

Effectiveness of Manual Therapy for Pain in Neck Pain Patients: A Systematic Review and Meta-Analysis

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ABSTRACT

Background: Neck pain (NP) is a musculoskeletal public health problem that is often experienced, especially by modern society, with a high prevalence that can cause disability. Neck pain can be treated with various physiotherapy modalities, one of which is manual therapy/ manipulation of the cervical spine. This study aims to determine the effectiveness of manual therapy in reducing pain in neck pain patients.

Subjects and Method: This was a systematic review and meta-analysis study, using PICO model. Population= neck pain patients. Intervention= manual therapy. Comparison= usual care. Outcome= reduction in pain. The articles included in this study were selected from Google Scholar, PubMed, NCBI, Science Direct, Embase, and Springer Link databases, which published between 2010 and 2023. The keywords used to search for articles were: "neck pain" OR "chronic neck pain" OR "cervical pain" OR "cervicalgia" OR "upper cervical pain" OR "nonspecific neck pain" OR "non-specific chronic neck pain" AND "manual therapy" OR "mobilization" OR "musculoskeletal manipulation" OR "cervical manipulation" AND "RCT" OR "randomized controlled trial" OR "randomized controlled trial". This data were analyzed using the RevMan 5.3. The results of the meta-analysis were reported using PRISMA flow diagrams.

Results: A total of 9 RCTs from Spain, Canada, Germany, Turkey, and Pakistan was included for meta-analysis. Manual therapy significantly reduced neck pain compared to usual care (SMD=-2.01; 95% CI= -3.00 to -1.03; p= 0.001).

Conclusion: Manual therapy significantly reduces neck pain compared to usual care.

Keywords: manual therapy, neck pain, cervical pain, mobilization, manipulation

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BACKGROUND

The millennial generation in the era of globalization and modernization is a generation that is technology literate. The sophistication of technology offered has provided many conveniences, including

accessing the internet, transactions, social media, and even online games which will influence a person's activities. One of the technologies that we can see progress in is gadgets. The widespread use of gadgets will certainly affect health conditions, where on

average it is done sitting and takes a lot of time. As many as 75% of people spend several hours every day using gadgets with their heads bent forward (David *et al.*, 2021; Warda *et al.*, 2023). The position of lowering the head, neck, and shoulders when using gadgets can cause sitting distortion and increase pressure in the cervical area (Fares *et al.*, 2017). The position of lowering the head, neck, and shoulders when using gadgets can cause sitting distortion and increase pressure in the cervical area (Rizwan *et al.*, 2023).

The World Health Organization (WHO) ranks neck pain and other musculoskeletal diseases 4th and 10th respectively among all health conditions in the world (Fares *et al.*, 2017; Putsa *et al.*, 2022). Neck pain (NP) is one of the public health musculoskeletal problems that is often felt, especially by modern society, with a high prevalence which can cause disability (Thomaidou *et al.*, 2023; Safiri *et al.*, 2020; Cohen, 2015). Around 22-70% of the population has experienced neck pain at least once during their life (Mayo & Keating, 2023). In Indonesia, according to Riskesdas data in 2019, the prevalence rate of pain due to diagnosed neck pain was 24.7%. The prevalence of neck pain complaints experienced by adults reached 16.6%, with 0.6% caused by severe neck pain (Lubis *et al.*, 2023).

Neck pain that lasts more than three months is defined as chronic neck pain (CNP). Research shows that chronic neck pain can cause problems, such as functional limitations, fear of movement, disability, and which ranges from 2-11% (Mayo & Keating, 2023). If it does not receive proper treatment, neck pain will become a chronic problem, so it is important to identify risk factors for prevention and early diagnosis (Kazeminasab *et al.*, 2022).

Several previous studies have explored various risk factors that cause neck pain, both changeable and irreversible, such as lack of physical activity, duration of daily computer use, perceived stress, elderly, female gender, low social support, and previous history of neck pain (Kazeminasab *et al.*, 2022). Neck pain attacks women more often with the greatest prevalence, especially when they enter the fifth decade of life.

Neck pain can be treated with various physiotherapy modalities, one of which is manual therapy/cervical manipulation. A literature review shows that manual therapy is beneficial for patients suffering from acute and chronic neck pain (Thomaidou *et al.*, 2023; Hidalgo *et al.*, 2017). Manual therapy involves neurophysiological mechanisms such as reduction of inflammatory biomarkers, decreased spinal excitability, pain sensitivity, modification of activity in cortical areas involved in pain regulation, and excitation of the sympathetic nervous system (Bernal-Utrera *et al.*, 2020).

