ORIGINAL ARTICLE

Comparison of McKenzie and Isometric Exercises on Neck Functions of Computer Users with Forward Head Posture

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ABSTRACT

Introduction: Prolonged use of computer can lead to poor posture such as forward head posture (FHP). This posture is associated with imbalance and stiffness of the neck muscles, lack of postural awareness and inappropriate ergonomics, resulting in work-related musculoskeletal disorders. These disturbances can affect the performance and productivity of office workers. Postural awareness training, neck exercises, and modalities are interventions in FHP management. Research that compares the effectiveness of cervical McKenzie and isometric exercise on neck functional score in computer users with forward head posture has not been conducted.

Methods: This research was a quasi-experimental. The participants, 24 computer users working at Kariadi Hospital, Semarang, were divided into 2 groups by purposive sampling receiving cervical McKenzie exercise (n=12) and cervical isometric exercise (n=12). Each group received different exercise. Neck functional score was assessed by Neck Disability Index (NDI) questionnaire before and after intervention. The mean differences before and after treatment, as well as between groups was compared statistically using paired t-test.

Results: The mean NDI score in the McKenzie group after treatment showed an improvement of 7.84 ± 3.54 with p = 0.002. The mean NDI score in the isometric group after treatment also showed an improvement of 3.93 ± 3.75 with p = 0.004. The difference in NDI score improvement in the cervical McKenzie group was greater than the one in isometric group and statistically significant with p = 0.017.

Conclusion: Cervical McKenzie exercise was proved to be more effective in improving neck functional scores in patients with FHP compared to cervical isometric exercise.

Keywords: McKenzie exercise, isometric exercise, Neck Disability Index

ABSTRAK

Latar Belakang: Penggunaan komputer dalam waktu lama dapat menimbulkan postur yang buruk seperti *forward head posture* (FHP). Postur ini dikaitkan dengan ketidakseimbangan dan kekakuan otot-otot leher, kurangnya *postural awareness* dan ergonomis yang kurang sesuai sehingga timbul gangguan muskuloskeletal terkait kerja. Gangguan ini dapat mempengaruhi performa dan produktivitas pekerja kantoran. Pelatihan kesadaran postural, latihan leher, dan modalitas adalah intervensi dalam manajemen FHP. Latihan McKenzie dan latihan isometrik servikal telah digunakan secara luas dan ditunjukkan dalam penelitian sebelumnya dan secara efektif meningkatkan fungsi leher. Kedua intervensi ini efektif untuk memperkuat *deep cervical flexors*, yang penting untuk menjaga keselarasan tulang belakang leher. Namun penelitian yang membandingkan efektivitas kedua latihan pada pengguna komputer dengan FHP belum pernah dilakukan.

Methods: Penelitian ini merupakan *quasi experimental*. Subjek adalah 24 orang karyawan pengguna komputer di RSUP Kariadi, Semarang yang dibagi menjadi 2 kelompok secara purposive sampling dan mendapatkan latihan McKenzie servikal (n=12) dan latihan isometrik servikal (n=12). Derajat skor fungsional leher dinilai dengan kuesioner NDI *(Neck Disability Index)* sebelum dan sesudah intervensi.

Hasil: Rerata skor NDI pada kelompok McKenzie sesudah perlakuan menunjukkan perbaikan sebesar 7,84 ± 3,54 dengan p = 0,002. Rerata skor NDI pada kelompok isometrik sesudah perlakuan juga menunjukkan perbaikan sebesar 3,93 ± 3,75 dengan p = 0,004. Selisih perbaikan skor NDI pada kelompok McKenzie servikal sebesar bermakna secara statistik dengan p = 0,017.

Simpulan: Latihan McKenzie servikal terbukti lebih efektif dalam memperbaiki fungsi leher pada penderita FHP dibandingkan dengan latihan isometrik servikal.

Kata kunci: Latihan McKenzie, latihan isometric, *Neck Disability Index*

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INTRODUCTION

Recent increase in computer-related activity has increased the prevalence of neck complaints among computer office workers.[1] Long-term computer use can result in a number of health issues, including poor neck posture, musculoskeletal disorders of the neck and upper extremities, obesity, and eyesight impairment.[2,3] Previous research found that people who positioned their monitors and sat incorrectly reported frequent neck and upper back pain.[4] Poor posture during work can continuously increase the static stress on certain soft tissues in the neck

and lead to musculoskeletal disorders, eventually impairing work performance and productivity.[5]

