x10) • Shoulder Shrugs (3x15) • Scapular Retraction with Theraband (3x15)	• Cervical ROM (10 reps each direction) • Thoracic Seated Rotations (10 reps)	• Chin Tucks (3x10) • Wall Posture Drill (3x30 sec)	• Workstation assessment • Basic ergonomic education
3–4	• Progress Theraband resistance • Continue Shrugs and Retraction with added reps	• Progress ROM (within pain-free limits) • Introduce Thoracic Extension Mobilisation	• Reinforce Neutral Spine Awareness	• Individual workplace modifications implemented
5–6	• Light Dumbbell Resistance for Shoulder Exercises • Neck Isometrics with Slight Resistance	• Continue Mobility Routine • Emphasise Full-Range Thoracic Movements	• Posture Correction Integrated into Daily Activities	• Micro-break scheduling introduced (5 min/hour)
7–8	• Progress Dumbbell and Theraband Resistance • Functional Strengthening (e.g., resisted scapular movements)	• Maintain Mobility Routine • Encourage Self-Monitoring	• Mirror Feedback for Posture Correction	• Re-evaluation of ergonomic setup • Minor adjustments
9–10	• Functional Strengthening and Endurance Focus • Combined Resistance and Endurance Drills	• Full Mobility Routine • Participant-led Mobility Sessions	• Independent Posture Monitoring • Final Reinforcement	• Final ergonomic assessment • Long-term recommendations

[Table/Fig-2]: 10-week supervised integrated exercise protocol.

Exercise category	Specific exercises	Description / How performed
Strengthening exercises	Isometric Neck Flexion and Extension	Performed in neutral sitting posture. Gentle isometric contractions held for 5 seconds in flexion and extension against manual resistance, 3 sets of 10 repetitions. Progression: increase hold time/resistance each week.
	Shoulder Shrugs	Standing or seated; elevate shoulders toward ears, hold 2 seconds, slowly lower; 3 sets × 15 reps. Enhances upper-trapezius strength and scapular control.
	Scapular Retraction with Theraband	With elbows flexed 90°, retract scapulae against elastic resistance, avoiding neck strain; 3 sets × 15 reps.
	Functional Strengthening (Dumbbell/Theraband)	Progressive resistance for shoulder stabilisers and deep neck flexors; integrated with simulated desk-task positions.
Mobility exercises	Cervical Range of Motion (ROM)	Active ROM in flexion, extension, rotation, and lateral flexion; 10 reps per direction, pain-free range.
	Thoracic Seated Rotations	Seated, arms crossed over chest; slow thoracic rotation to both sides; 10 reps.
	Thoracic Extension Mobilisation	Sitting or standing; extend thoracic spine over chair back/ foam roller, 10 reps.
Postural correction	Chin Tucks	Seated/standing, retract chin to align ears over shoulders; hold 5 seconds, 3 sets × 10.
	Wall Posture Drill	Stand with occiput, scapulae, and sacrum touching wall; hold 30 seconds × 3 repetitions.
	Mirror Feedback Training	Self-correction of cervical and thoracic alignment using mirror feedback; daily practice during seated work.
Ergonomic training and workplace adjustments	Workstation Assessment and Education	Individual assessment of chair, monitor, keyboard, and posture; ergonomic advice implemented in Week 1-2.
	Micro-break Scheduling	Scheduled 5-min micro-breaks every hour including neck-shoulder stretching and posture reset.
	Re-evaluation and Long-term Recommendations	End-of-program workstation reassessment; self-monitoring and posture-maintenance guidelines provided.

[Table/Fig-3]: Integrated Exercise Protocol (IEP).

Variables	CG (n=53)	IEG (n=49]	p-value
Age (years, Mean±SD)	35.8±6.1	35.0±5.9	0.75
Gender (M/F)	34/26	33/27	0.68
Duration of computer use (hours/day)	7.4±1.2	7.3±1.3	0.53
NDI	28.2±4.5	28.6±4.2	0.60
WHOQOL-BREF Total score	62.3±8.1	61.8±7.9	0.73
Presence of neck pain (%)	50 (83.3%)	49 (81.7%)	0.56

[Table/Fig-4]: Baseline characteristics of participants

Outcome measures	Groups	Pre-intervention (Mean±SD)	Post-intervention (Mean±SD)	Mean Change (95% CI)	p-value
Neck Disability Index (NDI)	IEG (n=49)	28.2±4.5	18.3±3.8	-9.9 (-11.6 to -8.2)	<0.001
	CG (n=53)	28.6±4.2	27.9±4.1	-0.7 (-1.8 to 0.4)	0.23
WHOQOL-BREF Total score	IEG (n=49)	62.3±8.1	75.5±7.5	+13.2 (11.3 to 15.1)	<0.001
	CG (n=53)	61.8±7.9	63.2±7.8	+1.4 (0.1 to 2.7)	0.08
Musculoskeletal symptoms (%)	IEG (n=49)	81%	35%	-46% (-58.1% to -33.9%)	<0.001
	CG (n=53)	83%	79%	-4% (-12.3% to 4.3%)	0.30

[Table/Fig-5]: Intragroup comparison of outcome measures pre- and post-intervention.