Therefore, this research aimed to show the effectiveness of manual therapy in reducing pain in patients experiencing neck pain. The specific aim of this research is to use a meta-analysis method based on primary studies from previous research by synthesizing the results of studies conducted to reduce bias.

SUBJECTS AND METHOD

1. Study Design

This was a systematic review and meta-analysis. Search sources for the articles studied were taken relying on online article searches. Some of them are Google Scholar, PubMed, NCBI, Science Direct, Embase, and Springer Link between 2010 and 2023. The keywords used to search for articles are: "neck pain" OR "chronic neck pain" OR "cervical pain" OR "cervicalgia" OR "upper

cervical pain” OR “nonspecific neck pain” OR “nonspecific chronic neck pain” AND “manual therapy” OR “manipulation” OR “mobilization” OR “musculoskeletal manipulation” OR “cervical manipulation” AND “RCT” OR “randomized controlled trial” OR “randomized controlled trial”. This research analysis was carried out using the RevMan 5.3 application.

2. Inclusion Criteria

The articles included in this research were articles with a Randomized Controlled Trial (RCT) study design published between 2010 and 2023. The research subjects were sufferers of chronic neck pain with an age range of 18 to 65 years. Selected articles provide the main interventions based on manual therapy to treat pain in neck pain patients.

3. Exclusion Criteria

Articles that were not included in this research were articles that were not in English, research designs other than Randomized Controlled Trial (RCT), articles that were not full text, articles in manuscript form, articles that did not include the Standardized Mean Difference (Mean – SD), articles that did not use the Visual Analogue Scale (VAS) measurement tool to measure pain, articles published before 2010.

4. Study Variables

The dependent variable is pain, the independent variable is manual therapy.

5. Operational Definition of Variables

Manual therapy is a variety of therapeutic techniques carried out manually or with the hands of a therapist for diagnostic and therapeutic purposes. Instrument: with categorical measurement scale.

Pain is an unpleasant feeling due to a protective mechanism triggered by nociceptors to increase awareness when the body is or will experience tissue damage. Instrument: with categorical measurement scale.

6. Study Instruments

The identified studies report, then each study is assessed based on eligibility criteria. The quality and design of the studies analyzed in a meta-analysis are very important because they influence the results. This research uses Critical Appraisal Tools of Randomized Controlled Trials (RCT) published by CEBM University of Oxford 2014.

- a. Does the research address a clearly focused statement/problem?
- b. Is the Randomized Controlled Trial research method suitable for answering the research questions?
- c. Were there enough subjects in the study to determine that the findings did not occur by chance?
- d. Are subjects randomly allocated to experimental and control groups? If not, could this introduce bias?
- e. Are inclusion/exclusion criteria used?
- f. Were the two groups comparable at the start of the study?
- g. Are objective and unbiased outcome criteria used?
- h. Are objective and validated measurement methods used to measure the results? If not, were the results assessed by someone blind to group assignment (were assessments blinded)?
- i. Is effect size practically relevant?
- j. How precise is the effect estimate? Is there a confidence interval?
- k. Could there be confounding factors that have not been taken into account?
- l. Can the results be applied to your research?

7. Data analysis

Research data was processed using the Review Manager application (RevMan 5.3) to conduct a systematic review of the pain levels of neck pain patients. Next, calculate the mean difference in Visual Analogue Scale (VAS) pain scores to determine the

combined research model that will form the final results of the meta-analysis.

RESULTS

Figure 1 shows the process of searching a journal database to find articles. There were 609 articles identified from the database, after the process of eliminating duplicate articles, 353 articles were accepted, 23 of

which met the research requirements, resulting in 9 articles being included in the synthesis and meta-analysis study. Figure 2 shows 9 articles originating from 3 continents, namely America, Europe and Asia. 1 study from the American Continent, 6 studies from the European Continent, and 2 studies from the Asian Continent.

