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# The Efficacy Of Adding Muscle Energy Technique To A Participatory Ergonomic Approach To Reduce Pain And Improve Functional Ability In Employees With Mechanical Neck Pain In A Private Company In West Kalimantan

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**ABSTRACT**

Employees of Credit Union Lantang Tipo (CULT) work in abnormal postures using computers causing mechanical neck pain (MNP) characterised by complaining of pain and reduced functional ability. This study aims to prove the efficacy of adding muscle energy technique (MET) to the participatory ergonomics approach (PEP) to reduce pain and improve functional ability in employees with MNP. This study used a true experimental design involving 40 subjects (n=20), consisting of treatment group I (PEP)) and treatment group II (addition of MET to PEP). Pain measurement used VAS and functional ability used NDI. Data analysis used Independent-Samples T-Test with a significance level of 5% (α = 0.05). The results of this study are that there is a significant difference in the mean after intervention, treatment group I (VAS 5 ± 0.59 p = 0.00, NDI 22.60 ± 6.77 p = 0.01) and treatment group II (VAS 3.5 ± 0.66 p = 0.00, NDI 17.80 ± 4.15 p = 0.01) with a p value <0.05. The decrease in the mean score of VAS and NDI in treatment II was greater than treatment I. The conclusion of this study is that the added MET to PEP is proven to be more effective in reducing pain and improving functional abilities in employees with MNP.



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## INTRODUCTION

Musculoskeletal disorders are occupational diseases that are experienced by many workers related to inappropriate human and task interactions. An underlying factor in the appearance of musculoskeletal disorders in workers is work posture. Most of the workers who work with computers are sitting with their heads tilted forward and their backs slouching in a static and repetitive position. This condition may induce postural fatigue and have an effect on soft tissue pressure on the cervical which causes neck pain symptoms. Inappropriate postures at work can occur due to a lack of compatibility between the task load, workstation, and the use of work tools.

The prevalence of neck pain in office workers in Australia was reported at 82% (Pereira et al., 2019). The prevalence in Asia was 10.14%, Australia 10.13%, Caribbean 9.7%, and

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Central Asia 9.8% (Khan et al., 2022). In 2020, neck pain affected 203 million people worldwide. In other words, the burden of neck pain is 2.9% higher in women than men, with a peak prevalence between the ages of 45 and 74 years in both genders. In office workers, the annual prevalence of neck pain ranges from 42% to 63%. Neck pain and tenderness are the most common causes of absenteeism among office workers, impairing their functional ability (Alshehre et al., 2023).

The employees of CU Lantang Tipo work with a computer in a sitting position for ± 8 hours in a static position that can produce postural muscle fatigue. In an observation, most employees work with a flexed neck and forward head posture and a bent and hunched back with their forearms hanging down while typing. This work position can certainly lead to repeated mechanical stress on the cervical soft tissues, such as ligaments, facets, discs, fascia, and muscles which result in the appearance of pain in the neck.

From the studies of 8 aspects of ergonomics, it was found that there were unnatural work postures in most employees of CU Lantang Tipo who worked using computers. Based on the results of a preliminary study conducted on 18 and 19 September 2023, it was found that there were 68 employees experiencing neck pain complaints from 89 employees who worked using computers from the Nordic Body Map (NBM) examination. The complaints felt were pain in the back of the neck, palpation pain in the upper trapezius and levator scapulae muscles, and decreased cervical functional ability.

Mechanical neck pain is a non-specific neck pain condition that is commonly associated with neck and head posture. Pain is experienced at the back of the neck which is exacerbated by neck movement and static postures. Mechanical neck pain can be related to the forward head posture factor in employees who work using computers. Forward head and neck posture caused by prolonged head flexion results in postural deviations in the sagittal plane and limited cervical mobility and results in balance or head control which increases mechanical load and cervical dysfunction. This posture deviation is caused by sitting in a slouched position holding the head forward for a prolonged period of time in repetitive motion during work (Balthillaya et al., 2022). Mechanical neck pain symptoms experienced by most employees of CU Lantang tipo can be intervention with the addition of muscle energy technique (MET) in participatory ergonomics approach(Phadke et al., 2016).

A participatory ergonomics approach with sitting posture correction and stretching exercise was chosen because it has been shown to reduce upper extremity musculoskeletal disorders and improve the functionality of employees working with computers (Baydur et al., 2016). Participatory ergonomics approach interventions are conducted through active participation by workers in developing and implementing changes in the workplace with the aim of increasing productivity and reducing risks related to safety and health (Burgess-Limerick, 2018).

In previous studies, participatory ergonomics can reduce musculoskeletal disorders in computer workers with neck disability symptom reduced in the intervention group compared to the control group $p < 0.05$ (Baydur et al., 2016). The combination of stretching exercise and modified ergonomics effectively reduces musculoskeletal symptoms in office workers with a significance of $p < 0.05$ (Shariat et al., 2018). In this study, the authors implemented participatory ergonomics to reduce pain and improve the functional ability of CU Lantang Tipo employees with mechanical neck pain through correction of sitting posture and stretching exercise.

