Jurnal Keterapian Fisik
Vol. 8, No. 1, May 2023
https://doi.org/10.37341/jkf.v8i1.492

Original Research

Kinesio Taping and Quadriceps Strengthening Exercise Reduce Osteoarthritis Pain: A Literature Review

Aji Darwin Kurniawan Waskito[1*], Marti Rustanti[2], Sukadarwanto Sukadarwanto[3]

[1,2,3] Departement of Physiotherapy, Poltekkes Kemenkes Surakarta, Indonesia

ABSTRACT

Background: *Osteoarthritis is one of the most common degenerative diseases, not only in Indonesia but also throughout most of the world. This disease causes pain in sufferers. Kinesio taping has therapeutic effects for muscle function correction by increasing weak muscle strength and improving blood and lymphatic circulation. Quadriceps strengthening exercises are one form of strengthening exercise recommended to increase the strength of the quadriceps and lower extreme muscles. The purpose of this study was to determine the effect of kinesio taping and quadriceps strengthening exercises on reducing osteoarthritis pain based on the literature.*

Methods: *This study was a literature review using PICOT analysis. Five databases were used, namely PubMed, Sage Journal, BMC, Science Direct, PEDro, and snowballing technique. After all articles were collected and checked for duplication and screening, 11 articles were accepted and analyzed from 223 articles.*

Results: *In this literature study, the researchers searched for and selected articles from 223 titles to 11 titles that met the inclusion criteria. Nine of the eleven journals had an effect on knee OA pain.*

Conclusion: *Research on the effect of Kinesio Taping and quadriceps strengthening exercises on knee osteoarthritis pain was conducted using a literature study method, and eleven articles that passed the screening test showed that Kinesio Taping and quadriceps strengthening exercises have an effect on knee osteoarthritis pain.*

ARTICLE HISTORY
Received: November 24th, 2025
Accepted: December 9th, 2025

KEYWORDS
kinesio taping, osteoarthritis, pain, quadriceps strengthening exercise;

CONTACT
Aji Darwin Kurniawan Waskito
✉
ajidarwinkurniawanwaskito@gmail.com
Departement of Physiotherapy, Poltekkes Kemenkes Surakarta. Jl. Kapten Adi Sumarmo, Tohudan, Colomadu, Karanganyar Regency, Central Java, Indonesia.

Cite this as: Kinesio Taping and Quadriceps Strengthening Exercise Reduce Osteoarthritis Pain: A Literature Review. (2023). *Jurnal Keterapian Fisik*, *8*(1), 35-46. https://jurnalketerapianfisik.com/index.php/jpt/article/view/492

INTRODUCTION

Osteoarthritis is one of the most common degenerative diseases, not only in Indonesia but also throughout most of the world. This disease causes pain in sufferers, which can interfere with daily activities. There are two types of osteoarthritis: primary osteoarthritis and secondary osteoarthritis. Primary osteoarthritis is a degenerative disease that is not related to systemic diseases and local changes in the joints, while secondary osteoarthritis is a degenerative disease that usually occurs due to

predisposing and progressive pathological factors that affect 40% of men and 60% of women over the age of 65 (Yovita & Enestesia, 2015).

The prevalence of osteoarthritis continues to increase with age, usually between the ages of 40 and 60. Osteoarthritis affects approximately 3.3% to 3.6% of the global population. It causes moderate to severe disability in 43 million people, making it the 11th most debilitating disease worldwide. In the United States, it is estimated that 80% of the population over the age of 65 has radiographic evidence of OA, although not all individuals experience symptoms related to the radiographic findings. Therefore, radiographic changes do not prove that OA is the cause of a patient's joint pain (Franciozi, 2013).

Osteoarthritis is a degenerative joint disease associated with cartilage damage. Osteoarthritis is chronic and slowly progressive, characterized by changes in joint cartilage. Risk factors for osteoarthritis include age, genetics, obesity, joint injury, and inflammatory joint diseases, all of which significantly influence the development of osteoarthritis (Yovita & Enestesia, 2015).

Physical therapy plays a role in the healthcare field in treating osteoarthritis, aiming to reduce pain, prevent deformities, and restore joint function so that patients can resume their normal activities. Physiotherapy modalities in treating osteoarthritis are based on evidence-based practice. Research developed in line with current advances in technology has produced many new discoveries and methods, one of which is kinesio taping and quadriceps strengthening, which are often used and considered effective and efficient in treating osteoarthritis (Nayanti et al., 2020).