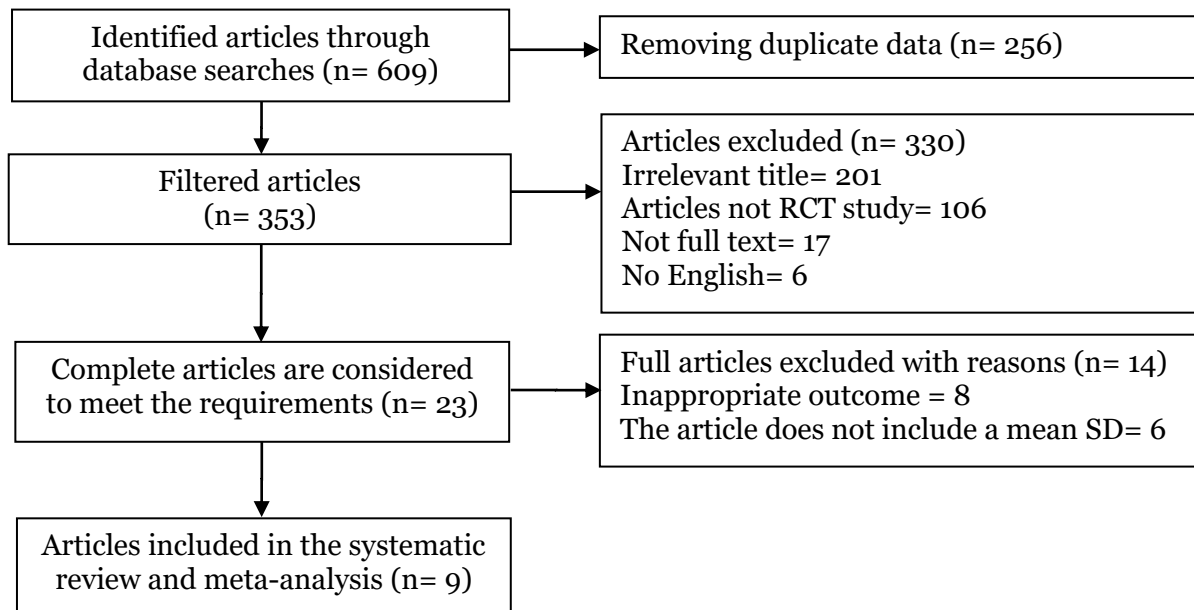


Figure 1. PRISMA flow diagram.



Figure 2. Map of the research area on the effectiveness of manual therapy for pain in neck pain patients.

Table 1. Assessment of Study Quality Using CEBM Critical Appraisal Tools for Randomized Controlled Trials from University of Oxford, 2014

NO	Checklist Questions	Publication (Author and Year)								
		(Rodríguez-Sanz et al., 2020)	(Bernal-Utrera et al., 2020)	(Martel et al., 2011)	(Bernal-Utrera et al., 2022)	(Haller et al., 2016)	(Retamal et al., 2021)	(Brück et al., 2021)	(Corum et al., 2021)	(Khan et al., 2022)
1	Does this research address a clear research focus?	1	1	1	1	1	1	1	1	1
2	Is the Randomized Controlled Trial research method suitable for answering the research questions?	1	1	1	1	1	1	1	1	1
3	Were there enough subjects in the study to determine that the findings did not occur by chance?	1	1	1	1	1	1	1	1	1
4	Are subjects randomly allocated to experimental and control groups? If not, could this introduce bias?	1	1	1	1	1	1	1	1	1
5	Are inclusion/exclusion criteria used?	1	1	1	1	1	1	1	1	1
6	Were the two groups comparable at the start of the study?	1	0	1	0	1	1	0	1	1
7	Are objective and unbiased outcome criteria used?	1	1	1	1	1	1	1	0	1
8	Are objective and validated measurement methods used to measure the results? If not, were the results assessed by someone blind to group assignment (i.e. were assessments blinded)?	1	1	1	1	1	1	1	1	1
9	Is effect size practically relevant?	1	1	1	1	0	0	1	0	1
10	How precise is the effect estimate? Is there a confidence interval?	1	1	1	1	1	1	1	1	1
11	Could there be confounding factors that have not been taken into account?	0	0	0	0	0	0	0	0	0
12	Can the results be applied to research?	1	1	1	1	1	1	1	1	1
Score		11	10	11	10	10	10	10	9	11

*Note: 1=Yes, 0=No. The question in item number 11 was given a score of 0 because it was given a positive value

9 articles prove the effectiveness of manual therapy intervention in reducing pain in neck pain patients.