Outcome measures	Time point	IEG (Mean±SD)	CG (Mean±SD)	p-value (between groups)
NDI	Pre	28.2± 4.5	28.6±4.2	0.61
	Post	18.3± 3.8	27.9±4.1	<0.001
WHOQOL-BREF Total score	Pre	62.3± 8.1	61.8±7.9	0.74
	Post	75.5±7.5	63.2±7.8	<0.001
MS (NMQ)	Pre	81%	83%	0.68
(Presence of neck/ upper back pain)	Post	35%	79%	<0.001

[Table/Fig-6]: Comparison of outcome measures between groups at pre- and post-intervention time points.
*Integrated Exercise Group; CG: Control Group; CI: Confidence Interval

DISCUSSION

In the present study, the targeted strengthening of these muscle groups through the IEP may have contributed to the observed improvements in NDI scores, approximately a 35% reduction. Although the study did not assess musculoskeletal or postural changes directly, the functional improvements suggest that enhancing muscular control and support may help reduce neck-related disability. The strengthening of these muscles reduces excessive pressure on facet joints, intervertebral discs, and ligaments, thereby minimising further degeneration and associated mechanical stress [15-17]. Muscular weakness caused by poor posture and long-term inactivity is a key factor in the development of cervical dysfunction in CP. Strengthening exercises improve muscular endurance, thereby enhancing the ability of the cervical and periscapular muscles to maintain optimal posture and reduce static loading on compromised vertebral structures [18-19]. It is further assumed that strengthening exercises also play an important role in retraining the proprioceptive feedback mechanisms by improving joint position awareness and facilitating reflexive muscle activation [20]. This neuromuscular re-education contributes to improving cervical stability and movement control. Muscular activity not only helps in the biomechanical support, but also regular activation of cervical and periscapular muscles enhances local blood circulation, which facilitates the delivery of oxygen and nutrients to soft tissues and promotes the removal of inflammatory mediators [21]. These circulatory effects are hypothesised to contribute to reductions in inflammation and pain commonly associated with CS. The present study reinforces this synergy between physical and ergonomic strategies, as participants in the IEG experienced a statistically significant reduction in self-reported musculoskeletal complaints, particularly in the neck and upper back, as measured by the NMQ. Johnston V et al., evaluated the impact of an Ergonomic and Exercise Training (EET) intervention and an Ergonomic and Health Promotion (EHP) intervention on neck pain intensity among all workers and a subgroup of neck pain cases at baseline. He concluded that EET was more effective than EHP in reducing neck pain intensity in both groups immediately after the 12-week intervention period but not at 12 months. However, changes at 12 weeks reached clinically meaningful thresholds for the neck cases. Findings suggest the need to continue exercise to sustain benefits in the long term [22].

The comprehensive approach of the intervention, which included postural awareness, physical activity, and ergonomic management in addition to targeting musculoskeletal abnormalities, may be responsible for the observed improvement. Similar multidimensional interventions have shown comparable outcomes in recent trials. Alshehre YM et al., (2023) reported that a combined ergonomic modification and neck-specific exercise program significantly improved pain, functional capacity, and quality of life among office workers with chronic non specific neck pain [23]. Likewise, a 2024 randomised controlled study demonstrated that workplace-based flexibility, strength, and balance exercises effectively reduced musculoskeletal pain and improved overall functional performance in sedentary employees [24]. These findings reinforce that integrating ergonomic strategies with active physical interventions enhances both preventive and therapeutic outcomes by addressing biomechanical, postural, and psychosocial factors simultaneously. In contrast, the CG, which received only ergonomic advice, exhibited minimal changes across all outcome measures.

Limitation(s)

The study employed a quasi-experimental design rather than a randomised controlled trial. Although efforts were made to ensure baseline group comparability, the lack of randomisation may have introduced selection bias. Second, the reliance on self-reported outcome measures for musculoskeletal symptoms and QoL may have been subject to recall or response bias; future studies should consider incorporating objective clinical assessments such as physical examinations or imaging to improve measurement accuracy. Third, the study sample consisted of CPs aged 25 to 50 years from IT companies in a specific geographic region, limiting the generalisability of the findings to other occupational groups, age ranges, or settings with different ergonomic or cultural contexts.

CONCLUSION(S)

The integrated intervention demonstrated greater improvements in cervical function, mobility, and overall well-being, supporting a combined physical and ergonomic approach for preventing and managing work-related musculoskeletal problems; future research should use randomised controlled trials with larger, more diverse samples to improve validity and generalisability, include long-term follow-up to assess durability, isolate and analyse individual IEP components to optimise design, and examine psychosocial factors such as stress, anxiety, and job satisfaction as moderators of symptoms and outcomes.

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