Kinesio taping is an elastic therapeutic tape made of a thin material that resembles skin and has therapeutic effects for correcting muscle function by increasing the strength of weak muscles, improving blood and lymphatic circulation by lifting the skin around areas experiencing inflammation, pain, edema, and stimulating cutaneous mechanoreceptors, thereby reducing pain, stimulating proprioceptors, and aiding in restoring joint function, improving stability, and correcting movement direction. Quadriceps strengthening exercises are one form of strengthening exercise recommended to increase the strength of the quadriceps and lower extremity muscles, which are useful for supporting body weight, thereby reducing the pressure on the knee joint cartilage (Nayanti et al., 2020).

Based on research by Castrogiovanni et al., (2016) it was concluded that quadriceps strengthening and kinesio taping interventions in patients with knee OA are more effective in reducing pain. Knee OA is closely related to significant pain and disability, and these interventions have been proven to reduce symptoms in patients with knee OA. Additionally, a study conducted by N. Shakoor in Bangladesh aimed to determine the effect of quadriceps strengthening exercises on reducing knee OA pain and concluded that quadriceps strengthening exercises are quite effective in reducing pain. The increasing number of osteoarthritis cases, which often present with varying complaints of pain and the continuous development of science in the health sector have encouraged new research.

Based on sources related to osteoarthritis and pain reduction interventions using quadriceps strengthening and kinesio tapping, which concluded different and relatively affordable results, the author was interested in taking the title "The Effect of Kinesio Tapping and Quadriceps Strengthening Exercise on Osteoarthritis Pain: A Literature Review" to review and examine previous research articles conducted by several researchers related to the research to be conducted by the author.

MATERIALS AND METHOD

This study uses a systematic literature review design with a narrative synthesis approach. This design was chosen because it is able to identify, assess, and analyze various previous research results in a structured manner to obtain scientific conclusions regarding the effectiveness of kinesio tapping and quadriceps strengthening exercises in reducing pain in patients with knee osteoarthritis. This approach also helps researchers find gaps in knowledge and strengthen the basis for evidence-based practice.

The literature search strategy analysis in this study used the PICOT (Population, Intervention, Comparison, Outcome, Type of study) approach. The Population component included men and women aged 35–70 years suffering from knee osteoarthritis. The Intervention component included the application of kinesio taping and quadriceps strengthening exercises. The Comparison component is the control group or the group that receives other interventions. The Outcome component is the reduction in knee pain after the intervention, while the Type of study is experimental research with a randomized controlled trial (RCT) or randomized clinical trial (RCT) design. The PICOT approach is used to focus the research questions and ensure that the articles obtained are relevant to the study objectives.

The research was conducted through online literature searches in five major databases, namely PubMed, Sage Journal, BMC, Science Direct, and PEDro. The search process was carried out using Boolean searching techniques with a combination of the keywords "knee osteoarthritis AND kinesio tapping OR kinesio tape OR kinesiology tape OR elastic therapeutic taping AND quadriceps strengthening exercise OR quadriceps strengthening OR QS AND pain". The article collection process took place from January to May 2022. The Zotero application was used to manage and sort articles, while the methodological quality assessment was conducted using the PEDro scale.

The research variables consisted of independent variables in the form of kinesio tapping and quadriceps strengthening exercise interventions, dependent variables in the form of a reduction in knee pain levels, and control variables in the form of other types of interventions. The instrument used to assess the quality of the research was the PEDro (Physiotherapy Evidence Database) scale. This scale assesses eleven methodological aspects such as randomization, blinding, and statistical analysis. The assessment was conducted by two independent assessors, with scores categorized into four quality levels, namely Q1 (very good, 75.1–100%), Q2 (good, 50.1–75%), Q3 (fair, 25.1–50%), and Q4 (poor, 0–25%).

The review and reporting process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The PRISMA stages included four main steps: identification, screening, eligibility, and inclusion. In the identification stage, all articles obtained from the five databases were collected and selected based on keyword relevance.

