



Effectiveness of ultrasound addition in intervention McKenzie's neck exercise in reducing the mechanical neck pain

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ABSTRACT

Background: The activity of using a smartphone for a long time in a static position and bad posture, will result in Mechanical neck pain (MNP), which is known as a neck condition caused by change in the cervical curve to flatten due to overload on the muscles, ligaments, joints, and bones of the neck at the back and the muscles of the upper back and shoulders. The effectiveness of adding ultrasound to the McKenzie's neck exercise (MNE) intervention to reduce MNP.

Methods: The study used a quasi-experimental method with a pre and post-two-group design. The number of samples was 20 research subjects experiencing chronic non-specific MNP, not experiencing spondylolisthesis, fracture, and hernia nucleus pulposus in the cervical area. Group I was given the MNE and ultrasound, and group II was given MNE only. This research was conducted three times a week for four weeks at the *Action and Hydrotherapy Laboratory*. The measuring tool used is the northwick neck pain tool. Normality

test using *Shapiro Wilk* test and homogeneity test using *Lavene's* test. Paired sample *t*-test was used to determine the effectiveness of the intervention of the two groups in reducing MNP, and an independent sample *t*-test was used to see the difference in the effect of the intervention results of the two groups.

Results: The characteristics of study respondents by age were in the average range of 19.7±0.9 years for group I and 19.6±0.6 years for group II. Based on other data, groups I and II decreased pain significantly after their respective treatments ($p=0.04$). There is no significant difference effect after interventions between the group I and group II ($p>0.05$).

Conclusions: The program of MNE only effectively reduced MNP with the same good effect as the MNE with ultrasound therapy in subject with MNE. The addition of ultrasound to the MNE does not have a significant effect on pain reduction.

Keywords: McKenzie's neck exercise, mechanical neck pain, northwick neck pain tool, ultrasound therapy.

Cite this Article: Arti, W., Tenriwulan, A.F., Anjasmara, B. 2023. Effectiveness of ultrasound addition in intervention McKenzie's neck exercise in reducing the mechanical neck pain. *Physical Therapy Journal of Indonesia* 4(1): 1-5. DOI: [10.51559/ptji.v4i1.60](https://doi.org/10.51559/ptji.v4i1.60)

BACKGROUND

Neck pain is a big problem often complained about in the community. One of the triggering factors is the use of mobile phones and laptops for a very long duration in a position that is not ergonomic.¹ The prevalence of mechanical neck pain (MNP) found in society reached 23.1%, 54% of the individuals experiencing MNP less than well in the last six months. The prevalence of MNP increases due to age and generally occurs in women.²

The development of the Covid-19 outbreak in Indonesia one of the sectors affected in the world of education, in April 2020 in recent times, the Universitas Muhammadiyah Sidoarjo acted on the implementation of circular III Number: 647/II.3.AU/02.00/PEDR/III/2020 concerning the regulation of employee work patterns and lectures online lecture environment in extension to make students active in college, doing lecture assignments and final assignment guidance more spent in front of the computer is done virtually one of the prevention of the spread of Covid-19 with *social distancing*.³

The body's position when the gadget user usually reflects the neck to stare at the lower object and keep the head in a position in front for a long duration. With posture, the body will experience a decrease in lordosis of the cervical from the lower cervical vertebrae and create a posterior curve in the upper thoracic vertebrae. The neck posture will change the Center of Gravity (COG), which will experience balance disorders and cause pain in the neck.⁴

Digital 2021 Global Overview Report showed that 5.22 billion people use smartphones, equivalent to 66.6% of the world's total population. Since January 2020, smartphone users have increased by 1.8% (93 million). In 2016 there were about 170.6 million people out of 269.6 million Indonesians already using smartphones. This means about 63.3 percent of the Indonesian population makes mobile phones a primary need. The prediction is that by 2025, at least 89.2 percent of the population in Indonesia will take advantage of various smartphones features.⁵

The use of smartphones for a long duration turned out to be a trigger factor for MNP by 85.76%

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Received : 2023-01-17
Accepted : 2023-02-29
Published : 2023-03-19

and shoulder pain by 58.60% due to unbalanced posture positions, so it becomes a trigger for neck pain. The position in question is the neck that looks down continuously, flexing the neck excessively or forward head posture when using a smartphone.⁶ One research mentioned that 1051 people in Australia use smartphones with forwarding head posture positions, 70% of young adults and 30% of adolescents complain of MNP, mainly found at the productive age of 20-30 years.⁷