While stretching exercise is performed with self-stretching movements on the work chair on the cervical and upper back muscles, such as neck extensor, neck flexor, neck rotator, lateral neck, neck and back with hand behind back, and chest anterior. Stretching exercise is beneficial in muscle relaxation, increasing muscle flexibility, improving muscle metabolism, reducing muscle tissue irritation, and increasing the range of motion of joints that can reduce pain in mechanical neck pain conditions (Shariat et al., 2018).

Based on the above description, a participatory ergonomics approach through sitting correction and stretching exercise can reduce pain complaints and improve functional ability in mechanical neck pain conditions. This approach has been widely implemented regarding active changes in the workplace. However, in the condition of mechanical neck pain, the upper trapezius and levator scapulae muscles are hypertonic/tensioned which causes pain and functional impairment. Hypertonicity of these two muscles is caused by repetitive low-strength tasks involving movements that require little force generated by the muscles while the employee works in a static seated position using a computer with a forward head posture. The muscle action is maintained for long periods of time and is repetitive during a work cycle. Injuries caused by this type of computer work activity are not usually associated with inflammation or extensive myofibre degeneration, but are characterised by muscle pain and rapid muscle fatigue (Marras & Karwowski, 2006).

The MET technique via PIR on the upper trapezius and levator scapule muscles effectively reduces complaints of pain and functional limitations of the neck with VAS and NDI measurement results after 6 days of intervention $p < 0.05$ in Phadke et al., (2016) research. Whereas in the research of Joshi & Poojary (2022) the combination of muscle energy technique and posture correction exercises is effective in reducing pain and improving functional ability in mechanical neck pain patients with forward head posture. The significant results in group A (MET and posture correction exercise) reduce neck pain greater than group B (srengthening exercise) with $p < 0.001$.

Muscle energy technique (MET) intervention with postisometric relaxation technique was applied to m. upper trapezius and m. levator scapula with 5 repetitions using 20% maximal isometric contraction. MET decreased pain perception by increasing stretching tolerance. Stretching and isometric contractions that occur simultaneously stimulate muscle and joint mechanoreceptors and proprioceptors. This in turn reduces pain sensation, makes successive stretches easier and more tolerable and improves joint mobility in mechanical neck pain (Phadke et al., 2016). The addition of muscle energy technique intervention to the participatory ergonomics approach effectively reduces pain and improves the functional ability of CU Lantang Tipo employees with mechanical neck pain by achieving relaxation of m. upper trapezius and m. levator scapulae.

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## METHODS

The design of this study was a true experimental design with a simple random method through a lottery, involving 40 subjects who were divided into two groups through re-drawing. Treatment group I of 20 subjects worked with a participatory ergonomic approach (correction of sitting posture and stretching exercise). Treatment group II of 20 subjects worked with the addition of MET through PIR on m. upper trapezius and m. levator scapulae to the participatory ergonomics approach. The study's target population was employees of CU Lantang Tipo's head office in Pusat Damai Village, Sanggau Regency, West Kalimantan and the target population was employees who worked in front of a computer.

The inclusion criteria for this study were (1) men and women aged 20-55 years, (2) working using a computer, (3) complaints of neck pain and or can be accompanied by decreased ROM or cervical functional mobility, (4) a minimum work period of 1 year, and (5) willing to become a research subject by filling out informed consent. Exclusion criteria were (1) subjects with BMI > 25 kg/m2, (2) history of trama, fracture, or history of surgery on the cervical, (4) serious disease / red flags such as malignancy, inflammatory disorder / rheumatoid disease, infection, and vascular disease such as vertebrobasilar insufficiency, and (4) signs and symptoms of cervical myelopathi and cervical radiculopathy. The dropout criteria were that the subject did not participate in the study more than once and or the subject fell ill so that he could not continue the study.

1. Measurement of Pain Complaints
   Measurement of pain complaints using a visual analoque scale (VAS). Visual analogue scale (VAS) is a measuring instrument along 10 cm or 100 mm which represents a psychometric response scale to measure pain intensity in the form of numerical values that have a score of 0 no pain and a score of 10 unbearable pain (Khan et al., 2022). The test-retest reliability of the VAS is reported to be very high (ICC = 0.71-0.99). While the validity of the VAS is reported to be moderate (0.71-0.78). VAS values for mild < 3.4 cm, moderate 3.5-7.4 cm, and severe > 7.5 cm (Siddiqui et al., 2022). Pain measurements before the intervention were taken on Monday at 11.00 am and after the intervention on Saturday at 2.00 pm.
2. Functional Ability Measurement
   Measurement of functional ability using the neck disability index (NDI). NDI has evidence based at level 2 (Siddiqui et al., 2022). Neck disability index (NDI) is a widely used tool to measure perceived impairment due to neck pain. This tool is a self-assessment tool consisting of 10 sections, namely the severity of pain, self-care, lifting, work, headache, concentration, sleep, driving, reading, and recreation. Each answer has a 6-point score with a scale range from 0 (no limitations) to 5 (severe limitations). Some evaluators multiply the score by 2 and report NDI results on a scale of 0-100% (Alshehre et al., 2023). The reliability and validity of the NDI questionnaire in neck pain patients with inter-class correlations ranging from 0.50-0.98 (Khan et al., 2022). Measurement of functional ability before intervention was carried out on Monday at 11.00 WIB and after intervention on Saturday at 14.00 WIB.