The screening stage was conducted to remove duplicates and irrelevant articles based on the title and abstract. Next, the eligibility stage was carried out by reading the full text to assess whether the article met the inclusion criteria. Articles that met all criteria were then included in the inclusion stage and analyzed in depth. The article selection process flow is presented in a PRISMA diagram that illustrates the number of articles at each stage.

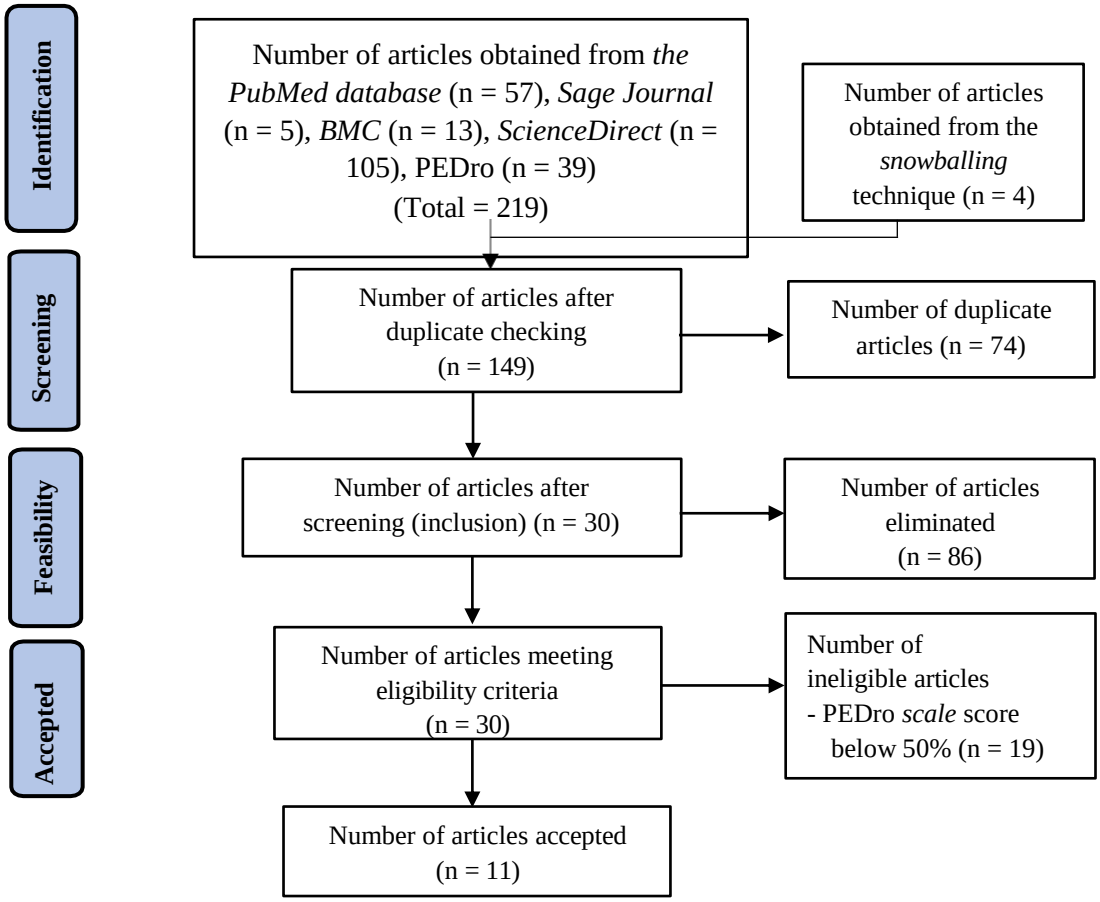

Figure 1. PRISMA Diagram

RESULTS

The eleven journals were analyzed based on research title, year of research, research design, data collection methods, sample size, intervention, and research results. The results of the analysis were used as material for discussion in the research topic. Of the eleven journals, all subjects were men and women aged 38-70 years. The interventions given were not only kinesio taping and quadriceps strengthening, but also combined with stretching, strengthening with elastic bands, and balance and stabilizing training.

The researchers determined that the subjects used in this literature study were adults and elderly people with knee OA. The total sample obtained in this study was 597 people. The subjects used in the literature review were men and women aged between 38 and 70 years. Among the eleven articles selected by the researchers, there was one journal article from Indonesia, one journal article from South Korea, one journal article from Brazil, two journal articles from Turkey, one journal article from Germany, one journal article from Italy, one journal article from Spain, one journal article from the United States, one journal article from Nigeria, and one journal article from Australia. The duration of the therapy protocol in the studies varied from 4 weeks to 16 weeks.