Forward Head Posture (FHP) is a poor habitual neck posture defined as hyper extension of upper cervical, anterior translation of cervical vertebrae, and flexion of lower cervical with cranio-vertebral angle (CVA) less than 49° as a reference.[6-9] In previous studies, prevalence of FHP was reported to be 63,96% among university students in Pakistan, 85,5% among dental staff, and 66% among healthy participants between the ages of 20-60. Hence, 67% participants were identified with FHP while 58,5% were not aware of it.[10] The prevalence of musculoskeletal disorders among office workers who use computers is significantly influenced by postural awareness and workplace ergonomics. Maintaining the same position while looking at the display for extended periods results in excessive posterior curve at upper thoracic vertebrae and anterior curve at lower cervical vertebrae. [10-12]

Musculoskeletal pain and persistent discomfort can impair quality of life and may result in permanent impairment.[2,13,14] Restoring the ideal cranio-cervical posture through improved postural awareness, an ergonomic work environment, therapeutic exercises, motor learning, or particular manual treatment techniques is the key to managing FHP.[15] Therapeutic exercises are an effective intervention in reducing head and neck symptoms and disability.[16] Postural exercises are commonly used to treat poor posture and cervical dysfunction. The majority of strengthening exercises target the deep cervical flexors, which play an important role in maintaining cervical spine alignment. McKenzie and isometric neck exercises are two effective interventions for strengthening the deep cervical flexors.[6,9,17]

The purpose of the McKenzie exercise, a form of self-therapeutic training, is to stretch, rehabilitate, and improve neck flexor flexibility. It aims to reduce spasms in the cranio-cervical muscles, widen the range of motion, and restore the anatomical neck posture, or cervical lordosis.[18] Exercises targeting isometric function of the neck muscles are designed to keep the head and neck in an upright position.[19]

This study compared the effects of cervical McKenzie and isometric exercises on neck function in computer users with FHP. Despite the widespread use and demonstrated effectiveness of both exercises in improving neck function, there is currently no research comparing the efficiency of these two exercises in individuals with FHP. [18,20,21]

METHODS

This study employed a quasi-experimental design with pre and post-intervention group. It was conducted between May and June 2021 at the RSUP dr. Kariadi office building in Semarang. Participants were purposively allocated to either the McKenzie cervical exercise group (n=12) and the isometric group (n=12). The Neck Disability Index (NDI) questionnaire was used to assess the neck's functional score both before and after the fourth week of treatment.

Inclusion criteria were office workers with FHP, CVA $\leq 49^{o}$, daily computer usage of 6-8 hours, aged between 25 and 55 years old, and a minimum of one year of employment.

Participants with a history of trauma, surgery, muscle and ligament injuries to the neck region

within the past three months, a cervical fracture, degenerative disorders, inflammatory arthritis, spine deformity (scoliosis or kyphosis), and neck collar use within the previous six months were excluded from the study. Individuals with heart or vascular disorders, strabismus, visual field disorders, or untreated visual disorders were also excluded. Participants in each group performed their chosen exercise three times per week for four weeks.

Participants were excluded from the trial if they failed to complete the exercise twice consecutively, three times maximally, received any additional therapeutic or conservative exercises, or failed to adhere to the study rules.

As shown in Fig.1, twelve participants assigned to the cervical McKenzie program underwent movement training, which comprised two sets of six movements with a one-minute break between sets. Each movement was repeated six times, with a five-second hold time between repetitions. McKenzie cervical exercise lasted approximately 15 minutes.

- *Sitting Chin Tuck.* Use fingers to position the chin and press gently backward for 5 s before returning to the initial position
- *Sitting Neck Extension.* Pull the chin backward slowly and extend the head for 5 s before returning to the initial position
- *Side-Bending.* Place one hand on the back of the neck and fix the neck or on the knee comfortably while using another hand to pull the head in the opposite direction.
- *Neck Rotation.* Pull the chin backward and rotate the head for 5 s before returning to the initial position.
- *Sitting Neck Flexion.* Place one hand positions on the back of the neck and fix the neck while using another hand to push the head gently forward for 5 s.
- *Neck Extension and Rotation.* Pull the chin backward and alternately extend and rotate the head for 5 s.
- The remaining 12 participants assigned to cervical isometric exercise program underwent training movements performed in sitting position by resisting at the forehead toward cervical flexion, extension, lateral flexion and rotation using their own hand for 10 seconds, with 30-second breaks between holds, and completed 10 repetitions as shown in Fig.2. To adapt to isometric exercises, each participant began with submaximal resistance.