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3. Participatory Ergonomics Approach
   Participatory ergonomics is the active involvement of workers in developing and implementing changes in the workplace that will improve productivity and reduce risks related to safety and health (Burgess-Limerick, 2018). Through this approach, workers are responsible for identifying, developing solutions, and implementing changes in the work environment to reduce risk factors in work routines (Lund Rasmussen et al., 2022). The implementation of a participatory ergonomics approach programme for workers who experience musculoskeletal disorders due to mechanical neck pain, namely by correcting sitting posture and stretching exercise. This participatory ergonomics approach is expected to provide benefits in reducing pain complaints and improving functional abilities in workers who experience mechanical neck pain.
   a. Correction of Sitting Posture
      Sitting posture supports body stability during tasks that require concentration, vision, and fine motor control (Moriguchi et al., 2019). A good sitting posture where there is a vertical balance between the head, neck, chest, and abdomen positions (Yanto & Ngaliman, 2017).A neutral posture while sitting to work is recognised with a proper balance of body support. The neck, shoulders, and arms are relaxed with the elbows at the sides and open at an angle of no less than 90◦ (Stack et al., 2016). Correction of sitting posture by re-education on ergonomic sitting posture while working at the computer. The correction of sitting posture was applied when starting work again at 13.00 WIB after the subject had rested. The intervention was conducted daily for 6 days (Monday to Saturday) in treatment group I and treatment group II.
   b. Stretching exercise is beneficial to reduce neck pain symptoms in workers by reducing muscle tension and increasing soft tissue flexibility, especially muscles (Guduru et al., 2022). Postural and muscular imbalances can be intervened through stretching exercise, which can improve health conditions, body fitness, and as an early preventive measure in the workplace in employees, which significantly improves work ability (Yaghoubitajani et al., 2022). Stretching exercise is performed with independent stretching movements on the work chair in the muscle groups of neck extensor, neck flexor, neck rotator, lateral neck, neck and back with hand behind back, and chest anterior. Stretching exercise on each muscle is done with 20 seconds of resistance and is done as many as 5 repetitions with a total time of 15 minutes. This intervention was applied to treatment group I and treatment group II at 12.30 WIB which was carried out every day for 6 days (Monday to Saturday).
4. Muscle Energy Technique (MET)
   Muscle energy technique (MET) is a method of osteopathic manipulation of soft tissue that is directed and controlled by the patient during isometric or isotonic contractions to improve musculoskeletal function and reduce pain (Joshi & Poojary, 2022. MET is widely used by osteopaths, where this technique uses the energy of the muscle itself in the form of mild isometric contractions to relax the muscle through autogenic or reciprocal inhibition and muscle lengthening (Gibbons, 2014). MET has 2 forms, namely

postisometric relaxation (PIR) and reciprocal inhibition (RI) (Chaitow, 2006). This technique was performed for 5 repetitions on each trapezius and levator scapulae muscle performed on employees after 4 hours of work. The muscle energy technique intervention was carried out once a day which was given every day for 6 days (Monday to Saturday). The addition of MET to the participatory ergonomics approach in treatment group II was given at 11.30 WIB to each subject for 6 minutes.

## RESULTS AND DISCUSSION

### Characteristics of research subjects

**Table 1.**Characteristics of research subjects

| Variable | Group | N | Mean | Median | SD | Range |
|---|---|---|---|---|---|---|
| Age | Group I | 20 | 39 | 38 | 6,3 | 32-55 |
| | Group II | 20 | 38 | 36 | 6,6 | 31-53 |
| Height (cm) | Group I | 20 | 163 | 163 | 6 | 155-174 |
| | Group II | 20 | 164 | 165 | 6 | 154-175 |
| Weight(kg) | Group I | 20 | 63 | 62 | 5,9 | 55-74 |
| | Group II | 20 | 66 | 67 | 5,8 | 55-76 |
| BMI (kg/m$^2$) | Group I | 20 | 24 | 24 | 1,07 | 20-25 |
| | Group II | 20 | 24 | 24 | 0,88 | 21-25 |
| Working Period (year) | Group I | 20 | 12 | 11 | 4,37 | 7-24 |
| | Group II | 20 | 12 | 11 | 4,46 | 7-25 |

Based on the data contained in Table 1, it is known that the mean age of group I subjects is 39 ± 6.3 years and group II is 38 ± 6.6 years, the mean BMI of treatment I is 24 ± 1.07kg/m2 and treatment II is 24 ± 0.88kg/m2 and the mean work period of group I is 12 ± 4.37 years and group II is 12 ± 4.46 years. Other data characteristics of the research subjects can be seen in Table 1.

