RESEARCH PAPER

Effect of Application Based Structural Anterior Muscle Chain Exercises on Pain and Posture in Office Workers Having Mechanical Neck Pain

Ms. Manaswi M Shelke[1], Dr. Soniya Lohana (PT)[2*], Dr. Smrutika Shinde[3]

[1]Intern, D. Y. Patil College of Physiotherapy, D. Y. Patil Education Society (Deemed to be University), Kolhapur, 416003, Maharashtra, India
[2*]Assistant Professor, Department of Sports Physiotherapy, D. Y. Patil College of Physiotherapy, D. Y. Patil Education Society (Deemed to be University), Kolhapur, 416003, Maharashtra, India
Email: dr.soniyalohanapt@gmail.com
[3]Assistant Professor, Department of Sports Physiotherapy, D. Y. Patil College of Physiotherapy, D. Y. Patil Education Society (Deemed to be University), Kolhapur, 416003, Maharashtra, India

Received: 25th Aug, 2026 | Revised: 1st Sep, 2026 | Accepted: 5th Sep, 2026 | Available Online: 11th Sep, 2026

ABSTRACT

Background: Mechanical neck pain is a common musculoskeletal condition among office workers due to prolonged sitting, poor posture, and repetitive activities. It often leads to pain, reduced functional capacity, and postural deviations. Recent advancements in rehabilitation emphasize the role of technology-based interventions, such as mobile applications, to improve exercise adherence and outcomes.

Aim : To evaluate the effectiveness of application-based anterior muscle chain exercises on pain and posture in office workers with mechanical neck pain.

Methods: A total of 69 participants were selected based on inclusion and exclusion criteria and randomly divided into three groups (23 each). Group A received a combination of conventional exercises and application-based exercises for 6 weeks. Group B performed only application-based anterior muscle chain exercises for 6 weeks, while Group C received only conventional exercises under supervision. The mobile application provided exercise guidance through visuals, reminders, and structured sessions including warm-up, targeted exercises, and cool-down. Pre- and post-intervention assessments were conducted.

Outcome Measures: Pain intensity was measured using the Numerical Pain Rating Scale (NPRS), and posture was assessed using the APECS scoring system.

Results: All three groups showed statistically significant improvement ($p < 0.05$) in pain and posture following the intervention. However, Group A demonstrated the most significant reduction in pain (NPRS at rest reduced from 2.43 to 0.70 and during activity from 5.65 to 1.70) along with marked improvement in posture (APECS score reduced from 1.48 to 0.30). Group B showed moderate improvement, while Group C showed comparatively minimal changes. Between-group analysis using ANOVA indicated that the combined intervention was significantly more effective than individual approaches.

Conclusion: Application-based anterior muscle chain exercises, when combined with conventional physiotherapy, are more effective in reducing pain and improving posture in individuals with mechanical neck pain compared to either intervention alone. This integrated approach enhances treatment outcomes and supports better rehabilitation.

Keywords: Mechanical neck pain, Anterior Muscle Chain, Mobile application, Pain, Posture

How to cite this article: Manaswi M Shelke1 Dr. Soniya Lohana (PT)2* Dr. Smrutika Shinde3. Effect of Application Based Structural Anterior Muscle Chain Exercises on Pain and Posture in Office Workers Having Mechanical Neck Pain. Int J Drug Deliv Technol. 2026;16(82s):1140-1149. DOI: 10.25258/ijddt.16.82s.125.

INTRODUCTION

Neck pain is a prevalent and burdensome condition particularly in office workers compared to other occupations. The annual prevalence of neck pain in office workers varies from 50-85% of general population Approximately 34% to 49% of workers report a new onset of neck pain during a 1-year follow-up.[1]

The worldwide trend is that the people are using computer for long periods daily, due to increase in computer-based tasks at work and also during leisure activities.[2] In 2007, Office workers working in Netherlands presented with a 31% decrease in their quality of life (QoL) scores after they started experiencing neck pain.[3]

Forward head posture (FHP) and protracted shoulder posture (PSP) are 2 of the most common postural deviations in office workers with neck pain.[4] Exercise is an important component of treatment programs for patients with neck pain.[5] Recently, many studies have focused on specific training on deep cervical muscles.[6] Craniocervical flexor-muscle training enhances ability and improves neuromuscular control of the deep cervical flexor muscles, including the longus colli and longus capitis.[7]

Numerous studies using craniocervical flexor exercise as a treatment have led to a reduction in pain and neck disability, and also enhanced activation of the deep and superficial cervical flexor muscles.[8] Anterior muscle chain includes : suprahyoid muscles, infrahyoid muscles,longus colli and captis, transversus thoracis, scalene muscles, sternocleidomastoid, sternalis, diaphragm, rectus abdominis, femoral triangle, pectineus, iliacus, psoas, levator ani, adductor brevis, adductor magnus and minimus, rectus femoris/quadriceps, short and longtoe extensors, tibialis anterior, and

special attention should be given to the next muscles: tibialis posterior and long toe flexors.[9]