Table 2. Description of primary studies included in the primary studies meta-analysis

Author (Year)	Country	Study Design	Sample		P (Population)	I (Intervention)	C (Comparison)	O (Outcome)	Value	
			Total	Intervention					Mean	SD
(Rodriguez-Sanz <i>et al.</i> , 2020)	Spanish	Randomized Controlled Trial.	58	29	Patients aged ≥18 years with chronic neck pain and upper cervical spine dysfunction	Manual therapy dan exercise	Exercise	Pain	0.98	1.49
(Bernal-Utrera <i>et al.</i> , 2020)	Spanish	Randomized Controlled Trial.	68/69	23	Patients aged 18–50 years with acute neck pain and chronic neck pain	Manual therapy	Sham treatment	Pain	18.23	4.33
(Martel <i>et al.</i> , 2011)	Canada	Randomized Controlled Trial.	92	32	Patients aged 18–60 years with nonspecific chronic neck pain	Spinal manipulative therapy	Attention control	Pain	2.3	2.9
(Bernal-Utrera <i>et al.</i> , 2022)	Spanish	Randomized Controlled Trial.	69	23	Patients aged 18–50 years with acute neck pain and chronic neck pain	Manual therapy	Sham treatment	Pain	18.23	4.33
(Haller <i>et al.</i> , 2015)	German	Randomized Sham-Controlled Trial.	54	27	Patients aged 18–65 years with nonspecific chronic neck pain	Craniosacral therapy	Sham treatment	Pain	31.6	19
(Retamal <i>et al.</i> , 2021)	Spanish	Randomized Controlled Trial.	96	31	Patient aged 18–40 years with chronic neck pain located between the os. occipital	Manual inhibition suboccipital technique	Instrumental sub occipital inhibition	Pain	1.21	1.65
(Brück <i>et al.</i> , 2021)	German	Randomized Controlled Trial.	60	20	Patients aged 30-65 years with chronic neck pain	Manual therapy	Control grup	Pain	1.2	1.4
(Corum <i>et al.</i> , 2021)	Türkiye	Randomized Controlled Trial.	39	12	Patient aged 19–48 years with neck pain and tension type headache	Manipulation dan exercise	Exercise	Pain	2	2.6
(Khan <i>et al.</i> , 2022)	Pakistan	Randomized Controlled Trial.	60	30	Patient aged 25–40 years with nonspecific chronic neck pain	Post Isometric Group	Myofascial release therapy	Pain	1.3	1

*Variables included in the meta-analysis

1. Forest Plot

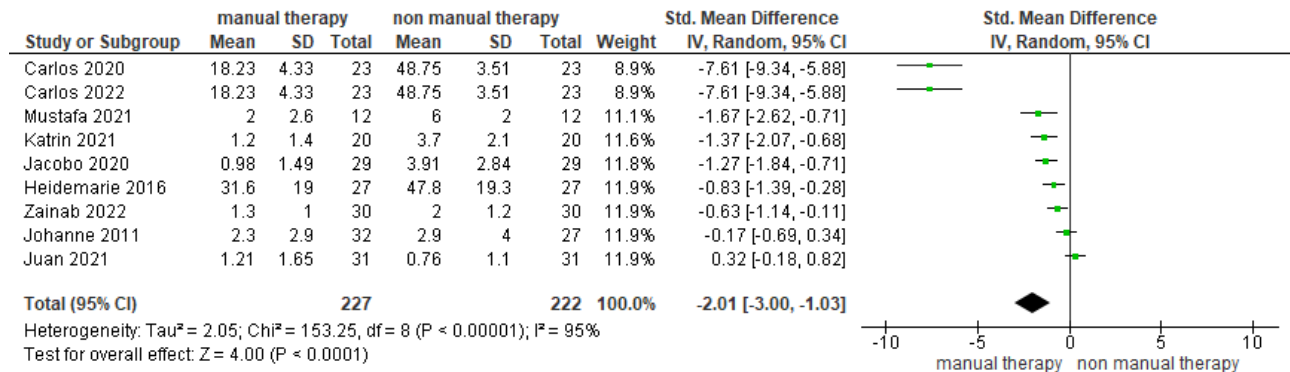


Figure 3. Forest plot of the effectiveness of manual therapy for pain in neck pain patients.