Figure 1. Cervical McKenzie exercise

Figure 2. Cervical isometric exercise

Prior to the study, researchers explained each exercise program, ergonomic working posture, and monitoring form included in participant's booklet about FHP. All sessions started with postural re- education, involving participants finding a neutral balance position while sitting. Stretching exercises for the neck flexor, extensor, lateral flexor, rotator, and shoulder shrug were performed by all participants for 30 seconds as warm-up and cool-down exercises.

Descriptive statistics were used to characterize the participants' demographic characteristics. The normality of the data was tested using Shapiro-Wilk test ($p > 0.05$). Age, body height, and BMI were normally distributed data. An independent t-test was used to compare the demographic variables. As length of work was not normally distributed, the Mann-Whitney U test was performed. To compare the differences in improvement (pre-post) of NDI between groups, the paired t-test was performed for normally distributed data. The Statistical Package for Social Sciences (SPSS) was used for all statistical analyses. A value of 0.05 was assumed to be significant for all statistical analyses with 95% confidence intervals.

The study was approved by Health Research Ethics Committee of Dr. Kariadi General Hospital Semarang (774/EC/KEPK-RSDK/2021) and Letter of Permit for Conducting Research was also obtained (No: DP.02.01/I.II/2423/2021). Written informed consent was obtained from all participants prior to data collection.

RESULT

A total of 24 individuals were analyzed until the end of the study, with no dropouts observed. No significant differences were noted between groups in terms of age, gender, body height, body mass index (BMI), physical activity level, working length, and neck pain complaint. The characteristics of data can be seen in table 1.

Throughout the study, neither group experienced any side effects from the exercise sessions.

At the beginning of study, the mean NDI scores in McKenzie group before and after training were 12.58 ± 6.86 and 5.09 ± 5.02, respectively, with p value = 0.002. In isometrics group, the mean NDI scores before and after training were 12.60 ± 6.61 and 8.68 ± 4.56, respectively, with p value = 0.004. The difference in pre-post training NDI scores was larger in McKenzie group (7,48 ± 3,54) than in isometrics group (3,93 ± 3,75) and was statistically significant (p=0.017).

Table 2 shows significant differences in NDI scores before and after treatment in McKenzie group (p=0.002) and isometrics group (p=0.004).

DISCUSSION

There were no statistically significant differences in participant characteristics between the two groups, (Table 1) (p value > 0.05). It means that the characteristics of the research subjects in both groups are homogeneous.

The Neck Disability Index (NDI) questionnaire was used to calculate neck functional score in this study. When comparing the results of the pre-test and post-test, both groups exhibited significantly increased mean score for NDI. Notably, the McKenzie group showed greater improvement than the isometrics group (Table 2).

Forward head posture can impose mechanical demands on cervical tissue, leading to pain due to increased stress on the joints, muscles, and nerves of the neck.[22] While FHP does not directly cause neck pain, the increased load on the neck can result in muscle length changes due to muscle imbalance, potentially causing pain over time.[23]

Table 1. Characteristics of the participants (n= 24)

Variable	Group		p
	McKenzie	Isometric	
Age	36,92 ± 6,56	37,67 ± 6,13	0,775†
Gender			
Male	3 (25%)	2 (16,7%)	1,000§
Female	9 (75%)	10 (83,3%)	
Body Height	1,55 ± 0,05	1,56 ± 0,05	0,599†
BMI	25,71 ± 3,01	26,31 ± 2,58	0,602†
Physical Activity			
Low	8 (66,7%)	9 (75%)	0,879§
Moderate	1 (8,3%)	1 (8,3%)	
High	3 (25%)	2 (16,7%)	
Length of working	10,67 ± 6,67	11,00 ± 6,33	0,838‡
Neck Pain			
Yes	6 (50%)	3 (25%)	0,200§
No	6 (50%)	9 (75%)	

* Significant; † Independent t; ‡ Mann whitney; § Chi square

Table 2. Comparison of mean NDI value between both group

NDI	Group		P
	McKenzie cervical	Isometric cervical	
Pre intervention	12,58 ± 6,86	12,60 ± 6,61	0,993§
Post intervention	5,09 ± 5,02	8,68 ± 4,56	0,104‡
P	0,002†*	0,004¶*	
Delta	-7,48 ± 3,54	-3,93 ± 3,75	0,017‡

* Significant (p<0.05); † Wilcoxon; ‡ Mann Whitney; § Independent t; ¶ Paired t;