The data used in this study were obtained from measurements using the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) Index, VAS (Visual Analog Scale), Numerical Rating Scale (NRS), goniometer, TUG/time up and go test,

Short-Form Health Survey/SF-36, Aggregated Locomotor Function, handle dynamometer, isokinetic dynamometer, algometer, Lysholm Knee Scoring Scale, digital pressure algometry, Balance Error Scoring System (BESS-Test), 10-m Walk Test (10MWT), maximum voluntary isometric contraction force (MVIC), and Hand Held Dynamometer (HHD).

The interventions conducted in the research journal articles consisted of Kinesio Taping with and without traction, Sham Taping, stretching exercises, strengthening exercises, walking exercises, and stabilizing exercises. Five of the 11 studies used a combination of Kinesio Taping and quadriceps strengthening exercises, four studies focused on Kinesio Taping, and two studies focused on quadriceps strengthening. Nine of the eleven studies showed significant differences before and after treatment, but one showed no significant differences between groups. Two studies showed insignificant results in measurements before and after treatment. One article stated that there was a relationship between pain and active range of motion (AROM) as well as proprioception.

The application of Kinesio Taping has been proven effective in improving the perception of knee function and mobility, especially when applied in daily activities. The mechanism of Kinesio Taping involves lifting the skin to improve blood and lymphatic flow, reducing pressure on muscle tissue, and stimulating proprioceptive receptors that help reduce pain. Several studies, such as those conducted by Nwe and Wu, show that the use of Kinesio Taping significantly reduces pain intensity and stiffness, and improves joint range of motion and physical function. However, other results found variations in effectiveness due to differences in the severity of osteoarthritis, duration of therapy, and application methods used.

Table 1. Research Data Extraction Results (n = 11 articles)

Title/Year	Author/Origin	Study Design and Objectives	Sample Size and Instruments	Intervention and Control	Research Results
Kinesiotape and quadriceps strengthening with elastic band in women with knee osteoarthritis and overweight or obesity (2018)	Saúl León-Ballesteros/ Spain	Randomized clinical trial; to determine the effectiveness of a combination of strengthening exercises and Kinesio Taping on pain reduction	n=32; WOMAC, VAS	Group 1: QS + KT n=11; Group 2: exercise + placebo n=11	No significant difference between groups (p=0.2).

Title/Year	Author/Origin	Study Design and Objectives	Sample Size and Instruments	Intervention and Control	Research Results
A comparison between the effect of combined chain exercises plus Kinesio Taping with combined chain exercises alone in knee osteoarthritis (2021)	Musa Sani Danazumi/Nigeria	Randomized clinical trial; comparing the effect of KT + CCEs with CCEs alone	n=60; VAS, TUG, goniometer, SF-36	Group 1: KT+CCEs n=30; Group 2: CCEs n=30	There was a significant difference: KT+CCEs showed better results ($p<0.05$).
Effects of Exercise Training Alone and in Combination with Kinesio Taping on Pain, Functionality, and Biomarkers (2017)	Ramazan Oğuz/ Turkey	Randomized controlled trial; analyzed the effects of ET and ET+KT on pain, function, and biomarkers	n=22; VAS, WOMAC, blood sampling	Group 1: ET+KT n=11; Group 2: ET n=11	Reduction in pain and functionality in both groups ($p<0.05$), not significant between groups.
Does Kinesio Taping of the knee improve pain and functionality in patients with knee osteoarthritis? (2017)	Ebru Kaya Mutlu/ Turkey	RCT; effect of KT on functionality and pain compared to sham-tape	n=42; WOMAC, VAS, dynamometer, goniometer	Group 1: KT n=21; Group 2: sham-tape n=21	Reduction in LGS and VAS ($p<0.05$); no significant difference in muscle strength between groups.
Kinesio Taping does not improve the symptoms or function of older people with knee osteoarthritis (2016)	Bruna Wageck/ Australia	RCT; evaluating the effects of KT on older adults with knee OA	n=72; isokinetic dynamometer, WOMAC, Lysholm Scale	Group 1: KT n=31; Group 2: sham-tape n=31	No significant differences between groups.