In accordance to principle B, the following muscles and muscular group should be added in a functional version: all flexors of the spine from head to pelvis, all muscles involved in inspiration, adductors of the hip, pelvic floor muscles, flexors of the hip, all extensors of the knee, all dorsiflexors, and all toe extensors. Because of this connection with the tibialis posterior and the long toe flexors, the plantar flexors and toe flexors should be added (principle C), which may require some slight alterations in the stretch position in case of a shortening in this part of the chain. The inversion of the foot will be seen in the spiral chain at the second part of this article. The connective tissues elements added by Myers [4] in these two chains are as follows: scalp fascia, fascia pretrachialis, medial scalene fascia, pharyngeal raphe, sternochondral fascia, fascia endothoracica, fascia prevertebralis, pericardium, mediastinum, parietal pleura, crura and central tendon of the diaphragm, anterior longitudinal ligament, anterior intermuscular septum, anterior longitudinal ligament, pelvic floor fascia, posterior intermuscular septum, fascia of the popliteus, and subpatellar tendon and anterior crural compartment.[10]

The group that had an added smartphone app plus global postural re-education (GPR, including anterior and posterior muscle chain stretching exercises) of four sessions/week for 8 weeks showed better outcomes than the GPR alone and control (ergonomic education only) groups (20 vs. 20 vs. 20 patients) .[11]

It has also been suggested that using smartphone applications could be beneficial in reducing the rate of medical errors and the time required to care for a patient.[12]

Neck pain associated with FHP is associated with poor posture, workload, and structural disorders that may affect activities of daily living, emotional control, and quality of life. [13]

The therapeutic options for FHP with neck pain include exercise and manual therapy and modalities [14]

This review was the first to demonstrate that treatment programs such as exercises and manual therapy were beneficial for improving FHP (as measured via CVA), pain (as measured via VAS and NRS), and disability (as measured via NDI).[15]

Mechanical neck pain is a multifactorial musculoskeletal disorder characterized by pain and discomfort in the cervical region without a specific pathological cause. It is commonly associated with prolonged static postures, repetitive movements, and inadequate ergonomic conditions, particularly among office workers and individuals engaged in computer-based occupations.[16]

The increasing reliance on digital technology in modern workplaces has significantly contributed to the rising incidence of neck pain, making it a major public health concern worldwide.[17]

Office workers are particularly vulnerable due to sustained sitting, forward head posture (FHP), and prolonged screen exposure. These factors lead to muscle imbalance, altered biomechanics, and increased mechanical stress on cervical structures**.**[18] Over time, such stress may result in reduced muscular endurance, impaired proprioception, and decreased functional capacity, ultimately affecting productivity and quality of life.[19]

Forward head posture is one of the most commonly observed postural deviations in individuals with mechanical neck pain. It is characterized by anterior displacement of the head relative to the trunk, leading to increased load on the cervical spine. Studies suggest that for every inch of forward head posture, the load on cervical structures increases significantly, thereby predisposing individuals to pain and dysfunction.[20]

This altered alignment not only affects the cervical region but also influences the thoracic spine, shoulder girdle, and overall body mechanics.[21]

The concept of muscle chains provides a comprehensive understanding of how different muscle groups function in coordination. The anterior muscle chain, in particular, plays a crucial role in maintaining posture, facilitating movement, and ensuring biomechanical stability.[22]

Dysfunction or shortening within this chain can lead to compensatory mechanisms, postural deviations, and musculoskeletal pain.[23]

Therefore, targeting the anterior muscle chain through structured exercises may help restore balance, improve posture, and reduce pain.

Recent advancements in physiotherapy have emphasized the importance of global and functional approaches rather than isolated muscle training. Techniques such as Global Postural Re-education (GPR) and muscle chain exercises aim to address the body as an integrated system.[24]

These approaches focus on stretching shortened muscles, strengthening weak muscles, and improving neuromuscular control, thereby enhancing overall functional outcomes.[25]

Exercise therapy remains one of the most effective non-invasive interventions for managing mechanical neck pain. It not only reduces pain but also improves muscle strength, flexibility, and endurance.[26]

Specifically, exercises targeting deep cervical flexors and anterior muscle chain components have shown promising results in improving posture and reducing disability.[27] Additionally, consistent exercise practice has been associated with long-term benefits, including prevention of recurrence and improved functional independence.[28]

In recent years, the integration of technology in healthcare has led to the emergence of mobile health (mHealth) interventions. Smartphone-based applications have become increasingly popular due to their accessibility, affordability, and ability to provide real-time guidance.[29]

These applications offer features such as exercise demonstrations, reminders, progress tracking, and feedback, which can enhance patient adherence and engagement.[30]

Adherence to exercise programs is a critical factor influencing treatment outcomes. Traditional physiotherapy often faces challenges related to poor compliance due to time constraints, lack of motivation, and limited supervision.[31]

Application-based interventions address these challenges by providing continuous support and encouraging regular participation.[32]

This is particularly beneficial for office workers who may find it difficult to attend frequent physiotherapy sessions due to demanding work schedules.