Table 3. Comparison of NDI section between both group

NDI section		Group							
		McKenzie cervical				Isometrik cervical			
		Pre	Post	p†	Delta	Pre	Post	p†	Delta
1.	Pain intensity	0,75 ± 0,62	0,17 ± 0,39	0,008	-0,58 ± 0,52	1,33 ± 0,99	0,67 ± 0,65	0,005	-0,67 ± 0,49
2.	Personal care	0,42 ± 0,90	0,08 ± 0,29	0,102	-0,33 ± 0,65	0,33 ± 0,65	0,08 ± 0,29	0,083	-0,25 ± 0,45
3.	Lifting	0,42 ± 0,67	0,17 ± 0,58	0,257	-0,25 ± 0,75	0,42 ± 0,65	0,25 ± 0,62	0,317	-0,17 ± 0,58
4.	Reading	1,00 ± 0,74	0,50 ± 0,67	0,014	-0,50 ± 0,52	0,83 ± 0,39	0,67 ± 0,49	0,317	-0,17 ± 0,58
5.	Headaches	0,92 ± 0,52	0,67 ± 0,49	0,083	-0,25 ± 0,45	1,08 ± 1,00	0,75 ± 0,75	0,046	-0,33 ± 0,49
6.	Concentration	0,50 ± 0,52	0,17 ± 0,39	0,046	-0,33 ± 0,49	0,83 ± 0,84	0,67 ± 0,65	0,317	-0,17 ± 0,58
7.	Work	0,67 ± 0,65	0,17 ± 0,39	0,034	-0,50 ± 0,67	0,58 ± 0,67	0,42 ± 0,52	0,317	-0,17 ± 0,58
8.	Driving	0,43 ± 0,54	0,43 ± 0,54	1,000	0,00 ± 0,58	0,40 ± 0,52	0,30 ± 0,48	0,564	-0,10 ± 0,57
9.	Sleeping	0,75 ± 0,87	0,25 ± 0,45	0,059	-0,50 ± 0,91	0,33 ± 0,49	0,33 ± 0,49	1,000	0,00 ± 0,43
10	Recreation	0,42 ± 0,52	0,25 ± 0,45	0,157	-0,17 ± 0,39	0,17 ± 0,39	0,08 ± 0,29	0,317	-0,08 ± 0,29

* Significant ($p<0.05$); † Wilcoxon

A previous study comparing individuals with and without neck pain, those experiencing neck pain had lower range of motion of cervical joints in the sagittal plane and CVA values. The severity of pain is related to the severity of neck functional disability, and the CVA degree is related to the manifestation of neck pain. Neck pain not only induces mechanical limitations of the cervical joints, resulting in physical limitations such as reduced joint range of motion and muscle fiber contraction. However, it remains unclear whether FHP affects pain or if the movement limitation itself causes the pain.[24]

Although trigger points in neck muscles, particularly the descending part of the trapezius muscle, are strongly associated with nonspecific neck pain, a link between FHP and chronic neck pain, or tension-type headache, has not always been unequivocally established. As a result, even when the pressure sensitivity of the neck muscles is increased, the presence of FHP alone does not always result in clinical symptoms such as chronic or unpleasant muscle and tissue pain in the neck region.[25]

In this study, no statistically significant difference in neck pain complaints variable was found in either groups, indicating that it had no effect on the results of study.

Prior to the study, education on ergonomic work postures was provided and was also included in the FHP guidebook. Previous research demonstrated that combining cervical isometric exercises with ergonomic guidance resulted in higher Visual Analogue Scale (VAS) and NDI scores when compared to the group that only received ergonomic intervention.[20]

The mean NDI score in the McKenzie group exhibited statistically significant improvement. A previous study also discovered a significant decrease in NDI scores following treatment, attributed to less muscle imbalance in the neck and surrounding tissues, causing FHP relaxation and less load on neck joints.[26]

Previous meta-analyses classified McKenzie and isometric exercises as "base element" exercises. This refers to the fundamental element of movement that contributes to muscular strength, endurance, mobility, length, and elasticity. This study found that exercises incorporating base and biomechanical elements were the most effective for neck disability with forward head posture.[27]

McKenzie exercise improves fatigue and functional scores by relaxing tense muscles and strengthening weak muscles, aiming to maintain proper neck posture. Prolonged improper neck posture can adversely affect neck function, resulting in pain and decreased muscle strength. In a previous study, the McKenzie group experienced less fatigue when compared to the control group. McKenzie exercise delays replacement of fast-twitch fibers in the upper trapezius and splenius capitis muscles, helping to alleviate muscle fatigue, reduce neck pain, and improve functional scores by perfecting muscle pathology, changes in muscle fiber length, and inhibiting the exertion of the superficial neck muscles.[28]