### Characteristics of subjects based on age

The subjects of this study had an age range of 32-55 years in treatment group I and an age range of 31-53 years in treatment group II, which is included in the productive age range and is at risk of musculoskeletal complaints related to physical work factors. In addition, Kazeminasab et al ( 2022) suggested that as people age, the normal anatomy of the cervical spine can change, which can cause neck pain and long-term disability. However, neck pain is common in adults and can occur at any age.

### Characteristics of subjects based on height, weight, and BMI

In this study as a whole there were 35 (87.5%) subjects with BMI 20-24.9kg/m2 which were included in the normal BMI category. While 5 (12.5%) subjects have a BMI of 25kg/m2 which is included in the overweight category. Most of the research subjects were included in normal BMI which was not associated with neck pain complaints. As stated by Cohen (2015)based on some epidemiological study results, there is not always a relationship between neck pain and BMI.

**Characteristics of subjects based on work period**

In this study, the overall data on the working period of the subject with a range of 7-25 years where this working period can affect the subject experiencing mechanical neck pain complaints. In a long working period, employees can be at risk of musculoskeletal disorders. This is caused by exposure to repetitive mechanical loads on muscles, joints, and the spine, especially the cervical with forward head posture and hunched back every day with a working period of more than 7 years. As according to A. Rahman et al ( 2021), if the habit of unbalanced work posture and workstation is carried out for a long period of time and repetitively, it can cause musculoskeletal disorders that can reduce the mobility of the neck.

**Analysis of work environment conditions**

**Tabel 2.** Analysis of work environment conditions

| Variable | Group | Mean | SD | *P Value* |
|---|---|---|---|---|
| Lighting | Group I | 153,5 | 3,27 | 0,12 |
| (lux) | Group II | 156 | 2,04 | |
| Temperature | Group I | 29,2 | 1,61 | 0,87 |
| (°C) | Group II | 29,4 | 1,33 | |
| Humidity | Group I | 73 | 4,94 | 0,77 |
| (%) | Group II | 73,8 | 4,95 | |
| Noise | Group I | 68,2 | 1,47 | 0,45 |
| (dBA) | Group II | 69 | 1,82 | |

Based on the results of the comparability test of work environment conditions, all p values> 0.05 on each measurement variable were obtained, where there were no differences and no significant meaning in work environment conditions between treatment group I and treatment group II. It can be concluded that the working environment conditions of the two groups are not different and not meaningful, where no intervention is carried out on the conditions, the work environment as a control variable and does not affect the results of providing interventions in each group.

**Analysis of work environment conditions based on lighting**

Workspace lighting requirements according to Permenkes 48/2016 are at least 300lux (Republik Indonesia, 2016). Adequate lighting should always be provided depending on the task. Ambient lighting (which is the general illumination of a room) should be between 300 and 500lux. The average workspace lighting in both groups was 150 lux where the lighting intensity in the workspace was below the requirements of a comfortable and ideal workspace. The reason why the workspace is rather dark is because the lighting intensity of the workspace lamps is not able to illuminate the entire space with the walls covered by curtains. Due to sub-ideal workspace lighting, employees rely on computer monitor lighting for work such as creating reports and reading various data. This is done for a long time by working for 6 days with 8 hours per day can cause eye fatigue and trigger tension in the neck muscles because employees have to bow their heads staring at the monitor screen.

**Analysis of work environment conditions based on temperature**

The average temperature of the working environment of CU Lantang Tipo employees in treatment group I was 29.2 ± 1.61°C and treatment group II was 29.4 ± 1.33°C. The average workspace temperature between treatment group I and treatment group II is 29 ° C, where this room temperature is a room temperature that is not cold or uncomfortable. Where according to the Minister of Manpower Regulation No.5 of 2018, the requirements for a comfortable workspace temperature must be maintained with the requirements that the dry temperature is 23 ° C - 26 ° C with humidity 40%-60%, the difference between temperatures is not more than 5 ° C (Republik Indonesia, 2018).

In each room an air conditioner (AC) is installed where the number of ACs installed in the room is only 3 units (1 PK each) which is not in accordance with the workspace area of 6.5 x 15m. In addition, the work building is a glass wall that is easily heated by exposure to sunlight. The impact of room temperature that is not cool can cause discomfort and disruption of concentration on employees while working. As for the results of research by Maiseka et al (2022) that the level of room temperature of the work environment affects the decrease in worker productivity.