Furthermore, application-based exercise programs allow individuals to perform exercises at their convenience while ensuring proper technique through visual and instructional guidance.[33]

This not only enhances the effectiveness of the intervention but also empowers individuals to take an active role in their rehabilitation process.[34]

Studies have demonstrated that digital interventions can significantly improve clinical outcomes, including pain reduction, functional ability, and quality of life.[35]

Another important aspect of mechanical neck pain is its impact on psychological and social well-being. Chronic pain conditions are often associated with stress, anxiety, and reduced work performance.[36]

Addressing these factors through comprehensive rehabilitation approaches, including exercise and behavioral interventions, can lead to better overall outcomes.[37]

Ergonomic modifications also play a vital role in the prevention and management of neck pain. Proper workstation setup, appropriate chair support, screen positioning, and regular breaks can significantly reduce the risk of developing musculoskeletal disorders.[38]

However, ergonomic interventions alone may not be sufficient, and they are most effective when combined with targeted exercise programs.[39]

The use of outcome measures such as the Numerical Pain Rating Scale (NPRS) and posture assessment tools like APECS provides objective evaluation of treatment effectiveness. These tools are widely used due to their reliability, validity, and ease of application in clinical and research settings.[40]

Accurate assessment helps in monitoring progress, guiding treatment, and ensuring evidence-based practice.[41]

Despite the growing evidence supporting exercise therapy and digital interventions, there remains a need for studies that specifically evaluate the combined effect of application-based anterior muscle chain exercises and conventional physiotherapy. Most existing studies focus either on isolated exercise programs or general interventions, with limited emphasis on structured muscle chain approaches delivered through mobile applications.[42]

Another advantage of mobile-based interventions is their scalability and cost-effectiveness. Once developed, these applications can be used by a large number of individuals with minimal additional cost.[43]

This makes them particularly useful in resource-limited settings where access to physiotherapy services may be restricted.[44]

In countries with a high burden of musculoskeletal disorders, such interventions can play a crucial role in improving public health outcomes.[45]

Despite the numerous benefits of application-based rehabilitation, it is important to recognize its limitations. Lack of direct supervision may result in improper exercise technique, which can reduce effectiveness or even lead to injury.[46]

Therefore, combining application-based interventions with conventional physiotherapy may provide the best outcomes by ensuring both accessibility and accuracy of exercise performance.[47]

The integration of traditional and digital approaches represents a shift towards more patient-centered care. By combining the expertise of healthcare professionals with the convenience of technology, it is possible to deliver more effective and sustainable rehabilitation programs.[48]

This approach not only addresses the physical aspects of neck pain but also enhances patient engagement and satisfaction.[49]

In the context of office workers, who are constantly exposed to risk factors such as prolonged sitting and poor posture, such integrated interventions are particularly relevant. Providing them with tools that promote regular movement, correct posture, and consistent exercise can significantly reduce the burden of mechanical neck pain.[50]

METHODOLOGY

This comparative experimental study was conducted on Office workers/IT workers (Clerks) working in and around Kolhapur. Study was conducted for a duration of 6 Months. Using Convenience sampling 69 subjects were selected according to inclusion and exclusion criteria. Recent cervical spine surgery or trauma, Neurological symptoms, Cervical disc herniation, Lack of smartphone access, undergoing other structured exercise programs, Patient not willing to participate, Lack of smartphone access

PROCEDURE

Pilot study was done on 8 normal individuals before starting the study. Computer workers were selected on the basis of inclusion and exclusion criteria. Numerical pain rating scale was given to assess the degree of pain. Research was carried out in 3 groups (23 in each group)

Group A: Conventional based Exercises + Mobile based Application Exercises

Group B: Mobile based Application Exercises

Group C: Conventional based exercises

Group A participants received Conventional based exercises for 3 weeks followed by Application based exercises for 3 weeks. Group B received Application based anterior muscle chain exercise program was followed by participants for 6 weeks. Group C received Conventional Exercises was given in the presence of therapist which was same as designed for the application. It was given for 6 weeks. The App which was named as "Physiochain" sent 4 reminders daily, prompting exercise sessions approximately every 3 hours.

Each session included:

Warm up (dynamic stretching 3-4min)

2 targeted exercises (5-8 reps,2 sets)

Cool down (stretching and breathing 2-3 min)

Daily schedule was:

7:00 AM - 2 exercises

11:00 AM - 2 exercises

3:00 AM - 2 exercises

7:00 AM - 2 exercises

Exercise delivery:

Exercise delivered via videos/graphics in the App for proper guidance.

Week 1-2 exercise -

Front Lunges

Push Ups

Boat holds

Wall sit

Reverse Planks

Tibial Raises

Overhead Presses

Heel Touches

App was tracking daily activity and send reminders

Weekly follow ups were taken to monitor progress

Pre - post intervention data was analysed to evaluate effectiveness of program.

App provides Exercises through the Graphics for Proper Monitoring.

And gives Timer for completion of the exercises.