2. Funnel Plot

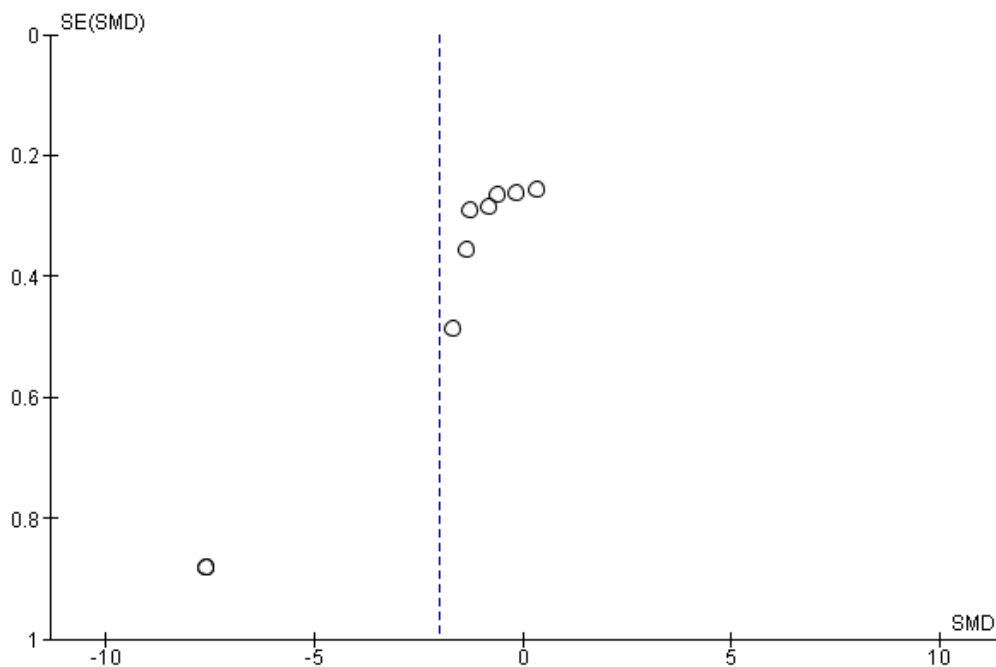


Figure 4. Funnel plot of the effectiveness of manual therapy for pain in neck pain patients.

Based on the results of the forest plot (figure 3), it shows that manual therapy can reduce pain in neck pain patients. Neck pain sufferers who received manual therapy experienced -2.01 units lower pain than those who did not receive manual therapy, and the effect was statistically significant (SMD= -2.01; 95% CI -3.00 to -1.03; p <0.001). Heterogeneity of estimates between studies is high with I²= 95%. Thus,

the synthesis of estimates of the overall effect of primary studies was carried out using a random effect model approach.

The funnel plot (Figure 4) shows that there is a potential for publication bias which is characterized by asymmetry between the left plot and the right plot, on the left there is 1 and on the right there are 7. The estimated effect distribution is located further to the right of the estimated

central vertical line than to the left. Therefore, funnel plots indicate publication bias. Publication bias reduces the true effect because the direction of the bias is to the right of the zero vertical line, as opposed to the diamond mean in the effect estimate, which is to the left of the zero vertical line (underestimate).

DISCUSSION

Current meta-analysis found that neck pain patients who received manual therapy intervention experienced pain -2.01 units lower than those who did not receive manual therapy (SMD=-2.01; 95%CI= -3.00 to -1.03; $p < 0.001$). Heterogeneity of estimates between studies is high with $I^2 = 95\%$ so the distribution is heterogeneous (random effect model).

According to (Rodríguez-Sanz et al., 2020), there was a statistically significant increase in all research variables in the manual therapy group compared to the exercise group in the short and medium term. In the manual therapy group a statistically significant improvement was found in post-intervention VAS (Mean= 0.98; SD= 1.49 vs Mean= 3.91; SD= 2.84; $p < 0.001$) and increased pain pressure thresholds at all follow-ups. Research shows that providing manual therapy that focuses on treating upper cervical joint movement restrictions into the cervical exercise protocol significantly increases cervical mobility in the sagittal and transverse planes.

According to (Bernal-Utrera et al., 2020), the results of the final evaluation of the manual therapy group showed differences compared to the control group in all research variables, one of which was the VAS (Mean= 18.23; SD= 4.33 vs Mean= 48.75; SD= 3.51; $p = 0.002$). Meanwhile, the control group showed no difference in VAS in each evaluation carried out. This statis-

tically significant improvement shows the clear efficacy of manual therapy intervention for chronic neck pain patients. Researchers believe that manual therapy can be considered as a treatment option on its own without adding other interventions.