**Analysis of work environment conditions based on humidity**

The results of calculating the humidity of the work environment for CU Lantang Tipo employees in treatment group I obtained a mean of 73 ± 4.94 % and in treatment group II a mean of 73.8 ± 4.95 %. According to the Minister of Manpower Regulation No. 5 of 2018, the air humidity in a work space that is considered comfortable is 40% -60% (Republik Indonesia, 2018). The results of measuring the relative humidity of the air in the working environment of CU Lantang Tipo employees found an average of 73% in both groups. The humidity in this work space is above the recommended work space humidity, namely 40% -60%. The high humidity in the work space is influenced by the slightly hot room temperature.

**Analysis of work environment conditions based on noise**

The results of calculating the noise in the work environment of CU Lantang Tipo employees in treatment group I obtained a mean of 68.2 ± 1.47 dBA and treatment II obtained a mean of 69 ± 1.82 dBA. According to Minister of Health Regulation no. 48 of 2016, the office room noise standard is 55-65dBA (Republik Indonesia, 2016). The noise intensity in the work room between treatment group I and treatment group II was above 65dBA with exposure to working hours for 8 hours.

Even though the noise level in CU Lantang Tipo's work space is above 65dBA on average, sounds that disturb you while working should be avoided or reduced, such as conversations between employees and reducing the volume of music on computers. The intensity of noise levels has a maximum exposure time of 8 hours a day, because it can trigger stress and emotional work which interferes with work concentration. Research by Marisha & Herawati (2020) states that there is a relationship between noise and work stress in workers in the yarn production section of PT Arteria Daya Mulia (ARIDA) Cirebon with noise ≥ 85dBA. The noise threshold value according to Minister of Manpower Regulation 5 of 2018, noise intensity is 85dBA with a maximum exposure of 8 hours a day (Supriyadi, 2021).

**Pain measurement analysis**

**Table 3.** Pain measurement analysis based on treatment effect between group

| Variable | Period | Group | Mean | SD | *P Value* |
|---|---|---|---|---|---|
| | *Pre* | Group I | 6,5 | 0,66 | 0,80 |
| Pain | | Group II | 6,6 | 0,74 | |
| | *Post* | Group I | 5 | 0,59 | 0,00 |
| | | Group II | 3,5 | 0,66 | |

Based on the results of the treatment effect test presented in Table 3, the pain value after treatment in treatment group I and treatment group II was p = 0.000 where p < 0.05, so there was a decrease in pain complaints due to the effect of the intervention given. The average pain value after treatment in treatment group I was 5 ± 0.59 cm and the average pain value in treatment group II was 3.5 ± 0.66 cm.

**Functional ability measurement analysis**

**Table 4.** Functional ability analysis based on treatment effect between group

| Variable | Period | Group | Mean | SD | *P Value* |
|---|---|---|---|---|---|
| Functional ability | *Pre* | Group I | 32,4 | 8,86 | 0,22 |
| | | Group II | 35,8 | 8,60 | |
| | *Post* | Group I | 22,6 | 6,77 | 0,01 |
| | | Group II | 17,8 | 4,15 | |

Based on the results of the treatment effect test presented in Table 4, the value of functional ability after treatment in treatment I and treatment group II was p = 0.01 where p < 0.05, so there was an increase in functional ability due to the effect of the intervention given.

**Effectiveness comparison test between treatment I (participatory ergonomics approach) and treatment II (addition of MET to the participatory ergonomics approach)**

**Table 5.** Test the comparison of effectiveness between treatment I and treatment II

| Variable | Group | Period | Mean | SD | *P Value* |
|---|---|---|---|---|---|
| Pain | Group I | *Post* | 5 | 0,59 | 0,00 |
| | Group II | | 3,5 | 0,66 | |
| Functional ability | Group I | *Post* | 22,6 | 6,77 | 0,01 |
| | Group II | | 17,8 | 4,15 | |

Based on Table 5, the pain complaint score in the post period in treatment group I (participatory ergonomics approach) was found to be a mean of 5 ± 0.59cm, while treatment II (addition of muscle energy technique to the participatory ergonomics approach) was found to be a mean of 3.5 ± 0.66 cm. The difference in pain before and after treatment in treatment group I decreased by 1.4cm (14%), while in treatment group II pain decreased by 3cm (30%).

For comparison of functional abilities, the mean value of functional abilities (post) in treatment group I (participatory ergonomics approach) was 22.6 ± 6.77%, and treatment II (addition of muscle energy technique to the participatory ergonomics approach) was 17.8 ± 4 .15%. The difference in the increase in functional ability before and after the intervention in treatment group I was 9.8% (19.8%) and treatment group II was 18% (36%).

## Discussion

### Pain complaints

Measurement of pain after intervention in treatment group I showed a mean decrease of 5±0.59cm from pre-intervention 6.5±0.66cm. The average pain of subjects in group I decreased but remained within the moderate pain category. Treatment group II experienced a decrease in pain with a mean of 3.5±0.66cm from pre-intervention 6.6±0.74cm. The mean pain decrease in group II shifted from mild pain category to mild pain category. The test results for the intervention effects in treatment groups I and II yielded a value of $p<0.05$. It can be concluded that the participatory ergonomic approach (treatment group I) and the addition of muscle energy technique to the participatory ergonomic approach (treatment group II) are effective in reducing complaints of pain in CU Lantang Tipo employees with mechanical neck pain.