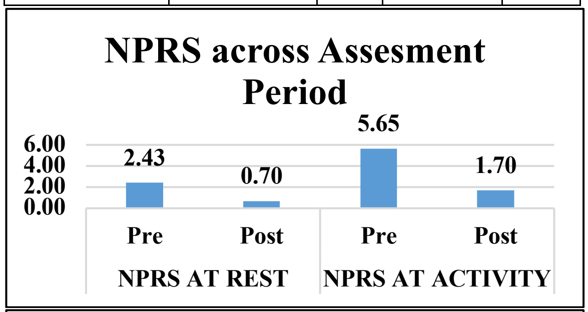
RESULT

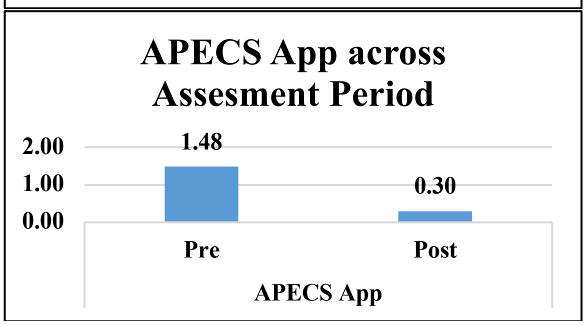
A total of 69 participants were included in the study and were equally allocated into three groups, with 23 participants in each group, namely Group A (application-based exercises combined with conventional therapy), Group B (application-based exercises), and Group C (conventional exercises).

Group A included 23 participants who received a combination of application-based and conventional exercises. The chart and graphical analysis show a clear improvement in all outcome measures after the intervention. Initially, most participants reported mild to moderate pain at rest and higher pain during activity; however, after the intervention, the majority shifted towards minimal or no pain levels. Similarly, postural assessment indicated that many participants who had noticeable postural deviations before treatment showed improved alignment post-intervention. The graphs demonstrate a consistent reduction in pain scores and improvement in posture among most participants in this group. Overall, Group A showed marked and uniform improvement, indicating the effectiveness of the combined intervention approach.

Group A				
Parameters	**Assessment Period**	**Mean**	**Std. Deviation**	**p-value**
NPRS AT REST	Pre	2.43	1.04	<0.001*
	Post	0.70	0.47	
NPRS AT ACTIVITY	Pre	5.65	1.19	<0.001*

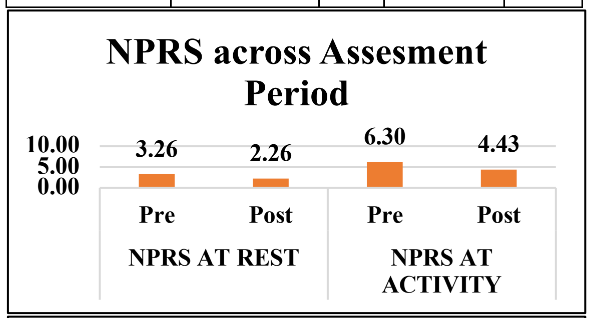
	Post	1.70	0.56	
APECS App	Pre	1.48	0.51	<0.001*
	Post	0.30	0.47	

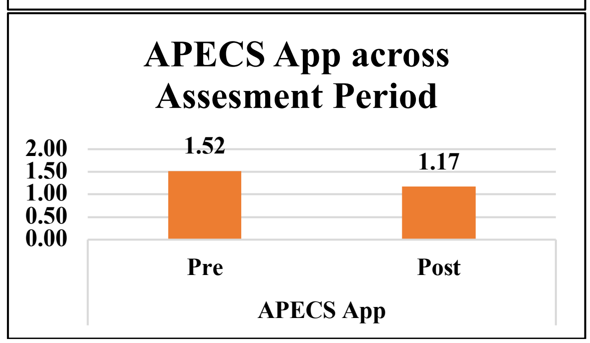




Group B consisted of 23 participants who performed application-based anterior muscle chain exercises. The chart and graphical analysis indicate a moderate level of improvement in all outcome measures following the intervention. At baseline, most participants reported moderate pain at rest and during activity, which showed a noticeable reduction after the intervention, although not to the same extent as observed in Group A. Postural assessment also demonstrated some improvement, with a portion of participants showing better alignment in the post-intervention phase. However, the changes were less uniform, with a few participants still presenting with residual pain and postural deviations. Overall, the graphs reflect a gradual improvement trend in Group B, suggesting that application-based exercises alone are effective, but produce comparatively lesser results than the combined approach.