Title/Year	Author/Origin	Study Design and Objectives	Sample Size and Instruments	Intervention and Control	Research Results
Kinesio Taping improves perceptions of pain and function of patients with knee osteoarthritis (2018)	Anna Lina Rahlf/ Germany	RCT; assessed the effects of KT on pain, function, and neuromuscular control	n=131; WOMAC, dynamometer, algometry	Group 1: KT n=47; Group 2: sham-tape n=47; Group 3: no intervention n=47	Significant effects on pain, stiffness, and function ($p<0.05$).
Kinesio Taping improves pain, range of motion, and proprioception in older patients with knee osteoarthritis (2015)	Hwi-young Cho/ South Korea	RCT; effects of KT on pain and proprioception	n=46; VAS, PPTs, inclinometer	Group 1: KT (tension) n=23; Group 2: sham KT (no tension) n=23	Significant reduction in pain and improvement in ROM and proprioception in the KT group.
Quadriceps strengthening exercises improve pain and quality of life in knee OA (2012)	Aline Mizusaki Imoto/Brazil	RCT; assessed QS at 8 weeks for pain and knee OA function	n=81; TUG, NRS, SF-36	Group 1: exercise n=41; Group 2: knee OA education n=40	Significant improvement in pain and TUG test ($p<0.001$). [1]
Quadriceps strengthening exercise and knee biomechanics during walking in knee OA (2018)	Paul DeVita / USA	Two-center RCT; effects of QS on knee quadriceps muscle biomechanics	n=30; gait analysis, WOMAC, dynamometer MVC	Group 1: QS n=15; Group 2: control n=15	QS increased muscle strength without significant biomechanical changes.

Title/Year	Author/Origin	Study Design and Objectives	Sample Size and Instruments	Intervention and Control	Research Results
The Effects of Kinesio Taping and Quadriceps Muscle Strengthening Exercise on Quadriceps Muscle Strength and Functional Status in Knee OA (2020)	Anggia P. Nayanti /Indonesia	RCT; combined effects of KT and QS on muscle strength & knee function	n=26; HHD, WOMAC	Group 1: KT + QS n=13; Group 2: sham-tape + QS n=13	Significant improvement in muscle strength and WOMAC in the treatment group (p=0.019).
The Effects of Exercise and Kinesio Tape on Physical Limitations in Patients with Knee Osteoarthritis (2016)	Paola Castrogiovanni/Italy	RCT; combined effects of exercise and KT on knee function	n=57; WOMAC, VAS, TUG	Group 1: exercise; Group 2: exercise + KT (tension); Group 3: exercise + KT (no tension)	Reduction in knee pain, improvement in knee function, and reduction in medication requirements in the KT combination group.

DISCUSSION

This study aimed to determine the effect of Kinesio Taping and quadriceps strengthening exercises on pain in patients with knee osteoarthritis (OA). The researchers identified eleven journals that passed the selection criteria, nine of which had an effect on knee OA pain.

The Effect of Kinesio Taping on Knee Osteoarthritis (OA) Pain

The use of Kinesio Taping in patients with knee OA reduced pain during activity in the Kinesio Taping group compared to the sham-taping group. After a 1-month follow-up, KT also reduced pain at night (Mutlu et al, 2017). It was also found that KT application was highly effective in reducing pain when applied during activities compared to when at rest (Cho et al., 2015).

In the study by Wagect et al., (2016) it was shown that KT application for 4 days did not significantly affect pain, muscle strength, swelling, knee-related health status, or functional ability in elderly people with knee OA. However, in a study by Lina et al., (2018) it was found that the use of KT for 3 consecutive days was effective in reducing pain perception, joint stiffness, and physical function in patients with knee OA aged over 50 years compared to the group given sham tape or no intervention, based on self-reports using the WOMAC index.

In Nayanti et al.,'s (2020) study one person experienced an allergic reaction to Kinesio Taping in the form of redness and itching, so they had to be excluded from the study. From this, further research is still needed to discuss the occurrence of allergies so that the exact cause of allergies to Kinesio Taping can be determined.