The participatory ergonomic approach in the treatment group I effectively reduces complaints of pain in employees with mechanical neck pain. Stretching exercises have an impact on reducing pain due to MSDs in the workplace ($p=0.00$ where $p<0.05$). Subjects with mechanical neck pain experience tension and stiffness in the cervical muscles, triggering pain and reduced cervical mobility (Purwantini et al., 2021). Similarly, a study on ikat weavers in Ndao, Rote Ndao Regency, where the weavers work with repetitive forward head posture for prolonged periods, resulting in musculoskeletal complaints. To alleviate the weavers' complaints, an effective intervention of workplace stretching exercise (WSE) was implemented, which reduced musculoskeletal complaints measured on the Nordic Body Map (NBM) from 50.94 to 41.06 with a value of $p=0.007$ (Luik et al., 2021).

Complaints of pain in mechanical neck pain are caused by mechanical loading on the cervical spine due to deviations in static work posture and repetitive computer use (Khan et al., 2022). Employees at CU Lantang Tipo who predominantly work with computers often adopt a forward head posture and hunched back in a static sitting position. This work posture occurs repeatedly and for prolonged periods, burdening the cervical spine and triggering complaints of neck pain. A participatory ergonomic approach involving stretching exercises and correcting sitting posture during work reduces complaints of pain due to mechanical neck pain. Independent cervical stretching exercises performed in the workplace chair can reduce mechanical loading on the cervical spine, increase muscle elasticity, reduce pain, and improve joint mobility. Addressing muscle imbalances and postural misalignments through stretching exercises can enhance health conditions, improve workers' physical fitness, and serve as early preventive measures in the workplace, significantly enhancing work capacity. It is essential to address this issue when individuals experience pain while working (Yaghoubitajani et al., 2022).

In workers complaining of mechanical neck pain, an unnatural working position can trigger an increase in pain intensity. Participatory correction of posture by workers can reduce the burden on soft tissues, thus alleviating pain due to mechanical neck pain. A comfortable and ergonomic working posture can reduce the impact of biomechanical body structure exposure (Vishal et al., 2023). Furthermore, maintaining a good sitting posture can preserve postural stability, balance postural muscles, enhance cervical proprioceptors, and reduce neck pain. Implementing ergonomic principles in the workplace, particularly in working postures, can help prevent musculoskeletal disorders and maintain worker health (Soares et al., 2023).

The addition of muscle energy technique intervention to the participatory ergonomics approach in the treatment group II effectively reduces pain complaints in CU Lantang Tipo employees with mechanical neck pain. The findings of this study are consistent with previous research Joshi & Poojary (2022), where the MET group (muscle energy technique and posture correction exercise) was more effective in reducing pain in chronic neck pain with a value of $p < 0.01$ compared to the control group (range of motion treatment). The upper trapezius and levator scapulae muscles are commonly affected in upper extremity disorders, particularly in the neck or shoulder, especially in cases of mechanical neck pain (Graveling, 2019). This leads to the accumulation of lactic acid metabolism, resulting in muscle spasms and tension (Page et al., 2010). Muscle tension causes muscle pain with prolonged contraction of intrafusal muscle fibres occurring through the activation of gamma motor neurons and increased sympathetic nervous system activity (Kashyap et al., 2018).

Excessive tension in the m. upper trapezius and m. levator scapulae triggering muscle spasm and pain reactions, in the case of mechanical neck pain experienced by the subjects in this study, may benefit from the addition of muscle energy technique intervention in a participatory ergonomic approach. The mechanism of Muscle Energy Technique (MET) in reducing pain resulting from mechanical neck pain in the cervical muscles involves assisting in reducing excessive activation and tension in shortened muscles through the neuro-physiological activation mechanism by the Golgi tendon reflex, which inhibits alpha motor neurons and generates muscle reflex relaxation, thus reducing pain (Joshi & Poojary, 2022). Muscle energy technique can improve the elasticity of soft tissues, reduce mechanical loading on the cervical region, leading to a decrease in pain, allowing workers to return to work without complaints of pain (Phadke et al., 2016). Therefore, the addition of muscle energy technique intervention in a participatory ergonomic approach effectively reduces pain by accelerating the decrease in tension in the m. upper trapezius and m. levator scapulae in employees with mechanical neck pain.