Neck pain can be treated with exercise therapy methods that require consistent and progressive treatment by physiotherapists. One of the modern physiotherapy treatments, which can be done anywhere, the McKenzie neck exercise (MNE) method this exercise aims to improve and reshape optimal posture. This exercise method will be very effective in improving the posture of people with MNP because one of the movements is to stretch, retrain, and increase the flexibility of the neck flexor muscle and reduce pain.⁸ Another series of exercise movements will help reduce spasms in the neck muscles, increase the limited range of motion of the joints, and restore the posture of the neck in an anatomical and average position, namely *cervical lordosis*, along with reduced neck pain. In the selection of MNE, a form of corrective neck exercise can be a solution to MNP by activating mechanoreceptor type A β thick-haired nerve fibers, especially Ruffini (type II) and interstitial (type IIIa) located in the skin, connective tissue, muscles, tendons, and joints, to inhibit type C thin-haired nerve fibers in lamina II, III, and V of the *substantia gelatinosa* (SG). The exercise program stimulates the release of enkephalin neurotransmitters at the spinal and supraspinal levels to inhibit the release of pain neurotransmitters, such as histamine, serotonin, bradykinins, and exterior amino acids, glutamate, aspartate, calcitonin gene-related peptide and substance P.⁹

Ultrasound is one of the modalities owned by physiotherapy, which is helpful as a supporting intervention instrument to repair muscle tissue that has regeneration problems. ultrasound provides a mechanical effect in the presence of the resulting pressure that can stimulate C afferent nerve fibers, resulting in dilation of capillary blood vessels and hyperemia to help heal tissues. In the tissues will increase the matrix; thus, the matrix protein will increase so that its elasticity will increase and treat the weakness of the flexor muscles and instability of the posterior longitudinal ligament in the forward head posture.¹⁰

The importance of controlled movement components with accurate direction (precisely controlled movement) and ultrasound in managing

pain-related cases. The MNE method aims to increase ROM in a segment without triggering or provoking pain experienced by the patient, while increasing muscle length and strength.

To answer the above problems will be researched the effectiveness of the ultrasound addition in the intervention MNE in reducing the MNP in students of the Faculty of Health Sciences, Universitas Muhammadiyah Sidoarjo.

METHODS

Study design and participants

This research design used a quasi with a two group pre and post-test group design which aimed to determine the effectiveness of adding ultrasound to the MNE intervention on reducing MNP in students of the Faculty of Health Sciences, Universitas Muhammadiyah Sidoarjo. The sample of this study was 20 students of the Faculty of Health Sciences, Universitas Muhammadiyah Sidoarjo that divided into two groups of MNE with ultrasound and MNE only. The measuring instrument used was the northwick neck pain tool on MNE intervention, used theraband during exercise for each sample. This research stage consists of sampling, *pre and post*-measurements of groups I and II, and analysis of results. The summary research stages are summarized in Figure 1.

In this study, research sampling using purposive sampling techniques was by choosing research subjects among the population according to the researcher wants based on specific criteria or inclusion and exclusion criteria that have been established. The inclusion criteria was using samples of students aged 17-22 years, have a non-specific chronic history of MNP, have no history of spondylolisthesis, have no history of hernia nucleus pulposus in the cervical area, have no history of cervical fracture, have no history of surgery three months ago, have no history of blood vessel disease, have no history of psychiatric problems hindering the survey, and the sample was willing to participate in the study.

As for the exclusion criteria such as: samples with fractures in the cervical area, have neuromyopathy, inflammatory disease, have a history of surgery in the neck and shoulders and have unstable blood pressure. For drop out criteria the sample did not follow the exercise until the study was completed and the sample had sustained injury when the study was conducted.

This study used the Northwick Neck Pain Tool instrument as an evaluation with the interpretation of value 1 is painless and feels normal all day, value 2 is mild pain and lasts less than 1 hour/day, value 3 is

moderate pain and lasts for 1-4 hours / day, value 4 is pain is rather severe and lasts more than 4 hours/ day, and value of 5 is pain is hefty and lasts all day.

Before the study began, the sample was first explained the purpose of the study. Then the sample was instructed to sign an informed consent as evidence of being willing to be a sample during the study. This research has received approval from the Research Ethics Commission of the Faculty of Health Sciences, Universitas Muhammadiyah Sidoarjo. The study sample signed informed consent

before the research procedure was carried out.

Data analysis

The normality test was used *the Shapiro-Wilk* test, and the homogeneity test was used *Lavene's* test. *Paired sample t-test* was used to find out the effectiveness of the interventions of both groups on the reduction of MNP, and an independent-sample *t-test* was used to evaluate the different influences of the intervention results of both groups on the study.

RESULTS

Table 1 showed study respondents with more women than men in each group. The characteristics of study respondents by age were in the average of 19.7 ± 0.9 years for group I and 19.6 ± 0.6 years for group II.