Group B				
Parameters	**Assessment Period**	**Mean**	**Std. Deviation**	**p-value**
NPRS AT REST	Pre	3.26	1.66	<0.001*
	Post	2.26	1.36	
NPRS AT ACTIVITY	Pre	6.30	1.22	<0.001*
	Post	4.43	1.12	
APECS App	Pre	1.52	0.67	0.008*
	Post	1.17	0.58	

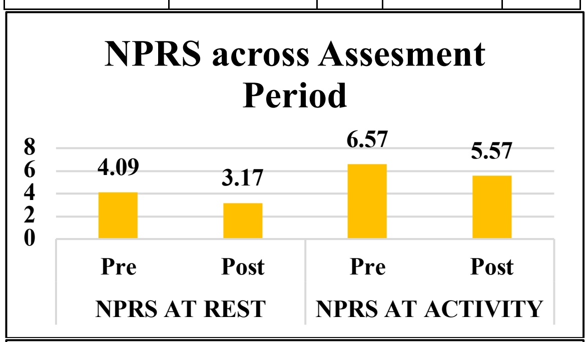


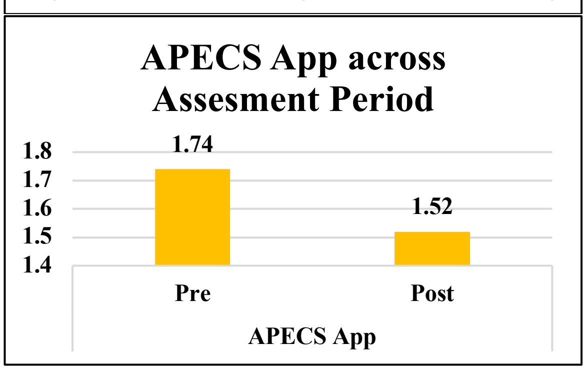


GROUP C

Group C consisted of 23 participants who received only conventional exercises under supervision. The chart and graphical analysis show a comparatively smaller improvement in the outcome measures following the intervention. At baseline, most participants reported moderate to higher levels of pain at rest and during activity, and although there was some reduction after the intervention, a considerable number of participants continued to experience residual pain. Postural assessment revealed minimal improvement, with many participants still showing postural deviations even after the treatment period. The graphs indicate a slower and less consistent trend of improvement compared to the other groups. Overall, Group C demonstrated limited changes, suggesting that conventional exercises alone were less effective than application-based or combined interventions.

Group C				
Parameters	**Assessment Period**	**Mean**	**Std. Deviation**	**p-value**
NPRS AT REST	Pre	4.09	1.041	<0.001*
	Post	3.17	0.984	
NPRS AT ACTIVITY	Pre	6.57	0.945	-
	Post	5.57	0.945	
APECS App	Pre	1.74	0.541	0.057
	Post	1.52	0.593	





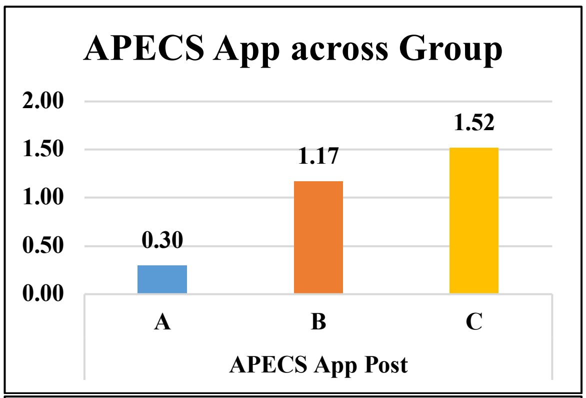
GROUP COMPARISON

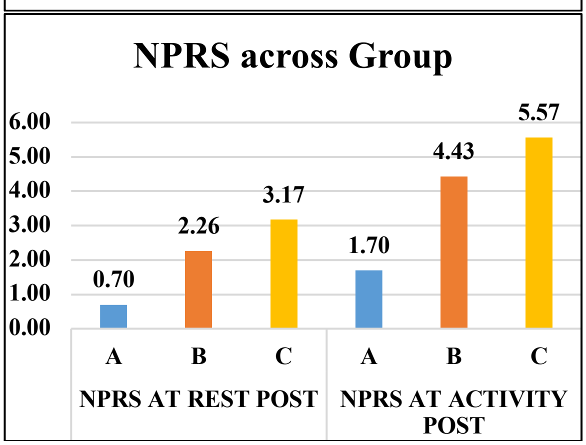
The comparative analysis of all three groups demonstrates a clear difference in the effectiveness of the interventions on pain and posture among office workers with mechanical neck pain. Group A, which received a combination of application-based and conventional exercises, showed the most pronounced improvement across all outcome measures. The majority of participants in this group shifted from higher pain levels at baseline to minimal or no pain post-intervention, both at rest and during activity. Additionally, postural assessment revealed a marked correction in alignment, with most participants demonstrating visible improvement.

Group Comparison				
Parameters	**Group**	**Mean**	**Std. Deviation**	**p-value**
NPRS AT REST POST	A	0.70	0.47	<0.001*
	B	2.26	1.36	
	C	3.17	0.98	
	Total	**2.04**	**1.43**	
NPRS AT ACTIVITY POST	A	1.70	0.56	<0.001*
	B	4.43	1.12	
	C	5.57	0.95	
	Total	**3.90**	**1.86**	
APECS App Post	A	0.30	0.47	<0.001*
	B	1.17	0.58	
	C	1.52	0.59	
	Total	**1.00**	**0.75**	

In contrast, Group B, which followed only application-based exercises, showed moderate improvement. While there was a noticeable reduction in pain levels and some degree of postural correction, a proportion of participants continued to experience mild to moderate symptoms, indicating that the improvement was present but less consistent compared to Group A. Group C, which received only conventional exercises, demonstrated the least improvement among the three groups. Although some reduction in pain was observed, many participants continued to report residual discomfort, and postural changes were minimal.