**Functional ability**

Functional ability measurements in treatment group I showed a mean of 22.6±6.77%, compared to pre-intervention at 32.4±8.86%. The functional capacity of treatment group I improved to the category of mild limitation. For treatment group II, the mean functional capacity post-intervention was 17.8±4.15%, as opposed to the pre-intervention mean of 35.8±8.60%. The mean functional capacity of subjects in treatment group II increased to the category of mild limitation. The test results for the effects on treatment group I and treatment group II post-intervention yielded a value of $p<0.05$. Thus, the participatory ergonomic approach (treatment group I) and the addition of muscle energy technique to the participatory ergonomic approach (treatment group II) are effective in enhancing the functional capacity of CU Lantang Tipo employees with mechanical neck pain.

Mechanical neck pain can occur due to musculoskeletal factors and work-related issues such as prolonged working hours, high workloads, and inappropriate computer workstation design, which can lead to muscle spasms, reduced cervical mobility, and functional limitations in work (Khan et al., 2022). Employees of CU Lantang Tipo with mechanical neck pain experience a decrease in functional abilities such as completing work tasks, reading data reports, difficulty sleeping, driving to work, and taking sick leave. Various factors from the work environment, workstation setup, psychosocial factors, and work attitudes can contribute to employees experiencing mechanical neck pain.

Workers with sedentary habits experience musculoskeletal complaints due to the loading of the spine associated with prolonged sitting, increased activation of back muscles in a seated posture, and lack of physical movement. Furthermore, the use of keyboards and mice for extended periods, high mental workload, and stress are hypothesized to contribute to musculoskeletal complaints in office workers with sedentary (Parry et al., 2019). Additionally, inadequate ergonomic adjustments to the workstation chair can increase the risk of excessive musculoskeletal loading (Moriguchi et al., 2019). Similarly, CU Lantang Tipo employees work in an environment with low room lighting (150 lux), slightly warm room temperature (29°C), computers positioned at an incline, and unnatural work postures.

Office workers with neck pain have a poor quality of life and experience limitations in performing daily activities such as sleeping, outdoor and indoor activities, lifting heavy objects, engaging in social activities, and driving (Guduru et al., 2022). A participatory ergonomic approach with workers is undertaken with the aim of changing habitual working postures in sitting, standing, and bending the back while working. Altering these working postures can impact workers' productivity, reduce postural fatigue, and alleviate musculoskeletal complaints (Lund Rasmussen et al., 2022). Stretching exercise interventions can enhance muscle flexibility, improve muscle strength, boost fitness levels, and correct postural misalignments (Yaghoubitajani et al., 2022). Furthermore, regularly performed stretching exercises can alleviate neck and shoulder pain, enhance neck function, and improve the quality of life for office workers experiencing moderate to severe chronic neck and shoulder pain (Amoudi & Ayed, 2021).

The provision of ergonomic interventions with corrections in sitting posture for workers has been reported to lead to a reduction in musculoskeletal pain and discomfort (Soares et al., 2023). Correcting the sitting posture of workers is carried out to reduce the mechanical loading on the cervical muscles, joints, intervertebral discs, facets, and ligaments, resulting in the workers' bodies feeling more relaxed, comfortable, with reduced postural fatigue, and an increase in cervical mobility in those experiencing mechanical neck pain. Improving sitting posture in a good working position can reduce soft tissue irritation and enhance the functional capacity of workers to complete tasks without easily feeling fatigued (Joshi & Poojary, 2022).

The addition of muscle energy technique to the participatory ergonomic approach in the treatment group II is effective in improving functional ability in employees with mechanical neck pain. Muscle energy technique influences the proprioceptors and mechanoreceptors of the joints, resulting in an impact on descending pathways, altering motor programming at the target joint. Furthermore, there is a reduction in pain and an increase in joint mobility caused by changes in the viscoelasticity of soft tissues through this technique. The mechanism of increased flexibility is achieved through improved stretching tolerance (Thomas et al., 2019). Muscle energy technique combined with postural correction exercises can help improve posture by recruiting and stimulating muscles and joint mechanoreceptors and proprioceptors, providing positive benefits for the spinal muscles in maintaining an upright position (Joshi & Poojary, 2022). Similarly, in this study, the addition of muscle energy technique to participatory ergonomics effectively enhances the functional ability of employees with mechanical neck pain by improving performance in completing work tasks, achieving better sleep quality, and increased productivity.

**Comparison of effectiveness between treatment I (participatory ergonomics approach) and treatment II (addition of MET to the participatory ergonomics approach)**

Reducing the intensity of pain complaints in treatment group II experienced a greater decrease compared to treatment group I. The difference in pain before and after the intervention in treatment group II was larger than in treatment group I, with the pain difference in treatment group II being 3cm (30%) and in treatment group I being 1.4cm (14%). The difference in pain before and after the intervention was greater in treatment group II, indicating a greater reduction in pain in treatment group II. It can be concluded that the addition of muscle energy technique intervention to the participatory ergonomics approach is more effective in reducing pain complaints in employees with mechanical neck pain.