Based on table 2, groups I and II decreased pain significantly after their respective treatments (0.04). Moreover, this study showed no significant mean difference between group I and group II ($p > 0.05$).

DISCUSSION

The analysis of research conducted three times a week for four weeks showed that group I and group II were shown to reduce pain in MNP with the same effectiveness. Neck pain occurs due to a process of chemical stimulation in the form of arachidonic acid release by muscle cells that experience spasm, irritation and result in local ischemia, triggering the production of prostaglandins, thromboxanes, monohydroxy fatty acids, and leukotrienes that trigger the release of active pain complements such as serotonin, histamine and bradykinin.¹¹

Ultrasound provides a mechanical effect in the presence of the resulting pressure that can stimulate C afferent nerve fibers, resulting in dilation of capillary blood vessels and hyperemia to help heal tissues.¹² In the tissues will increase the matrix; thus the matrix protein will increase so that its elasticity will increase and overcome the weakness of the flexor muscles and *instability of the posterior longitudinal ligament in the forward head posture*.¹³

Ultrasound is a physical therapy modality that exerts mechanical and thermal effects on targeted tissues, increased local metabolism, circulation, connective tissue extensibility, and tissue regeneration.¹⁴ In this article, both the group that got the addition of ultrasound to MNE and the group that only got MNE alone gave an equally significant pain reduction effect. Thus, the addition of ultrasound for pain reduction in neck pain does not have a significant impact. Research conducted by Dibai-Filho, et al. in 2017 by comparing the provision of therapy manuals plus ultrasound and