The graphical and tabular data collectively highlight a clear trend, where Group A outperformed both Group B and Group C, followed by Group B, while Group C showed the least effectiveness. This comparison suggests that integrating application-based anterior muscle chain exercises with conventional therapy provides superior and more consistent outcomes than either intervention alone.





DISCUSSION

The present study was undertaken to evaluate the effectiveness of application-based structural anterior muscle chain exercises on pain reduction and postural correction in office workers suffering from mechanical neck pain. The findings of this study demonstrate that all three intervention groups showed improvement in the selected outcome measures, namely pain intensity assessed using the Numerical Pain Rating Scale (NPRS) and posture evaluated using the APECS system. However, the magnitude and consistency of improvement varied significantly among the groups, with the combined intervention group (Group A) showing the most favourable outcomes, followed by the application-based group (Group B), while the conventional exercise group (Group C) exhibited comparatively lesser improvement.

Group A, which received a combination of application-based exercises along with conventional physiotherapy, demonstrated the most pronounced reduction in pain levels both at rest and during activity. A majority of participants in this group showed a clear shift from moderate levels of pain at baseline to minimal or no pain following the intervention period. In addition, postural assessment revealed marked improvement, with many participants achieving better alignment and reduction in forward head posture and associated deviations. This superior outcome can be attributed to the synergistic effect of combining supervised exercise sessions with application-based guidance. The presence of a therapist during conventional sessions ensures correct posture, technique, and individualized corrections, while the application component provides continuous reinforcement, structured exercise routines, and regular reminders. This dual approach likely enhances adherence, motivation, and consistency, which are critical factors in achieving optimal rehabilitation outcomes. Furthermore, the integration of visual and instructional support through the application may have improved participants' understanding and execution of exercises, leading to more effective engagement of the targeted anterior muscle chain.

Group B, which followed only application-based anterior muscle chain exercises, also showed a considerable degree of improvement in both pain and posture. Participants in this group demonstrated a reduction in pain levels and some correction in postural deviations; however, the extent of improvement was less pronounced compared to Group A. The effectiveness observed in this group highlights the potential of mobile health applications as a convenient and accessible tool for rehabilitation, especially for individuals with busy schedules such as office workers. Features such as exercise reminders, guided instructions, and ease of access may have contributed to better compliance and regular participation. However, the absence of direct supervision may have limited the accuracy of exercise performance, as incorrect posture or technique during exercise could reduce the overall effectiveness of the intervention. Additionally, without real-time feedback from a therapist, participants may not have been able to correct subtle errors, which could explain the comparatively moderate outcomes seen in this group.

Group C, which received only conventional exercises under therapist supervision, showed the least improvement among the three groups. Although there was some reduction in pain and slight improvement in posture, a significant number of participants continued to report residual symptoms at the end of the intervention period. The relatively lower effectiveness in this group may be due to limited engagement outside supervised sessions. Unlike application-based interventions, conventional therapy does not provide continuous reinforcement or reminders, which may affect adherence and consistency, particularly in individuals with demanding work schedules. Additionally, the lack of frequent follow-up or independent practice may have contributed to slower progress in this group. These findings suggest that while conventional exercises are beneficial, their effectiveness may be enhanced when combined with supportive tools that encourage regular practice and sustained engagement.

The comparative analysis of all three groups clearly indicates that the integration of application-based exercises with conventional therapy produces superior results in terms of both pain reduction and postural correction. The trend observed across the groups suggests that technology-assisted interventions can play a crucial role in improving rehabilitation outcomes by enhancing accessibility, adherence, and patient involvement. Office workers, who are often exposed to prolonged static postures and repetitive strain, may particularly benefit from such interventions, as they provide flexibility and ease of incorporation into daily routines.

The findings of this study are consistent with existing literature that supports the role of exercise therapy in managing mechanical neck pain and correcting postural deviations. Previous studies have reported that targeted muscle training, particularly focusing on the deep cervical flexors and anterior muscle chain, can significantly reduce pain and improve functional outcomes. Additionally, recent research has emphasized the growing importance of digital health solutions, including mobile applications, in improving patient compliance and treatment effectiveness. The present study builds upon these findings by demonstrating that a combined approach not only enhances clinical outcomes but also ensures more consistent improvement across participants.

Another important observation in this study is the reduction in variability of outcomes, particularly in Group A. The post-intervention data showed more uniform improvements among participants in this group, suggesting that the combined intervention was effective across individuals with varying baseline characteristics. This consistency further strengthens the clinical relevance of the findings and highlights the reliability of the intervention approach.