The Effect of Quadriceps Strengthening on Knee Osteoarthritis (OA) Pain

An 8-week quadriceps muscle strengthening exercise program has been shown to reduce pain, improve function, and enhance the quality of life of patients with knee OA (Imoto et al., 2012). The study by DeVita et al., (2018) showed that quadriceps strengthening exercises increased muscle strength and reduced knee OA symptoms, but did not change the biomechanical pattern of the quadriceps muscle or knee joint during walking.

The application of Kinesio Taping and quadriceps strengthening exercises did not improve pain compared to quadriceps strengthening exercises alone in knee OA, but it did increase muscle strength. This was influenced by the duration of the exercises, the continuity of Kinesio Taping application, and the grade of knee OA (León-Ballesteros S, et al 2018). In a study by Danazumi, et al., (2021) it was shown that after 8 weeks of treatment, a combination of quadriceps muscle strengthening exercises and Kinesio Taping application had an effect on reducing pain, increasing the range of motion of knee flexion, improving functional mobility and quality of life, compared to only muscle strengthening exercises.

The study by Castrogiovanni, Paola et al., (2016) reinforces these findings. In their study, they found that after 15 days and after three months, the use of Kinesio Taping in conjunction with an exercise protocol (customized physical activity) not only alleviated knee pain but also significantly improved knee function. This demonstrates that KT application with tension achieves optimal performance when applied over an extended period due to its stabilizing effect.

The Relationship Between Quadriceps Strengthening Exercises and Kinesio Taping on Knee Osteoarthritis (OA) Pain

The addition of KT to quadriceps strengthening exercises showed a significant increase in quadriceps muscle strength after week 6 in the intervention group compared to the control group. However, it did not result in any difference in the functional status of knee OA patients in both groups (Nayanti et al., 2020). This contradicts the study by Mutlu et al., (2017) which also showed insignificant results in iliopsoas, gluteus medius, quadriceps, and hamstring muscle strength in knee OA patients in the intervention group who received KT compared to the control group who received placebo taping.

Research by Nayanti et al., (2020) suggests that Kinesio Taping drainage techniques may have an indirect effect on pain. If there is a reduction in swelling, it can improve joint mobility, reduce intra-articular pressure, and provide pain relief. Microwaves are immediately formed under the skin when applying Kinesio Taping, and these microwaves, along with muscle activation, can facilitate the movement of swelling in the joint toward the lymphatic vessels, thereby improving drainage. Additionally, the skin area where KT is applied experiences a convoluted effect, which may increase blood volume and blood and lymph flow in this area due to the lifting effect, which expands the space between the muscle and skin (Cho et al, 2015).

This literature review study has several limitations in its writing: (1) this study only reviewed journal articles that were fully accessible and free (open access) from

available databases, while paid journal articles were not included in the research process; (2) this literature study obtained articles in which there were differences in the level of knee OA in the subjects in each study, so the results could be biased; and (3) this study used descriptive synthesis rather than meta-analysis using statistical calculations. Future research also needs to develop a more optimal methodology for synthesizing results in order to produce more comprehensive and valid conclusions for application in clinical practice.

CONCLUSION

This study shows that the application of Kinesio Taping and quadriceps muscle strengthening exercises has a significant positive effect in reducing pain in patients with knee osteoarthritis, based on a literature study of eleven articles that have been rigorously selected. However, the limited number of articles and the diversity in the quality of the articles are important considerations that affect the validity of these findings. Therefore, the recommendation for further research is to conduct studies with a broader journal coverage, including paid articles, and to involve quality assessments by experts to ensure the accuracy and precision of the results.

ACKNOWLEDGEMENTS

The author would like to express his deepest gratitude to the Palembang Health Polytechnic (POLKESTA) for the support and guidance provided during the research and writing of this journal. The support from all teaching staff and colleagues was also very helpful in ensuring the smooth running of the research so that it could be completed successfully.

REFERENCES

Adela Hruby, PhD, M., & Frank B. Hu, MD, PhD, M. (2015). The Epidemiology of Obesity: A Big Picture. *Pharmacoeconomics*, 33(7), 673–689. https://doi.org/10.1007/s40273-014-0243-x

Anandkumar S, Sudarshan S, Nagpal P. (2014). Efficacy of kinesio taping on isokinetic quadriceps torque in knee osteoarthritis: A double-blinded randomized controlled study. *Physiotherapy Theory and Practice*, 30(6), 375-383.