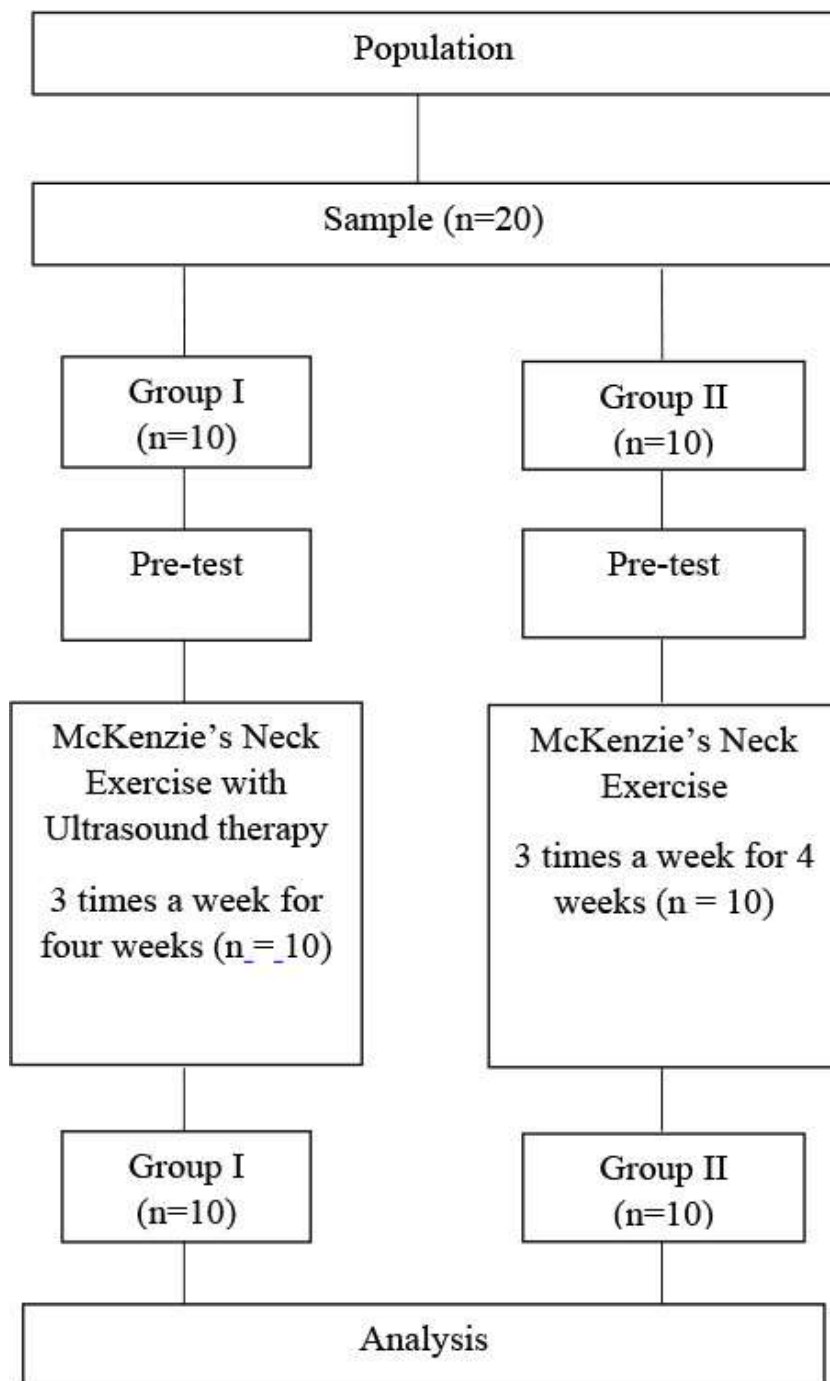


Figure 1. The study flowchart

only therapy manuals on neck pain found that the use of ultrasound in program therapy manuals did not produce more significant benefits than therapy manuals alone.

This is in line with the systematic review conducted by Noori, S.A., et al. in 2020, stating that ultrasounds that are often used in the treatment of low back pain and neck pain are often combined with other physiotherapy modalities, showing the significance of the results.¹⁵ The systematic results of this review do not recommend the use of ultrasound in cases of low back pain and chronic neck pain. However, they state that ultrasound as part of physical modality care may help relieve short-term pain, but not necessarily superior modalities. In 2018, Sayilir, S., said that administering ultrasound and TENS to chronic neck pain has a short-term effect on pain reduction and functional improvement.¹⁶

Giving the MNE program with mobilization movements and muscle stretching in each movement will activate mechanoreceptors of thick-spectrum nerve fibers of type A β , especially Ruffini (type II) and III in SG through the fast track pathway of the neospinothalamic tract in the dorsal spinal cord.¹⁷ Klaber Moffett, J., et al. stated in 2006 that MNE significantly reduced neck pain and restoring functions.¹⁸ With MNE approach, provides an effect of stalling soft tissue and the spine that can help centralize a patient's pain by moving it from the extremities to the spine because concentrating the pain is more likely to find the source of the pain than simply pursuing improvements in the symptoms. The findings align with research conducted by Neeraj, K. and Shiv, V., 2016 showing significant differences between MNE, isometric strengthening exercises, and hot packs for neck pain where MNE is considered more beneficial than isometric strengthening.¹⁹ MNE was better than strengthening exercises and ultrasounds, with a faster reduction in neck pain

over the first 3 weeks. MNE in conventional therapy are effective in increasing the range of motion of the neck, lowering pain, and increasing functional activity in non-specific neck pain patients.²⁰ In 2020, Edmond, S.L., et al. added a cognitive behavioral approach by physiotherapists to MNE to determine their effect on pain and functionality in non-specific neck pain. The authors found that there was insufficient evidence to show that patients managed by the MNE would achieve clinically relevant improvements in function or pain when adding to the cognitive-behavioral approach undertaken by a physiotherapist.²¹

There are many factors that may affect the development of MNP, including the physical activity carried out by respondents outside the research schedule, lack of self-awareness, habits, and duration of use of smartphones or laptops that were not ergonomic, which could influence the study results and became the limitations of this study.

CONCLUSION

The program of MNE only is effective in reducing MNP with the same good effect as MNE with ultrasound therapy in MNP patients. The addition of ultrasound to the MNE did not have a significant effect on pain reduction.

ETHICAL CLEARANCE

The Commission for Research Ethics, Faculty of Health Sciences, Universitas Muhammadiyah Sidoarjo.

CONFLICT OF INTEREST

This study does not have any conflict of interest.

ACKNOWLEDGEMENT

The authors thank all parties involved in this study.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Table 1. Characteristics data of research respondents.

Characteristics	Group I (MNE + UST)		Group II (MNE)	
	Pre-test	Post-test	Pre-test	Post-test
Age	19.7 \pm 0.9		19.6 \pm 0.6	
Sex				
Female	8 (80%)		6 (60%)	
Male	2 (20%)		4 (40%)	

MNE, McKenzie's neck exercise; UST, ultrasound therapy

Table 2. Neck Pain Frequency Distribution.

Measurement	Group I (MNE + UST)		p-value	Group II (MNE)		p-value	p-value Group I and Group II
	Pre-test	Post-test		Pre-test	Post-test		
Northwick Neck Pain Tool	3.2 \pm 0.6	1.5 \pm 0.5	0.04	3 \pm 0.5	1.3 \pm 0.5	0.04	>0.05

MNE, McKenzie's neck exercise; UST, ultrasound therapy

AUTHOR CONTRIBUTIONS

WA conceived the study design and data collection and drafted the manuscript; AFT and BA collected the data and revised the manuscript.

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