From a clinical perspective, the results of this study emphasize the importance of adopting a multidimensional treatment strategy for managing mechanical neck pain in office workers. Sole reliance on conventional therapy may not be sufficient to achieve optimal results, especially in populations with limited time and high occupational demands. Incorporating application-based exercise programs can bridge this gap by promoting self-management, improving adherence, and providing continuous guidance.

The discussion of the present study highlights that while all intervention approaches contribute to improvement in pain and posture, the combination of application-based and conventional exercises yields the most effective and consistent results. Application-based interventions alone also show promising outcomes, indicating their potential as a standalone or supplementary treatment option. However, conventional exercises, when used in isolation, may require additional support to achieve comparable effectiveness. These findings reinforce the value of integrating technology with traditional rehabilitation methods to enhance patient outcomes in modern clinical practice.

CONCLUSION

All three intervention groups demonstrated improvement in the selected outcome measures; however, the extent and consistency of improvement varied among them. The group receiving a combination of application-based and conventional exercises showed the most pronounced and uniform reduction in pain levels, both at rest and during activity, along with notable correction in postural alignment. This indicates that the integration of supervised physiotherapy with application-based guidance enhances treatment effectiveness by improving adherence, consistency, and accuracy of exercise performance.

Overall, the findings of this study support the use of a combined approach that integrates application-based exercise programs with conventional physiotherapy for more effective management of mechanical neck pain and associated postural deviations. This approach not only enhances clinical outcomes but also promotes better compliance and long-term sustainability of treatment in office workers.

REFERENCES-

1. Chen X, Coombes BK, Sjøgaard G, Jun D, O'Leary S, Johnston V. Workplace-based interventions for neck pain in office workers: systematic review and meta-analysis. Physical therapy. 2018 Jan;98(1):40-62.Eur

Spine (2007) , B. Cagnie , L. Danneels, D. Van Tiggelen , V. De Loose . D. Cambier

2. Cagnie B, Danneels L, Van Tiggelen D, De Loose V, Cambier D. Individual and work related risk factors for neck pain among office workers: a cross sectional study. European Spine Journal. 2007 May;16:679-86.
3. Louw S, Makwela S, Manas L, Meyer L, Terblanche D, Brink Y. Effectiveness of exercise in office workers with neck pain: A systematic review and meta-analysis. The South African journal of physiotherapy. 2017 Nov 28;73(1):392.
4. Mehri A, Letafatkar A, Khosrokiani Z. Effects of corrective exercises on posture, pain, and muscle activation of patients with chronic neck pain exposed to anterior-posterior perturbation. Journal of manipulative and physiological therapeutics. 2020 May 1;43(4):311-24.
5. Suvarnnato T, Puntumetakul R, Uthaikhup S, Boucaut R. Effect of specific deep cervical muscle exercises on functional disability, pain intensity, craniovertebral angle, and neck-muscle strength in chronic mechanical neck pain: a randomized controlled trial. Journal of pain research. 2019 Mar 7:915-25.
6. Suvarnnato T, Puntumetakul R, Uthaikhup S, Boucaut R. Effect of specific deep cervical muscle exercises on functional disability, pain intensity, craniovertebral angle, and neck-muscle strength in chronic mechanical neck pain: a randomized controlled trial. Journal of pain research. 2019 Mar 7:915-25.
7. O'Leary S, Jull G, Kim M, Vicenzino B. Specificity in retraining craniocervical flexor muscle performance. journal of orthopaedic & sports physical therapy. 2007 Jan;37(1):3-9
8. Jull G, Trott P, Potter H, Zito G, Niere K, Shirley D, Emberson J, Marschner I, Richardson C. A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache.
9. Rosario JL. Understanding muscular chains–A review for clinical application of chain stretching exercises aimed to correct posture. EC Orthop. 2017;5(6):209-34.
10. Myers TW. Anatomy trains: myofascial meridians for manual and movement therapists. Elsevier Health Sciences; 2009.
11. Abadiyan, F.; Hadadnezhad, M.; Khosrokiani, Z.; Letafatkar, A.; Akhshik, H. Adding a smartphone app to global postural re-education to improve neck pain, posture, quality of life, and endurance in people with nonspecific neck pain: A randomized controlled trial. *Trials* **2021**, *22*, 274. [**Google Scholar**]
12. Siebert, J.N.; Ehrler, F.; Combescure, C.; Lacroix, L.; Haddad, K.; Sanchez, O.; Gervaix, A.; Lovis, C.; Manzano, S. A Mobile Device App to Reduce Time to Drug Delivery and Medication Errors During Simulated Pediatric Cardiopulmonary Resuscitation: A Randomized
13. Controlled Trial. *J. Med. Internet Res.* **2017**, *19*, e31. [**Google Scholar**]
14. Kim, D.; Cho, M.; Park, Y.; Yang, Y. Effect of an exercise program for posture correction on musculoskeletal pain. *J. Phys. Ther. Sci.* **2015**, *27*, 1791–1794. [**Google Scholar**] [**CrossRef**]
15. Heydari, Z.; Sheikhhoseini, R.; Shahrbanian, S.; Piri, H. Establishing minimal clinically important difference for effectiveness of corrective exercises on craniovertebral and shoulder angles among students with forward head posture: A clinical trial study. *BMC Pediatr.* **2022**, *22*, 230. [**Google Scholar**
16. Binder AI. Cervical spondylosis and neck pain. BMJ. 2007;334:527–31
17. Hoy DG, Protani M, De R, Buchbinder R. The epidemiology of neck pain. Best Pract Res Clin Rheumatol. 2010;24(6):783–92.
18. Cagnie B, Danneels L, Van Tiggelen D, De Loose V, Cambier D. Individual and work-related risk factors for neck pain. Eur Spine J. 2007;16(5):679–86.
19. Ariëns GAM, Van Mechelen W, Bongers PM, Bouter LM, Van der Wal G. Physical risk factors for neck pain. Scand J Work Environ Health. 2000;26(1):7–19.
20. Hansraj KK. Assessment of stresses in the cervical spine caused by posture. Surg Technol Int. 2014;25:277–9
21. Koseki T, Kakizaki F, Hayashi S, Nishida N, Itoh M. Effect of forward head posture. J Phys Ther Sci. 2019;31(1):63–8.
22. Myers TW. Anatomy Trains. 3rd ed. Elsevier; 2014.
23. Page P, Frank CC, Lardner R. Assessment and Treatment of Muscle Imbalance. Human Kinetics; 2010.
24. Souchard PE. Global Postural Re-education. Elsevier; 2011.
25. Kisner C, Colby LA. Therapeutic Exercise. 6th ed. FA Davis; 2012.
26. Gross A, Paquin JP, Dupont G, et al. Exercises for mechanical neck disorders. Cochrane Database Syst Rev. 2015.