Anggia P Nayanti, T. P. (2020). The Effects of Kinesio Taping and Quadriceps Muscle Strengthening. *Journal of Medicine and Health*, 1-11.

Beischer, S., Senorski, E. H., Thomeé, C., Samuelsson, K., & Thomeé, R. (2018). Young athletes return too early to knee-strenuous sport, without acceptable knee function after anterior cruciate ligament reconstruction. *Knee Surgery, Sports Traumatology, Arthroscopy*, 26(7), 1966–1974. https://doi.org/10.1007/s00167-017-4747-8

Bouchard, C., Blair, S. N., & Haskell, W. (2012). Physical Activity and Health. *Illinois: Human Kinetics*, 2, 248-250.

Franciozi, C. E. S., Tarini, V. A. F., Reginato, R. D., Gonçalves, P. R. S., Medeiros, V. P., Ferretti, M., Dreyfuss, J. L., Nader, H. B., & Faloppa, F. (2013). Gradual

strenuous running regimen predisposes to osteoarthritis due to cartilage cell death and altered levels of glycosaminoglycans. *Osteoarthritis and Cartilage*, 21(7), 965–972. https://doi.org/10.1016/j.joca.2013.04.007

Gustina, E., Handani, M. C., & Sirait, A. (2020). Studi Kasus Kontrol di Rumah Sakit Tk. II Putri Hijau Medan Tahun 2017 American College of Rheumatology sebagai sekelompok kondisi heterogen yang Berdasarkan data Badan Kesehatan Dunia (WHO), penduduk yang mengalami. *Jurnal Mitrahusada*, 3(1), 88–103.

Kisner C, Colby LA. (2012). *Therapeutic exercise: foundation and techniques*. 6th edition. Philadelphia: F.A. Davis Company.

LeMone, P. (2016). *Buku Ajar Keperawatan Medikal Bedah*. (Edisi 5). Jakarta: EGC.

Makkiyah, F. A., & Setyaningsih, Y. (2020). Penyuluhan Osteoarthritis Lutut Pada Ibu Rumah Tangga Di Desa Sirnagalih Jonggol Jawa Barat. *Ikra-Ith Abdimas*, 3(3), 183–188. https://journals.upi-yai.ac.id/index.php/IKRAITH-ABDIMAS/article/download/780/586

Marlina, T.T. (2015). Efektivitas Latihan Lutut Terhadap Penurunan Intensitas Nyeri Pasien Osteoarthritis Lutut. *Jurnal Keperawatan Sriwijaya*, 1 (1), 1-8.

Mora, J. C., Przkora, R., & Cruz-Almeida, Y. (2018). Knee osteoarthritis: Pathophysiology and current treatment modalities. *Journal of Pain Research*, 11, 2189–2196.

Nursalam. (2015). *Metodologi Penelitian Ilmu Keperawatan*. 4th edition. Jakarta: Salemba Medika.

Sahrudi, S., Maria, R., & Herawati, T. (2019). Nyeri Lutut Berpengaruh terhadap Kemampuan Fungsi Fisik Pasien dengan Osteoarthritis Lutut. *Jurnal Ilmu Dan Teknologi Kesehatan*, 7(1), 39–46. https://doi.org/10.32668/jitek.v7i1.215

Tabrizi, A., Soleimanpour, J., Sadighi, A., & Zare, A. J. (2013). A short term follow up comparison of genu varum corrective surgery using open and closed wedge high tibial osteotomy. 7(1), 7–12. https://doi.org/10.5704/MOJ.1303.009

Treede, R. D. (2018). *The International Association For The Study Of Pain, Definition Of Pain: As Valid In 2018 As In 1979, But In Need Of Regularly Updated Footnotes*. PainReport UK, E643.

Yamato, T. P., Deveza, L. A., & Maher, C. G. (2016). Exercise for osteoarthritis of the knee (PEDro synthesis). *British Journal of Sports Medicine*, 50(16), 1013–1014. https://doi.org/10.1136/bjsports-2016-096104.

Yovita, L., & Enestesia, N. (2015). Hubungan Obesitas dan Faktor-Faktor Pada Individu dengan Kejadian Osteoarthritis Genu. *Jurnal Berkala Epidemiologi*, 2(1), 93–104.

Zuhri, S. (2020). *Konsep Nyeri & Manajemen Fisioterapi*. Poltekkes Kemenkes Surakarta.