Neck muscles have a higher density of muscle spindles than other muscles in the body. As a result, the neck muscles play an important role in providing proprioceptive sensory information. Previous research suggests that the FHP-induced change in neck muscle length negatively affects muscle spindle activity involved in proprioception, resulting in a decrease in joint position sensing.[29] McKenzie exercise can improve proprioception in the muscles, tendons, joints, and connective tissue around the neck, resulting in a more balanced proportion of motion.[30,31]

The FHP group has lower splenius and sternocleidomastoid muscle activity, as measured by electromyography. Poor posture disrupts the balance of neck muscles, leading to the shortening of neck extensor muscles (splenius, upper trapezius, and sternocleidomastoid) and the weakening of neck flexor muscles. Changes in muscle length are related to the force-length relationship.[32] McKenzie exercises improve posture and muscle imbalance by adapting movement throughout three directions of movement and correcting abnormal stress.[9] Repeated retraction movements result in reduced muscle tone, significant peripheral pain, and decreased compression of nerve roots. It also causes extension of lower cervical segment and reduce stress on the posterior annulus, thereby relieving pain.[31]

In this study, NDI scores improved in the McKenzie group, particularly in areas related to pain intensity, reading, concentration, and work (Table 3). This exercise helps to relieve pain and fatigue. Participants can improve their reading endurance and concentration and work by relieving pain.

At the end of the study, the cervical isometric exercise group had a statistically significant decrease in mean NDI score. Previous research found that isometric semi spinalis cervicis and deep cervical flexors exercises improved functional disability. This suggests the importance of cervical extensor and flexor muscles. Cervical isometric exercises can increase the activation of the cervical semi spinalis muscles to the splenius capitis.[33]

Isometric cervical flexor exercise improves neuromuscular control of deep cervical flexors and reduces pain intensity. The isometric exercise group exhibited significant reduction in pain intensity, which could be attributed to the activated deep and superficial cervical extensor muscles, improved neuromuscular function, and restored sensorimotor control in the cervical spine. Muscle contraction stimulates mechano receptors such as muscle spindles, Golgi tendon organs, and joint proprioceptors, leading to the release of endogenous opioids and endorphins stimulation.[33]

Due to increased extension of the middle cervical vertebrae and flexion of the lower cervical vertebrae, isometric cervical flexor exercise will affect lordosis of the cervical bones and improve muscle imbalance in individuals with FHP. This exercise focuses on motor control and coordination between the deep and superficial cervical muscles.[33]

The movements in this exercise lay a solid foundation for dynamic training, and the use of many postural muscles working isometrically will increase endurance and strengthen weak muscles.[19] This exercise increases the strength of both the cervical flexor and extensor muscles, increases flexibility, and improves neck function.[34]

In isometric group, there was improvement in NDI scores, especially in items related to the intensity of pain and headache (Table 3). Participants were able work more effectively on computers when experiencing less pain.

The difference in mean change in NDI score after cervical McKenzie exercise was statistically significant and greater than cervical isometric exercise. This is consistent with a previous study comparing the effectiveness of these two exercise types in patients with cervical radiculopathy, in which the McKenzie group showed a significant reduction in radicular neck pain when compared to another group. There was also a significant difference in Functional Rating Index (FRI) improvement between the McKenzie and isometric groups.[35]

Cervical McKenzie exercise is more effective than cervical isometric exercise in lowering NDI scores because the head retraction movement initiated in all positions helps reduce activity of the sternocleidomastoid muscle, upper trapezius, and other neck muscles. This finding is consistent with the findings of a neck assistive device trial based on the McKenzie method to facilitate neck retraction, which can reduce abnormal muscle activity and improve abnormal neck posture such as FHP. It is hypothesized that the decrease in electromyographic activity of the upper trapezius, sternocleidomastoid, and anterior scalenus muscles is due to changes in the ability to produce strength and correct posture through retraction movements.[36]

The research has some limitations. First, neither group was assigned randomly to the participants. A blinded randomized study should be included in future research. Second, generalizing the results may be difficult due to the small sample size.

More studies with a larger sample size are required. Third, this study did not control for work stations, exercise placement, or time. Future studies should account for these factors, even if the results differ. The proposed exercises,

according to the authors, can be applied to a much larger population than just computer users with forward head posture.

CONCLUSION

After training, both groups' mean NDI scores improved significantly, and McKenzie exercises were found to be more effective than isometrics.

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