The difference in functional ability after working in treatment group II is 18% (36%), compared to the difference in treatment group I which is 9.8% (19.6%). A greater difference in functional ability in treatment group II compared to treatment group I indicates a greater improvement in functional ability in treatment group II. It can be concluded that the addition of muscle energy technique intervention to the participatory ergonomics approach is more effective in enhancing functional ability in employees with mechanical neck pain.

The quicker reduction in pain observed in treatment group II is attributed to the muscle energy technique intervention in the participatory ergonomics approach. In cases of mechanical neck pain, two muscles experience tension and shortening, namely the m. upper trapezius and m. levator scapulae. These muscles are tonic or postural in nature, working to support the head, shoulders, arms, and upper back while employees sit and work at computers. Prolonged sitting with a static and repetitive forward head posture can lead to hypertonicity in these muscles. Additionally, there is an accumulation of lactic acid metabolism in these muscles, resulting in postural fatigue. This triggers complaints of pain in the cervical region and tenderness in the m. upper trapezius and m. levator scapulae, impacting the condition of mechanical neck pain (Kashyap et al., 2018).

According to previous research, the muscle energy technique intervention in non-specific neck pain significantly reduces pain intensity with $p < 0.001$ (Lin et al., 2023). Another study indicates that the autogenic inhibition (AI) technique of MET is more beneficial than the reciprocal inhibition (RI) technique in reducing pain in patients with mechanical neck pain (Siddiqui et al., 2022). Furthermore, subsequent research also shows that muscle energy technique (MET) intervention and stretching are effective in reducing pain (VAS) in mechanical neck pain with $p < 0.05$ (Phadke et al., 2016). However, VAS scores in the MET intervention group show a better improvement compared to the stretching group with $p < 0.025$. The combination of muscle energy technique intervention and postural correction exercises effectively reduces pain in patients with mechanical neck pain with forward head posture. Significant results in group A (MET through post-isometric relaxation and postural correction exercise) show a greater reduction in neck pain than group B (neck range of motion exercise) with $p < 0.001$ (Joshi & Poojary, 2022).

The addition of muscle energy technique intervention to the participatory ergonomics approach is more effective in improving functional ability in employees with mechanical neck pain. This is consistent with previous research where MET intervention effectively improved functional ability post-intervention with $p = 0.023$; moreover, MET combined with other treatments significantly enhanced functional ability with $p < 0.05$ (Lin et al., 2023). In another study (Phadke et al., 2016), intervention in the MET group significantly improved functional ability with a decrease in NDI scores in patients with mechanical neck pain compared to the stretching group with $p < 0.025$. Furthermore, a subsequent study Joshi & Poojary (2022) also indicated a decrease in NDI scores in group A (MET via post-isometric relaxation and posture correction exercise) with a significance of $p < 0.01$.

Physiologically, the mechanism of MET intervention in reducing pain can occur because, during isometric contraction through post-isometric relaxation of the agonist muscles upper trapezius and levator scapulae, mechanoreceptors in the muscles and joints are activated. This leads to the activation of the local gray matter periaqueductal which regulates pain reduction and sympathetic excitation induced by somatic efferents. Simultaneously, the gating of nociceptive impulses in the dorsal horn caused by mechanoreceptor stimulation then results in the inhibition of nociception in the dorsal horn of the spinal cord. By inhibiting smaller diameter nociceptive input neurons at the spinal cord level, MET may reduce pain by stimulating joint proprioceptors through increased joint movement or joint capsule stretching (Al Matif et al., 2023). Furthermore, rhythmic muscle contractions during MET affect lymphatic flow rate and blood circulation, altering interstitial pressure and increasing transcapillary blood flow, which can eliminate the sensitivity of peripheral nociceptive chemical mediators such as cytokines (Lin et al., 2023). This mechanism leads to a decrease in pain, and the reduction in pain enhances functional ability through the addition of MET intervention in participatory ergonomic approaches such as stretching and correcting sitting posture while working with employees experiencing mechanical neck pain at the CU Lantang Tipo company.

## CONCLUSION

This study concludes that the addition of muscle energy technique to a participatory ergonomics approach has been proven to be more effective in reducing pain and improving functional ability in employees with mechanical neck pain in private companies in West Kalimantan. In this study, the Visual Analog Scale (VAS) pain complaint scores and Neck

Disability Index (NDI) functional ability scores in the treatment group II significantly decreased compared to treatment group I. However, the researchers acknowledge limitations and weaknesses in the study. The study's weaknesses are related to the subjective nature of the VAS pain complaint measurement tool and the NDI functional ability assessment. In future research, other researchers may use different measurement tool references for the same variables. Additionally, the muscle energy technique intervention is an intervention that can only be performed by Physiotherapists, manual therapists, or other healthcare professionals who have received MET certification training. The participatory ergonomics approach can be a sustainable program to maintain employee health in a company due to its practical and easy implementation. To ensure the program's sustainability and integration into the company culture throughout the study, socialization is needed to broaden the insights of employees and management regarding the importance of health and safety at work. Moreover, reducing pain scores with the intervention of adding.

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