27. Falla D, Jull G, Hodges P. Training deep cervical flexors. Spine. 2004;29(19):2108–14.
28. Kay TM, Gross A, Goldsmith CH, et al. Exercises for mechanical neck disorders. Spine. 2012;37(1):E1–13.
29. Free C, Phillips G, Watson L, et al. Effectiveness of mobile-health technologies. PLoS Med. 2013;10(1):e1001363.
30. Direito A, Jiang Y, Whittaker R, Maddison R. Apps for physical activity. Br J Sports Med. 2015;49:159–65.
31. Jack K, McLean SM, Moffett JK, Gardiner E. Barriers to treatment adherence. Clin Rehabil. 2010;24(10):969–79.
32. Bassett SF. Role of technology in rehabilitation. Phys Ther Rev. 2003;8(3):143–51.
33. Bort-Roig J, Gilson ND, Puig-Ribera A, et al. Smartphone interventions. J Med Internet Res. 2014;16(3):e95.
34. Direito A, Dale LP, Shields E, et al. Do physical activity apps work? Int J Behav Nutr Phys Act. 2017;14:105.
35. Cottrell MA, Galea OA, O'Leary SP, Hill AJ, Russell TG. Telehealth in musculoskeletal physiotherapy. J Telemed Telecare. 2017;23(3):379–91.
36. Linton SJ. Psychological factors in neck pain. Spine. 2000;25(9):1148–56.
37. Gatchel RJ, Peng YB, Peters ML, et al. Biopsychosocial approach. Psychol Bull. 2007;133(4):581–624.
38. Robertson MM, Huang YH, Lee J. Ergonomic intervention. Appl Ergon. 2017;62:103–10.
39. Hoe VC, Urquhart DM, Kelsall HL, Sim MR. Ergonomic interventions review. Occup Environ Med. 2012;69(4):299–309.
40. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain. Arthritis Care Res. 2011;63:S240–52.
41. Portney LG, Watkins MP. Foundations of Clinical Research. 3rd ed. Pearson; 2015.
42. Shariat A, Cleland JA, Danaee M, et al. Effects of stretching on posture. J Back Musculoskelet Rehabil. 2018;31(3):589–98.
43. WHO. mHealth: New horizons. 2011.
44. Free C, Knight R, Robertson S, et al. Mobile health interventions. Lancet. 2013;381:183–203.
45. Vos T, Allen C, Arora M, et al. Global burden of disease. Lancet. 2016;388:1545–602.
46. Cottrell MA, Russell TG. Telehealth limitations. J Telemed Telecare. 2020;26(5):271–7.
47. Russell TG. Physical rehabilitation using telemedicine. J Telemed Telecare. 2007;13(5):217–20.
48. Dinesen B, Nonnecke B, Lindeman D, et al. Personalized telehealth. J Med Internet Res. 2016;18(7):e189.
49. Kruse CS, Krowski N, Rodriguez B, et al. Telehealth patient satisfaction. BMJ Open. 2017;7:e016242.
50. Oakman J, Macdonald W, Bartram T, et al. Workplace interventions. BMC Musculoskelet Disord. 2018;19:322.