According to (Martel et al., 2011), research shows that there are no additional benefits for non-specific chronic neck pain patients who receive spinal manipulation therapy with and without a home exercise program compared to the control group. The study also showed that no group differences were observed for primary, secondary and exploratory variables. The difference was not significant between the group given spinal manipulative therapy ($p = 0.006$) and the control group ($p = 0.032$) with post-intervention VAS scores (Mean= 2.10; SD= 2.30 vs Mean= 2.90; Mean= 2.90).

According to (Bernal-Utrera et al., 2022), showed a clear increase in non-specific chronic neck pain patients for the manual therapy group (Mean= 26.14; 95% CI= 1.29 to 36.98] in the short term and (Mean= 23.73, 95% CI= 12.01 to 35.45] in the medium term. Meanwhile, the control group did not improve in any evaluation, either VAS or OBI scores in any assessment. Statistically significant results compared with the control group were seen from the post-intervention VAS scores (Mean= 18.23 SD= 4.33 vs Mean= 48.75; SD= 3.51). Therefore, researchers believe that clinical improvement is the result of intervention in the form of manual therapy.

According to (Haller et al., 2016), the study revealed the efficacy of the craniosacral therapy (CST) group for chronic neck pain compared with the sham treatment group, post-intervention VAS score (Mean= 31.6; SD= 19 vs Mean= 47.8; SD= 19.3). Craniosacral therapy has been proven to be effective and safe for reducing pain inten-

sity, reducing functional disability, and quality of life up to three months post-intervention. Clinical pain reduction of at least 20% was reported by 74.1% of CST patients versus 40.7% of sham treatment patients at week 8 ($p = 0.013$), and 77.8% of CST patients versus 51.9% of sham treatment patients at week 20 ($p = 0.046$).

According to (Retamal et al., 2021), both the intervention and control groups studied were able to achieve large improvements in ROM, pain, and disability. Myofascial release therapy in the suboccipital area is effective in chronic neck pain patients, whether applied manually or through instrumental suboccipital inhibition. No significant differences between groups were found in any variable except for VAS during left rotation, with smaller improvements obtained for the intervention group (Mean= 1.21; SD= 1.65 vs Mean= 0.76; SD= 1.10).

According to (Brück et al., 2021), a mixed-design ANOVA showed a significant pain VAS intensity effect of time ($p < 0.001$) and a significant group-time interaction ($p < 0.001$). The results of the study also showed quite large improvements in pain, tension, weakness, and ROM in the manual therapy group. Meanwhile, the control group did not provide significant changes between measurements. Researchers confirmed the effectiveness of manual therapy for chronic neck pain patients, with a significant reduction in pain intensity ($p = 0.379$) in VAS scores after intervention (Mean= 1.2; SD= 1.4 vs Mean= 3.7; SD= 2.1).

According to (Corum et al., 2021), the manipulation group showed statistically significant improvements in all criteria compared with the control group both post-intervention ($p < 0.001$) and at third month follow-up ($p = 0.002$), respectively). In addition, the VAS neck pain score showed a significant difference between the manipulation group and the control group at the

third month of follow-up (Mean= 2.0; SD= 2.6 vs. Mean= 6.0; SD= 2.0). Providing upper cervical spinal manipulation and exercise to tension type headache patients with neck pain is effective in improving headache disability, reducing the frequency, severity and duration of headaches after treatment and in the third month of follow-up.

According to (Khan et al., 2022), pain intensity on VAS showed a significant group-by-time interaction ($p = 0.008$) with the post isometric group showing better pain reduction on VAS mean (Mean= 1.3; SD= 1.0; $p < 0.001$) over time compared to the control group (Mean= 2.0; SD= 1.2; $p < 0.001$). Recent study found that pain reduction after post isometric exercise can be caused by the inhibitory effect of the Golgi tendon organ which reduces the discharge of motor neurons thereby causing relaxation of the musculotendinous unit by modifying the Pacinian corpus. This reflex allows relaxation of the tension of the musculotendinous unit and reduces the perception of pain.

AUTHORS CONTRIBUTION

Yuyun Apriliyani led the conceptualization of the study, conducted a thorough literature search, and meticulously extracted and synthesized data from selected studies. These efforts were crucial in shaping the study's scope and ensuring comprehensive and rigorous data collection. Wahyuni took on the responsibility of analyzing data and critically reviewing selected articles for the meta-analysis. This role involved applying statistical methods to analyze the compiled data and ensuring the accuracy and robustness of the study's findings.

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CONFLICT OF INTEREST

There is no conflict of interest.

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